THE BURIAL CAIRNS AND THE LANDSCAPE IN THE ARCHIPELAGO OF ÅBOLAND, SW FINLAND, IN THE BRONZE AGE AND THE IRON AGE

TAPANI TUOVINEN

Department of Art Studies and Anthropology, University of Oulu

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Department of Art Studies and Anthropology, University of Oulu, P.O.Box 1000, FIN-90014 University of Oulu, Finland
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Abstract

Mortuary rituals express and cope with disorder brought about by a member's death in the community. The autonomous connection of the deceased with the community is disrupted through mortuary rituals. In many cultures the subsequent contacts with the realm of the dead are maintained in formalized practices, sometimes including or referring to objects or patterns that can be traced in the archaeological record. In this study it is asked, if the Bronze Age and Iron Age burial cairns (1200 BC - AD 1000) in the SW archipelago of Finland might be interpreted as monuments establishing a link between the landscape and the religious context of symbolic meanings, thus making it meaningful to examine the spatial references of grave sites.

The field studies include excavations, surveys, boulder analyses, and weathering studies. The number of cairns in the area is 444. Examination of samples of boulders suggested that the stones were usually collected from the adjacent terrain. The Schmidt hammer technique was applied to measure the weathering differences between basal and lateral surfaces, and possible secondary interference.

The chronology of the archipelago cairns is based on previous studies related to general chronological characteristics and datings of archipelago graves. Using discriminant analysis, the size of the cairn, the convexity of the surface at the grave site, and the topography of the terrain were identified as the variables most related to the differences between Group P, having a Bronze Age character (147 cairns), from Group *R* of Iron Age character (218 cairns).

Two models representing the shorelines of 500 BC and AD 1000 were reconstructed using a digital elevation model (DEM). Monte Carlo-testing was applied when the visible areas around grave sites were compared to reference sets in four subareas. The grave sites in Group *P* were often directed towards the land, whereas the grave sites in Group *R* were typically directed towards the sea. The difference might be related to differences in subsistence strategies. The cairns represented a conservative burial custom that belonged to local communities in maritime and northern areas, as opposed to the southern agricultural environments.

Keywords: Archaeology, Bronze Age, Burial cairns, Finland, Graves, Iron Age, Methods, Mortuary rituals, Sampling survey; Death, Viewshed analysis, Åboland; Archaeology

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Tiivistelmä

Vainajan omaehtoinen yhteys elävien yhteisöön katkeaa vasta yhteisöllisen kuolemanrituaalin lopullisesti päätyttyä. Monissa kulttuureissa kuolemanrituaalin jälkeiset yhteydet vainajaan kiteytyvät muodollisiksi käytännöiksi, jotka voivat tulla arkeologisesti näkyviin aineellisissa jäännöksissä tai luonnonmaiseman paikkojen, tilojen ja elementtien suhteissa. Työssä tarkastellaan, ovatko Turunmaan saariston pronssikauden ja rautakauden hautarauniot (1200 e.Kr. - 1000 j.Kr.) tulkittavissa monumenteiksi, jotka yhdistivät maiseman symbolisten merkitysten uskomukselliseen kontekstiin.

Kenttätutkimuksiin kuuluu kaivauksia, inventointi, lohkaretutkimuksia ja rapautumismittauksia. Hautoja on 444. Lohkaretutkimukset osoittivat kivien tulleen kerätyiksi hautapaikkojen läheisyydestä. Tapaustutkielmissa kiveyksen basaali- ja lateraalipintojen välistä rapautumiseroa ja sekundaarisia vaurioita tutkittiin kimmovasaramittauksin.

Hautaraunioiden kronologia perustuu aikaisempiin tutkimuksiin kronologisista tunnusmerkeistä sekä saariston ajoitettuihin hautoihin. Erotteluanalyysissa kiveyksen laajuus, hautapaikan maanpinnan kuperuus ja hautapaikan suhde ympäröiviin huippuihin osoittautuivat muuttujiksi, jotka selvimmin jakavat aineiston pronssikauden tyypin *P*-ryhmään (147 hautaa) ja rautakauden tyypin *R*-ryhmään (218 hautaa).

Numeerisesta korkeusmallista laskettiin kaksi maastomallia, jotka vastaavat rannansiirtymisen kehitysvaihetta 500 e.Kr. (*P*-ryhmä) ja 1000 j.Kr. (*R*-ryhmä). Hautapaikoilta näkyvissä olleita alueita verrattiin satunnaisesti valittuihin verrokkipaikkoihin Monte Carlo -testauksen avulla. Merkittävin ero oli, että *P*-ryhmän hautapaikat olivat tyypillisesti suuntautuneet merta ja *R*-ryhmän hautapaikat maata kohti. Ero liittynee toimeentuloon latautuneisiin odotuksiin ja epävarmuuksiin. Hautarauniot merkitsevät konservatiivista hautaustapaa, joka kuului enemmän mereisten ja pohjoisten paikallisyhteisöjen kuin agraarisen ja eteläisen asutuksen piiriin.

Asiasanat: Archaeology, Bronze Age, Burial cairns, Finland, Graves, Iron Age, Methods, Mortuary rituals, Sampling survey; Death, Viewshed analysis, Åboland; Archaeology

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To begin with, my thanks are due to the great number of islanders with whom I have had some very interesting discussions. If I were to give here a complete register of their names, the list would become far too long. Therefore I don't want to give precedence to any one of them; instead I would like to thank them all jointly for the information I have received and for their positive attitude towards my work.

In the Preface it becomes evident of what significance Professor Emeritus Unto Salo (University of Turku) has been for this work, and particularly its early phases. He deserves my special gratitude because without his support and positive attitude it would have been hardly possible to accomplish this work. Professor Milton G. Núñez (University of Oulu) guided the accomplishment of my assertation and provided me with valuable ideas. I am also grateful to the leader of the research group at Åbo Akademi University, Professor Nils G. Holm for the support I have enjoyed. My coworkers at the Department of Comparative Religion and Folkloristics created a free and warm feeling of togetherness. It was easy to work in such an atmosphere, and at the same time feel that your own field of research was appreciated and relevant even if it was very much different from the rest of the research conducted at the department. I want to thank them all!

Ph.D. Tarja Formisto has kindly made the osteological analyses whose results I have been able to exploit in this study. Leif Lindgren, the project planner at the Finnish Forest and Park Service, Nagu, initiated the field work in the area of combined activities of the Southwestern Archipelago National Park, and assisted my work in the terrain; I wish to thank him and the rest of the staff of the National Park. I am also very grateful to all the archaeologists, students of archaeology, and those interested in archaeology for the work they have done during the excavations needed for this work – their names appear in chapter 4 where the excavations are discussed. Without their contribution essential parts of my material would be lacking.

I have had the opportunity to take lodgings at the field stations on Själö, Nagu, and Lohm, Korpo, which are part of the Archipelago Research Institute, University of Turku. The staff at the Laboratory of Computer Cartography, University of Turku, has kindly provided me with access to computers and software which were indispensable for the study. Finally, I want to thank the Humanistic Faculty at the University of Oulu for accepting this work into the publication series of the university, and Ella och Georg

Ehrnrooths stiftelse for awarding a scholarship for the finishing touches of this work. The translation and revision work of this study has been financially supported by a grant from the Alfred Kordelin foundation, which is gratefully acknowledged. Chapters 4, 5, 6 and 7 were translated into English by Heli Virtanen, M.A. and Maija Núñez, M.A. and the other chapters by Erkki S. Makkonen, M.A. And, in conclusion, thank you Anja!

Lundströmska torpet, Houtskär, March, 2001

Tapani Tuovinen

Abbreviations

FFPS	Finnish Forest and Park Service (Metsähallitus), Natural Heritage Service of Southern Finland, Nagu
NBA	The National Board of Antiquities (Museovirasto), Helsinki
NM	The National Museum of Finland (Suomen Kansallismuseo), Helsinki
PMT	The Provincial Museum of Turku (Turun maakuntamuseo), Turku
TYA	The collections and archives of the Department of Archaeology, University of Turku (Turun yliopisto), Turku
ÅM	The Museum Office (Museibyrån, Ålands landskapsstyrelse), Mariehamn

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Preface

At the age of twelve in secondary school I was assigned to draw a geographical map of a place of my own choice. I chose the small island of Vuorkattila, Velkua with its rocks, bird nests, and skerries. At that time I did not know yet that observing birds and plants, catching jellyfish, and counting pinetree stems would one day turn into archaeological field work which in fact included largely similar elements. Fifteen years later Professor Unto Salo, Department of Archaeology, and the station foreman Aatos Petäjä, the Archipelago Research Institute, University of Turku, gave me the opportunity to start with looking for cairns in the archipelago. This also involved an opportunity to develop a more adult version of the boyish spark to search, map, and organize, which once started in Velkua such a long time ago.

Archaeological surveying in the archipelago is largely practical. It includes servicing and repairing the boat and its equipment, docking, boating and overnighting in varying circumstances. But above all, the field work in the archipelago means slow travelling from one island to another and hiking in forests, occasionally day out day in without any traces of new cairns. And when you eventually find one, it often appears to be very similar to those known previously. Redundancy, scanty variation in structure and appearance, and faithful observing of traditional burying rituals are typical features of cairns. The significances of the graves and their associations with to the surrounding nature have been expressed so delicately that understanding seems to increase only gradually as you can see them in forests and on rocks. The grave constructors were the first people to leave of themselves sustaining traces in nature, and, after all, it is not amazing that those traces are materially very minute.

The minimalistic message of the cairns might be one reason for the fact that cairns in the archaeology of the Finnish coastal areas have been taken so little notice of despite their great number and typical character; besides, they seem to offer remarkable opportunities to learn to understand the economic activity, 'society', and 'religion' of the coastal population. I was thus very lucky to be invited by Professor Unto Salo to join his excavation programme in the late 1970s; he also made me understand the relevance of the research of burial rituals, and see the challenges involved in the practical gathering and processing of the material. After the excavation projects of the first years Professor Salo began to collect a consistent material concerning the whole of the coast of southwestern Finland. On one hand, this required a lot of work to develop an appropriate computerized database, and, on the other hand, it was necessary to organize the field work. I was lucky enough to have the opportunity to participate in both projects, and my research area was to be the archipelago of Åboland (*Fi*. Turunmaa).

Since the cairns in the southwestern archipelago had been rather scantily investigated, my first task was to clarify the morphology, context, and locations of the graves. On the basis of the first field working periods it seemed to be evident that among the archipelagian graves there were several which had to date back to the Iron Age although they had previously been considered to be from the Bronze Age. Therefore it became actual in the next phase to conduct excavations in order to find practical means to date cairns of different types. The possibility offered to me by the Finnish Forest and Park Service to search for cairns in the outer archipelago 1994–1997 proved an important opening for this study because it was the survey work that gave evidence of the outer archipelago being a central area of cairns of Iron Age character.

With the gradual shaping of the morphology, context, and chronology of the cairns in the archipelago it became possible to examine questions of more theoretical character. In 1996 I was working at the Environmental Centre of Southwestern Finland in order to promote multidisciplinary research of the mutual relationship of man and nature in the Biosphere Reserve Area of the Archipelago Sea. When working with the archipelago researchers of other scientific fields I also came to the idea of concentrating and developing some more crystallized archaeological approaches of man's relationship with 'nature' on a symbolic level. At the end of the year 1997 I was able to start the framing of this dissertation in a group of investigators working with a research project of the Academy of Finland called *Socio-cultural plurality and biodiversity: compatibility or clash? A multidisciplinary study on the Archipelago Sea Biosphere Reserve Area, South Western Finland*, which is a part of the Finnish Biodiversity Programme FIBRE (1997–2002). The research team was led by Professor Nils G. Holm (Åbo Akademi University), and it consisted of Kjell Andersson, Lic.Soc., Ole Rud Nielsen, Lic. Phil., and Anja Tuomisto, Lic. Phil., and me.

1 Introduction

In the research area of this study, the archipelago of Åboland[1](see fig. 1), the small islands build up a diversified landscape rich in delicate details in which the open stretches of sea separate the larger islands and groups of islets from each other. Ever since the time when the archipelago began to shape itself on account of the glacio-isostatic land uplift many details of the landscape have changed, and new groups of islands have emerged. New islands and skerries have risen out of the sea in the outermost archipelago at the edge of the open sea while the islands close to the coast have grown fast into the mainland or remained separated by narrow straits. Land uplift has not, however, resulted in the disappearance of the archipelago which has only slided gradually further out towards the Baltic Sea. At the same time the difference remains between the outer archipelago dominated by stretches of open sea and the inner archipelago characterized by large coalescent islands. The mutual relationship between land and water is, on the other hand, reflected in local physical conditions such as the climate. As the thermal economy of the Baltic Sea is the essential regulator of the coastal climate, the closeness of the sea and the mutual relationship between land and water are apt to affect the local climatic conditions on the coast (Solantie 1990). It is probable that the relative climatic difference between the archipelago and the coast has consequently prevailed in the postglacial period. The phenomenon of land uplift allows us to observe the changes in the landscape, and to establish what things in the archaeological remains are constant and 'conservative', and what things are variable, and in what relationship the regional differences in archaeological remains and the time gradient stand to each other. The specific character of the natural geography of the archipelago constitutes one of the bases of this study, and will be discussed at the beginning of chapter 2.

1. The oldest name of the *Åboland* archipelago is *Finska skären* 'the Finnish skerries' from the year 1386. The name dates back to the time when the name Finland denoted merely the region in southwestern Finland which subsequently was called *Varsinais-Suomi* (*Sw. Egentliga Finland*), Finland Proper. See Zilliacus 1991 b, and Wolf-Knuts 1999. The use of *Turunmaa*, the Finnish equivalent of Åboland is not equally stabilized. Previously it was used to denote the vicinity of the town of Turku (e.g. Ailio 1927), but today the name Turunmaa is used mainly as a synonym of the name Åboland (e.g. Pitkänen 1985 a). *Saaristomeri* (*Sw. Skärgårdshavet*) 'the Archipelago Sea' is an established name in natural sciences, denoting the archipelagos of Åland and Åboland. Several new names have been suggested, the most recent in The Atlas of Finland, published by The Geographical Society of Finland (1999).

The field archaeological research history of the archipelago is different from that of the mainland in South-West Finland and Åland. It is an illustrative example of the construction of national prehistory in the 20th century, and therefore it has been devoted quite an extensive section in the second chapter. The earliest archaeological excavations and surveys were implemented in the 1880s, and their results are still partly relevant even if the technique used at that time does not meet today's demands. After the first investigators there was a tranquil period in the field archaeology of the archipelago. The ecological hypothesis of A.M. Tallgren developed in the 1930s into a notion according to which the archipelago was a culturally peripheral area and a fierce wilderness for man. This was not apt to revive the interest in field research. It was not until the postwar period that the field investigations gradually got started again.

Land, sea, and sky built the huge natural elements around the islanders. To some extent we are able to reconstruct the topography and the essential features of the natural landscape in the various periods, but, as such, they do not yet convey to us a very good idea of what the landscape of the islanders was like on a symbolic level, and what significance it possessed in the tradition of prehistoric communities. We will get closer by studying what symbolic levels we can establish in the archaeological remains and their relation to the surrounding nature. One of the most obvious targets of investigation is naturally the cairns. They were constructed of stone, the most sustaining material in nature. They were enduring monuments whose location in the archipelago made them easily accessible from generation to generation and they were easily discovered. Interpretations in archaeological and anthropological literature concerning graves and cairn sites, the sustainability of the material, monumentalism, and landscape as a cultural construction will be discussed in chapter 3 on the basis of the facts mentioned above.

Studies of the morphological variation of the graves, the locations of the cairns, and the relation between the grave sites and the landscape requires a sufficiently consistent and representative material. The previously available field archaeological material did not entirely meet these requirements, and thus it was necessary to do some fieldwork for this study. The hypotheses which emerged during the survey were examined by implementing excavations and sampling surveys. The surveys, the excavations, and the topography of the grave sites in their present environment affected by land uplift will be discussed in chapter 4. Investigations of boulders, comprising the weight of the stones in the cairns, various minerals, roundness, and the weathering of boulders and rock surfaces will also be discussed in chapter 4. The shape of the cairns, their surface topography, size, architectural construction, and burials will be discussed in chapter 5. In chapter 6 the relative location of the grave sites will be studied.

Land uplift resulted at places in conspicuous changes in certain details of the landscape during the period of cairn construction. We should thus attempt to locate the grave sites in the landscape in the phases of land uplift roughly corresponding to their ages. An analysis of the external features characterizing the cairns from the Bronze Age or from the Iron Age is given in chapter 7. On the basis of these features it is possible to divide the graves in the research area into two main type categories, those of Bronze Age character, and those of Iron Age character. The classification is principally chronological, and is in accord with the chronology of the shore displacement.

In chapter 8 the known graves from the four subareas are set in a digital elevation model (DEM) with which the topographies surrounding the grave sites are reconstructed to correspond to the years 500 BC, and 1000 AD. The views from the known grave sites are compared with viewshed analysis with those from randomly selected locations within the four subareas. The locations of the graves from the Bronze Age and those from the Iron Age seem to differ from each other as for the views from the sites. Finally, the results obtained are discussed in view of the settlement archaeology and the cultural ecology of the graves.

Fig. 1. The research area: the parishes Iniö, Velkua, Rymättylä (*Sw.* Rimito), Houtskär (*Fi.* Houtskari), Korpo (*Fi.* Korppoo), Nagu (*Fi.* Nauvo), Dragsfjärd, Västanfjärd and Kimito (*Fi.* Kemiö) and the town of Pargas (*Fi.* Parainen), and the islands belonging to the town of Turku (*Sw.* Åbo). The total area is 6384 km² including the sea areas.

2 Earlier Field Archaeology in the Archipelago of Åboland

2.1 A Mosaic of Small Islands And Brackish Water

2.1.1 The Archipelago Zones

The Baltic Sea is a shallow basin, a closed tideless system characterized by stratified brackish water, strong seasonal alternation, and shallow fragmented coastal topography. In southwestern Finland the coastal topography of the Baltic Sea is particularly fragmented. The archipelagian area of southwestern Finland is divided into the more westerly archipelago of Åland and the more easterly archipelago of Åboland. They are part of the top surface of the deep-worn basement in southern Finland, the subcambric peneplain descending in gentle undulation towards the Baltic Sea and forming an archipelago off the coast. The basement consists mainly of granite, migmatites, and schists (Salonen 1994). Nils Edelman (1986) compares the visible surface structure of the archipelago to a worn wooden floor on whose old structure lengthy fraying has left furrows and grooves. The relief reflects the zones of the minerals, the old folding tectonic, the lengthy weathering and erosion, the shear zones of the bedrock, the fracture valleys, the displacements and depressions, and the wearing and accumulating effect of the continental glacier (Fogelberg 1986; Fogelberg & Seppälä 1986). These factors are apt to shape the fragmented and small-scale landscape in which the general directions of the movements affecting the bedrock can still be seen – straits, coves, stretches of the sea, oblong islands, and various fissure systems.

The extent of the archipelago off the Finnish coast depends on the depth of the relief of the peneplain, and its angle of inclination. In southwestern Finland this angle is fairly gentle, 2–3 minutes, and, consequently, the archipelagos of Åboland and Åland form jointly an extensive zone which is more than 150 km in width. On the coast of the Gulf of Bothnia the width of the archipelagic zone is less than 10 km. The SW archipelago comprises more than 22000 islands, and more than 14000 km of shoreline. Most islands (15800) are smaller than one hectar in area. The archipelago of Åboland and the islands of Åland constitute jointly – when it comes to the multitude of the islands – the most extensive archipelago area in the world. The fragmentation of the landscape gives rise to a high geodiversity, a mosaic of land and water offering a multitude of habitats for various organisms (Granö *et al*. 1999: 11–15; Kirkkala 1999: 5).

When sailing from the Baltic Sea through the archipelago towards the mainland we can see how small skerries and rocks gradually give way to larger islands, and how the wide stretches of the sea separating the islands reduce into narrow straits between the islands. The differences in the relation of land and water areas build up a toposequence which can be divided into four sections (Granö *et al*. 1999: 27–38):

1. *Skerry zone*. Small skerries and underwater reefs.
2. *Outer archipelago zone*. Rocky islets. Land area less than 10 per cent of the water area.
3. *Inner archipelago zone*. Large islands. The proportions of land and sea approximately equal.
4. *Mainland zone*. Large islands and peninsulas. Small water areas. Till, silt, and clay deposits.

Sometimes the classification includes a fifth zone, the middle zone. The toposequence is in accord with the phytogeographical zones which were described by Ernst Häyrén a century ago (Häyrén 1900). The utmost skerries of the skerry zone are treeless, the islands of the outer archipelago zone are dominated by deciduous trees while the trees in the inner archipelago zone and the mainland zone are mainly coniferous. Since Häyrén's days the zonal succession of landscapes within the archipelago has been developed and used in geographically oriented research (Granö 1955; Varjo 1959; Granö 1981; Granö 1994), but in cultural research it has been seldom used as an analytical concept (e.g. Huldén 1996).

The amount of soil deposits is the smaller the more out in the archipelago and the nearer the open sea you are. The small islands and the highest tops of the large islands are cliffs polished by the continental ice sheet either bare or covered by a thin layer of soil. When approaching the coast the proportion of rocky moraine shores becomes more and more predominant; in the inner archipelago there are also clayey reed shores besides those with moraine soil (Granö *et al*. 1986). The number of glacifluvial formations is relatively small. The most important glacial formation is the ice-marginal formation Salpausselkä III (*Sw.* Stängselåsen III) which traverses the research area from the east to the west, either on the surface of the earth or on the bottom of the sea (Fogelberg 1964).

2.1.2 Shore Displacement

After the construction of the oldest cairns the surface of the earth has risen 20 m in regard to the surface of the sea. Even after the construction of the youngest cairns the amount of the land uplift has been about five metres. The land uplift is principally of glacio-isostatic origin, and is caused by the fact that the crust of the earth which due to the weight of the Ice-Age glacier had been compressed downwards tends to return to its previous condition. The total effect of the land uplift at the seashore is also influenced by the tectonic component caused by the lithospheric stress which is responsible for 10–20 per cent of the uplift rate, and the eustatic component, the elevation fluctuation of the surface of the Baltic Sea (Eronen 1987; Eronen 1994; Kakkuri 1987; Kakkuri 1997). In addition, particularly in the inner archipelago the fine-grained material is deposited on the bottom of the sea accelerating the effect of the land uplift (Granö *et al*. 1986). The joint influence of the various factors results in shore displacement due to which the islands grow in size, join together, and the water area is reduced. Simultaneously the archipelago zones will shift gradually towards the southwest as the underwater reefs of the skerry zone emerge out of the sea and turn into small islands. Since the primary factor for the formation of an archipelago coast is the surface structure of the submerged peneplain, not the shore displacement as such, we may conclude that the topographic structure of the prehistoric archipelago was much the same as it is today.

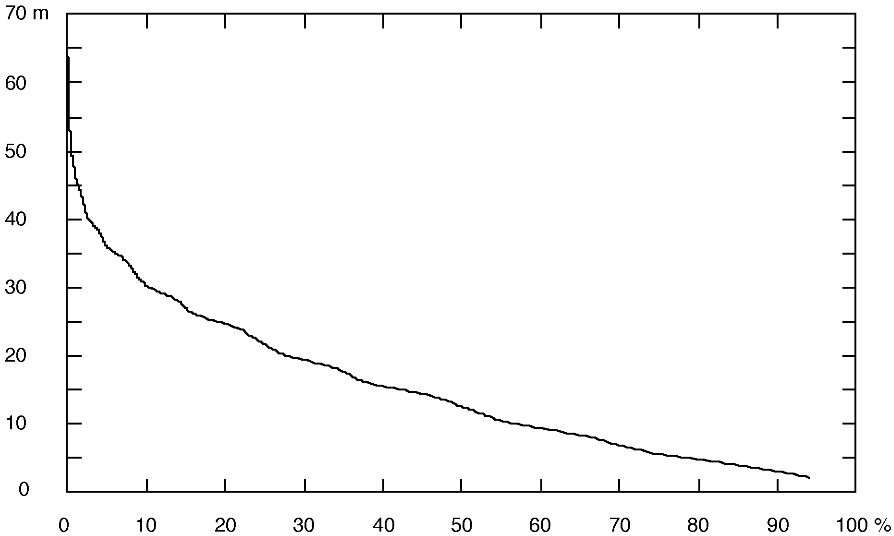

Fig. 2. The hypsographic curve of the archipelago of Åboland.

Land uplift also brings forth the nutrient load characteristic of the Baltic Sea, the resuspension of the old bottom sediments. With the gradual rise of the sea bottom which thus is subjected to the underwater turbulence caused by the waves, the sediments stratified on the bottom will emit some of their material, and consequently release nitrogenous and phosphoric nutrients. The biological primary production is enlivened by the ensuing nutrition circulation. Although the number of the species is not very great, they have no shortage of nutrition, and may appear in huge and productive masses as for instance the Baltic herring (*Clupea harengus*). Consequently, the river mouths and the muddy-bottomed shallow areas of the Baltic Sea can boast a high primary production (Håkanson 1991).

The hypsographic curve of the archipelago of Åboland (figure 2) indicates that the highest points of the skerries which were the first to emerge out of the sea are today at the height of 60–70 m. They are the highest peaks of the peneplain which were surrounded by deep waters at the time of their emersion. The land area increased slowly with the land uplift but in the Neolithic Stone Age when the peaks had reached the height of about -30 m the growth of the land area began to accelerate. The accelerated increase of the land area began in Åboland later than on Åland (cf. Jaatinen *et al*. 1989: 25–29; Núñez *et al.* 1997).

2.1.3 Climatology

In the postglacial period the Baltic Sea has experienced also other changes apart from shore displacement. The salinity of the surface water in the Baltic Sea has decreased after the maximal value, approximately 10 per mille in the sea area of southwestern Finland, (Eronen *et al*. 1979), during the optimal postglacial climatic conditions down to the present value of approximately 6 per mille (Kullberg 1981). The assortment of fish species consists of originally marine species and those characteristic of fresh water conditions, and both the groups have undergone physiological and morphological changes. During the optimal climatic conditions the fish fauna was, more than today, very similar to the fish fauna in the ocean. For instance the Baltic herring which spawns in autumn got distributed in the Baltic Sea probably at that very time (Ojaveer *et al*. 1981). In the present phase of the development the salinity of the brackish water is too low for several ocean fish species, and too high for many fresh water fish species. The salinity displays a distinct S–N gradient from the Danish straits northwards to the farthest corners of the Gulf of Bothnia and the Gulf of Finland so that the salinity is the lowest in the north. The same gradient appears in several hydrological, chemical, and biological variables (e.g. Kautsky 1991). The Baltic Sea is not a uniform marine area despite its basin-like nature.

Åland, Åboland, and the southwestern mainland coast are nowadays the only regions in Finland belonging to the hemiboreal climatic zone. The archipelago is characterized by mild winters, springs with scanty precipitation, and early summers. The snow melts, and the earth warms up in early spring. The average sum of effective temperature in the southwestern archipelago is 1300 ºCd, and the mean duration of the vegetational period is at least 180 days; these parameters are the highest in the country (Solantie 1990). Hard frosts, i.e. ground temperatures below -3.0 ºC, are practically absent during the vegetational period. In spring, the hard frosts are over earlier than on the mainland, and the capability of the sea water to level up the variations in temperature results in a very insignificant annual fluctuation of frosts. For instance, in the archipelago the mean duration of the period without hard frosts is 179 days whereas in the inland in regions with few lakes the corresponding duration is only 109 days (Solantie 1987). The vegetation period of the archipelago is thus characterized by early commencement dates, long periods without frosts, and the almost non-existent possibility of incidental frost risks – all these are significant climatic factors favourable to prehistoric agriculture which had to accommodate to extreme northern conditions (Zvelebil & Rowley-Conwy 1986).

The climatic factors measured in our day cannot be directly extrapolated to correspond to numerical values in the subboreal and the subatlantic period. But, as suggested by Eljas Orrman, the climatic difference between the archipelago and the mainland was nevertheless very much the same as today (Orrman 1991 a: 201), the marine climate and the capability of the sea water to store warmth are in fact linked up with each other. Nor is it possible to deduce any numerical values as for the extent or the duration of the coat of ice on the Baltic Sea (Makkonen *et al*. 1984) but we can assume that they too were in accord with the gradient from the open sea to the mainland coast.

To sum up the facts mentioned above we can establish that the archipelago of Åboland offered a rich, versatile, and naturally favourable environment to prehistoric people. The diversified mosaic-like archipelago which was rich in details, the marine climate, the ecology of the brackish water, and the conspicuous alternation of seasons were the specific features contributing to the welfare of man in those days. The significance of the coastal natural resources has been emphasized in the investigations concerning the subsistence strategies in the Stone Age, but when it comes to the economy of the Metal Age the marine natural resources have attained little attention (e.g. Siiriäinen 1981; Siiriäinen 1982; Núñez 1986; Núñez 1991; cf, however, Salo 1995: 1–2). Some reasons for this situation can be found in the history of research.

2.2 Field Archaeological Research into Burial Cairns since the 1880s

2.2.1 Early Field Investigations in Åboland

The earliest fairly reliable reference to a heap of stones as a possible grave site derives from the year 1735. A clergyman called Johan G. Salonius mentioned in his description of the parish of Nagu that on the island of Sandö there were sailors' graves constructed of stones[2]. Salonius called these cairns by the common popular name of *jättekast, jätukast* 'a giant's cast'. In Finnish the equivalent popular name is *hiidenkiuas* 'stove of beasts'. This popular name was adopted into professional usage to denote big cairns of Bronze-Age character, and was used in Finnish literature for most of the 20th century.

The first field archaeological investigations were conducted in the late 19th century. In 1878 Lars Wilhelm Fagerlund, the physician and museologist, published his work *Anteckningar om Korpo* och *Houtskärs socknar*. It was a description of the life of common people, and a reference to ancient remains was mentioned only on the very last pages. Fagerlund was aware of remains from the historic period only, and among these he mentioned the cairns at Furunabb, Houtskär. He assumed that they were remains of hiding places from the Great Northern War (1714–1721) (Fagerlund 1878: 293). Even another conclusion might have been possible as J.R. Aspelin had in 1871 taken notice of the similarity between the cairns on the coasts of Finland and the Swedish prehistoric cairns (Nordman 1968: 21; Aspelin 1875: 58; Aspelin 1885: 37). Maybe the archipelago seemed to Fagerlund to be a region where no prehistoric remains could possibly be found. A few years earlier the philologist Axel Olof Freudenthal (interestingly, one of the founders of the national movement of the Swedish-speaking population in Finland) had published a review of the archaeological remains in the eastern archipelago of Uusimaa (*Sw.* Nyland) (Freudenthal 1874) in which he described labyrinths and stone ovens – they were remains from the historical period which conspicuously differred from the then known prehistoric remains on the mainland.

2. The manuscript by Salonius 1735, NBA, p. 27.

In the 1880s three recipients of scholarships granted by the The Finnish Antiquarian Society, the teachers Abr. Björck and Kustaa Killinen accompanied by the university student Juho Sjöros, travelled around in the communities of Halikko, Piikkiö, Vehmaa, and Mynämäki which also comprised the archipelago parishes collecting valuable archaeological information (Björck 1883; Björck 1887; Killinen 1885; Sjöros 1887). Nevertheless only Björck and Sjöros reported on cairns in Nagu, Kimito, and Dragsfjärd. In other parishes no '*hiidenkiuas*' constructions were found.

The first excavation in the archipelago of Åboland was conducted by Rev. H.A. Reinholm on the island of Högholmen, Dragsfjärd (Hitis) in 1871 (Reinholm 1874). Volter Högman (later Rihtniemi), an instructor at the Teachers' College in Rauma carried out an excavation at the same place in summer 1886 during his expedition in Dragsfjärd. On the island Reinholm and Högman found heaps of stones which, at least according to Högman, might have been graves, but he was not able to establish the nature of the finds. It was not until the 1970s that the investigations conducted by the National Board of Antiquities made it clear that the place had been a fortified harbour in the 14th century (Edgren 1980; Ericsson 1989). In other aspects Högman's summer expedition to Hitis in 1886 was, however, very successful. His inventory listed 120 archaeological remains most of which were cairns, and he was able to excavate as many as 12 of these. Until the 1920s Högman's work remained thus the only systematically collected material concerning Åboland. The cairns excavated by Högman were:

1. *Labbnäsåsen, Dragsfjärd* (grave n:o 012)[3]. The cairn has been built on a rock outcrop sloping gently down from its near surroundings of bouldered moraine. The altitude is h = 30 m. According to Högman's report, the length of the cairn was about 12 m, the width 10.5 m, and the height 1.7 m. An outer circle laid of smooth-worn flagstones was uncovered, and inside the circle there were two more concentrical inner circles. On the SE edge inside the outer circle there were three large boulders. The inner circles were not built entirely on the rock, parts of them were lying on the soil. Some charcoal and soot was discovered in the whole area of the bottom layer, but no other finds could be detected in the cairn. In its present appearance, the cairn consists mainly of rounded boulders which were roughly similar in size (about 2–25 kg). The cairn is now traversed by a secondary stone fence.
2. *Jordbro, Dragsfjärd* (036)[4]. The burial place is located on a gravel slope gently inclining towards the lake of Dragsfärd which formerly was a narrow strait of the sea. According to Nils Cleve the place was a damp meadow in the 1940s. Today there is a courtyard and a field in the terrain, *h* = 18. The length of the cairn was about 9.3 m, the width 7.0 m, and the height 0.9 m. Högman reported on four artefact clusters

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3. Map sheet 2012 14, x = 6662 93, y = 2416 56 (± 50). Inv. report (survey report) by Högman 1886 (NBA), pp. 50–51. Inv. report by Planting 1932 (NBA), no. 10. Inv. report by Cleve 1943 (NBA), no. 82. Inv. report by Tuovinen 1985 (TYA), no. 29. Excavation report by Högman 1886: 112–116. It was not easy to find the cairn because the location was indicated rather inaccurately in older reports. Fortunately, Högman mentioned in his report that the cairn was located some forty fathoms from the boundary stone between the estates of Labbnäs and Ytterkulla. Thanks to this boundary stone the cairn was discovered again.
4. Map sheet 1034 14, x = 6662 39, y = 1581 04 (± 50). Inv. report by Planting 1933, no. 20 (NBA). Inv. report by Cleve 1943, no. 86 (NBA). Inv. report by Kuokkanen & Tuovinen 1983 (TYA), no. 118. Excavation report by Högman 1886: 58–59, 103–107 (NBA). Artefacts: NM 2503A: 22. The osteological analysis was made in 1987 by Tarja Formisto, University of Stockholm. Tallgren 1931 b: 111. Cleve 1942 b: 13, 22.

which in his view were linked with interments: (1) fragments of burnt bone and pottery in a sooty layer of humus, (2) a clay vessel under which some bone and charcoal was found, (3) a clay vessel and unburnt bones, and (4) fragments of burnt bone. According to C.F. Meinander (1954b: 60), at least part of the pottery might originate from a Late Neolithic cultural layer under the cairn. An osteological study carried out by Tarja Formisto in 1987 revealed that the bone sample consisted of 3.7 g of burnt and 10.9 g of unburnt seal bone. The occurrence of seal bone in the finds supports Meinander's view that part of the finds originate from an older settlement layer[5]. The cairn itself may thus have been without any finds.

3. *Långnäsudden, Dragsfjärd* (041)[6]. The burial site is located on a small sheer cliff at the tip of a cape pushing northwards into the lake of Dragsfjärd, close to another cairn. From the place, which in the Bronze Age was a small rocky islet there is a good visibility in all directions except S. The altitude *h = 25* m. The length of the cairn was about 13.3 m, the width 12.7 m, and the height 1.5 m. In the middle of the cairn there was a pit. When Högman and his research group were excavating the cairn, they started from the edges, and soon found a circle laid of large boulders. The outer measures of the uncovered circle were 13.3 and 11.5 m. On the rock surface there was a humus layer containing some charcoal. In an oval stone setting in the bottom layer a bronze dagger from the II period was detected (Meinander 1954 b: 15, 107, 211; Edgren 1999b: 1–3). The cairn was carefully restored, and today it is slightly larger than before the excavation. The boulders are mostly rounded, and of much the same size (about 2–50 kg).
4. *Rövik, Dragsfjärd*[7]. A shallow, oval, structureless cairn was detected in rocky terrain. It consisted of fairly small stones in one or two layers. Some charcoal was found in the bottom layer. The precise location of the cairn is unknown.
5. *Hammarsboda, Dragsfjärd 108* (045)[8]. The site is located on an ice-margin formation belonging to the ice-marginal formation of Salpausselkä III. The W–E top of the hill is surrounded by fields and pastures. The grave belongs to a group four cairns. The altitude *h* = 21.3 (levelled). The length and the width of the cairn were about 9.5 m, and the height 0.8 m. During the excavation some unburnt bone, and an indistinct inner circle were discovered, and in the middle of the cairn possibly a stone cist. The

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5. Seal bones were detected in excavations of Bronze-Age cairns at Kaunismäki, Harjavalta, and at Uotinmäki, Kiukainen. In these cases the seal bones seem to be originated from stratigraphically older cultural layers under the cairns (see Salo 1970: 12–15, 22–24; Lahtiperä 1970: 202–205; Salo 1981: 42–50; cf. Väkeväinen 1979).
6. Map sheet 1034 14, x = 6661 78, y = 1581 96 (± 50). Inv. report by Appelgren 1927 (NBA): 9. Inv. report by Planting 1932, no. 32 (NBA). Inv. report by Cleve 1943, no. 101 (NBA). Inv. report by Kuokkanen & Tuovinen 1983, no. 123 (TYA). Excavation report by Högman 1886: 60–61, 96–103 (NBA). Artefacts: NM 2503A: 1, 21. Heikel 1890: 179–182. Hackman 1897: 375. Tallgren 1931 b: 111. Cleve 1942 b: 12–13, 23. Cleve 1948: 490, 493. Meinander 1954 b: 15, 107, 211.
7. Map sheet 1034 13, x = 6656 32, y = 1581 60 (± 200). Inv. report by Planting 1932, no. 26 (NBA). Inv. report by Cleve 1943, no. 103 (NBA). Inv. report by Kuokkanen & Tuovinen 1983, no. 128 (TYA). Excavation report by Högman 1886, pp. 52–53, 111–112 (NBA). Tallgren 1931 b: 111. Cleve 1942 b: 23.
8. Map sheet 1034 11, x = 6661 21, y = 1578 69 (± 50). Inv. report by Planting 1932, no. 15–18 (NBA). Inv. report by Cleve 1943, no. 108 (NBA). Inv. report by Kuokkanen & Tuovinen 1983, no. 138 (TYA). Excavation report by Högman 1886, pp. 54–56, 107–111 (NBA). Report by Tuovinen 1990 (TYA), no. 14. Artefacts: NM 2503A: 23. Tallgren 1931 b: 111. Cleve 1942 b: 23.

age of the cairn could not be determined. In the year 1878, a clergyman called Ludvig Wennerström had, however, found a narrow-bladed palstave in the cairn Hammarsboda 106, which is only 20 m away. The artefact dates back to the II or III period of the Bronze Age (Meinander 1954 b: 211–212).

6. *Nämanön, Dragsfjärd (*061)[9]. On the NE slope of the highest point of the island of Nämanön there is a raised shore feature. The stones of the shore were probably used as building material for two cairns, one on the top, at the altitude of some 28 m, the other a few metres lower, partly on the raised shore. In 1886 Högman excavated the upper cairn. According to his report, the length of the cairn was 7.4 m, the width 7.0 m, and the height 0.8 m. Högman could not discover any internal structures or other finds except some charcoal in the bottom layer. His reconstruction of the grave is a round symmetrical cairn with an even upper surface.
7. *Tjuda, Kimito* (129)[10]. The site is located in moraine terrain in the vicinity of cultivated fields on a small flat rock outcrop. The cairn is the northern one of two cairns. The altitude h = 28 m. The length and the width were about 8.0 m, and the height 0.8 m. Högman discovered two concentric circle constructions the outer one of which had been demolished. The length of the outer circle was 6.0 m, and the width 5.0 m. In the inner circle the boulders were packed tightly against each other; this circle was 2.6 m long and 2.3 m wide. Even in this grave the bottom layer contained some charcoal. Inside the inner circle there was an area of 1.7 m x 0.7 m with some burnt bone. An osteological analysis was made of a joint sample of the two excavated cairns at Tjuda (129 and 130). Of the total amount of 34.6 g, 22.5 g was determined to be from a *calvarium*: *Infans II/Juvenilis*, minimum number of positively identified individuals (MNI): 1. In addition the sample contained 3.7 g of unburnt horse bone. In its present appearance the cairn consists of rounded and edged stones and boulders of about 1–150 kg.
8. *Tjuda, Kimito* (130)[11]. This grave is the southern one of two cairns, located only 20 m away from cairn 129. The altitude h = 28 m. According to the excavation report, the length and the width of the cairn were about 8.0 m, and the height 1.2 m. In the bottom layer there was an outer circle with a diameter of 7 m, constructed of large rounded boulders. A possible flagstone cist was detected inside the circle, the length of which was 1.8 m, and the width 1.0–1.3 m. The bottom humus contained some charcoal and unburnt bone, and a distinct area of 1.3 m x 0.8 m with burnt bone.

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9. Map sheet 1034 10, x = 6652 06, y = 1575 55 (± 50). Inv. report by Planting 1933: 3 (NBA). Inv. report by Kuokkanen & Tuovinen 1983, no. 116 (TYA). Excavation report by Högman 1886: 80-82, 131–133 (NBA).
10. Map sheet 2012 03, x = 6677 55, y = 2428 89 (± 50). Inv. report by Appelgren 1927, no. 24/25 (NBA). Inv. report by Tuovinen 1985, no. 96 (TYA). Excavation report by Högman 1886: 22, 95–96 (NBA). Artefacts: NM 2503A: 20. Osteological analysis by Tarja Formisto, University of Stockholm, 1987. Cleve 1942 b: 20.
11. Mapsheet 2012 03, x = 6677 54, y = 2428 89 (± 50). Inv. report by Appelgren 1927, no. 24/25 (NBA). Inv. report by Tuovinen 1985, no. 95 (TYA). Excavation report by Högman 1886: 22, 93–95 (NBA). Artefacts: NM 2503A: 19. Cleve 1942 b: 20.

9. *Jättekastberget, Kimito* (149)[12]. The cairn is located on the top of a rock outcrop, on a slope inclining towards NNW. It was built on a flat surface, almost on the highest point of the rock, *h* = 58 m. From the burial site the visibility is good towards NE, N, and NW. The length and the width of the cairn were about 12.5 m, and the height 2.0 m. A vertical dry-stone wall of flagstones, about one metre in height, had been erected on the bottom layer of stones. The construction had a trestlework of wedge stones in the crevices between the stones. The cairn was encircled by a structure of long boulders with the flat side outwards. The diameter of the circle was 9 m, and it had suffered some damage on the southern side. Inside the circle there was a semi-circle of stones, the other stones in the bottom layer were randomly set. Under the bottom stones some unburnt bone was detected. In the W part of the bottom layer there was some charcoal in two separate areas. In its present appearance the cairn consists of edged and rounded boulders of 1–100 kg; in the middle there is a deep cavity.
10. *Söderviken, Västanfjärd* (326)[13]. The cairn is located on a slope inclining towards the sea-shore in W and SW, on a plane terrace sloping slightly towards NW, *h* = 15 m. It is the northern of two cairns on the same rock outcrop. Originally the visibility from the site had been good towards S and SW. The material used in building the cairn consists of the same granite as the lower slope of the rock outcrop, with a high rate of weathering. The length and the width of the cairn were about 4.0 m, and the height 0.3 m. A rectangular outer frame was found around the cairn with randomly set stones inside. In the bottom layer some charcoal was found; no other finds could be detected. In the present appearance the cairn consists of mostly fairly small (about 0–25 kg) edged stones. According to a later report by Hildur Planting (1933), the cairn has suffered some damage after the excavation.
11. *Lillskogen, Västanfjärd (328)*[14]. This burial site is located on the rocky SW slope of a high rock outcrop, on a flat surface sloping slightly towards SW, *h* = 15 m. The visibility from the cairn is good towards the sea in SE, S, and SW. The cairn is the northern one of the two graves on the rock outcrop. The cairn is oblong and rectangular, lined by large boulders. The length was 7.5 m, the width 3.0 m, and the height 0.6 m. The longitudinal axis runs SE–NW. The bottom layer had possibly been divided between two stone frames, filled with small stones; no other internal structures could be detected in the cairn. Some charcoal and bnurnt bone were found in the bottom layer. Högman seems to have left the stone structure as it was; it consists of rounded and edged boulders of about 50–200 kg.

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12. Map sheet 2012 03, x = 6671 94, y = 2427 87 (± 50). Inv. report by Appelgren 1927, no. 45 (NBA). Inv. report Tuovinen 1985, no. 87 (TYA). Excavation report by Högman 1886: 31–32, 90–92 (NBA). Artefacts: NM 2503A: 18. Cleve 1942 b: no. 36.
13. Map sheet 2012 01, x = 6658 31, y = 2422 65 (± 50). Inv. report by Planting 1933:1 (NBA). Inv. report by Tuovinen 1985, no. 31 (TYA). Excavation report by Högman 1886: 62–63, 119–120 (NBA). Cleve 1942 b, no. 113.
14. Map sheet 2012 02, x = 6660 04, y = 2426 54 (± 50). Inv. report by Planting 1933: 1 (NBA). Inv. report by Tuovinen 1985, no. 41 (TYA). Excavation report by Högman 1886: 65, 118–119 (NBA). Artefacts: NM 2503A: 25. Cleve 1942 b: no. 115.

12. *Lillskogen, Västanfjärd* (329)[15]. This grave is situated on the same rock outcrop as cairn 328, slightly further SE on the slope at the altitude, *h* = 15 m. The length and the width of the cairn were about 8.0 m, and the height 0.9 m. In the middle of the cairn there was a cavity.Högman's excavation team discovered two inner circles; the outer one was 6 m in diameter, packed tightly with boulders, the inner one was of a smaller size measuring 3.6 m and 3.2 m, respectively. Some unburnt bone was found in the bottom layer. In its present appearance the cairn consists of rounded and edged stones and boulders (of about 1–100 kg). The boulders at the edges of the cairn, apparently left as they were found by Högman, weigh at their most several hundred kilograms.

Högman's excavation report of the grave at Långnäsudden discloses well his techniques. The excavation was begun at the edges of the setting to find out whether there were any stone circles under or around the cairn. When a circle was discovered, the excavation work at the edges was interrupted, and the work was continued in the upper part of the grave, ”jämnt öfver hela lagret”, (evenly all over the layer). The problem with his excavation techniques was that he was not able to see the entire bottom layer of stones and to investigate whether the borders actually formed patterns which were not of random sequence at the time of the erection of the structure. When the bottom layer of stones was uncovered, the excavators had already displaced some boulders at the edges of the grave. When starting the excavation work at the edges one always runs the risk of removing the boulders so that the displacement results in constructing unintentional circles. Högman – as well as some of his coevals – possibly came to regard some stone patterns as constructed circles on account of his/their general interest in architectural constructions although present-day field archaeologists would certainly hesitate in making such conclusions. I have not been able to confirm all the circles mentioned by Högman in his inventory report (e.g. Östermark, Kimito (161))[16].

The results established by Högman during his summer expedition influenced for several decades the conceptions concerning the age and the cultural context of the burial cairns in the SW archipelago. He found and excavated mainly large-sized cairns, and the artefacts detected by him were thus representative of large cairns only. In this respect it is not surprising that the Iron-Age mortuary ritual was not discussed in his records. Högman was possibly unlucky also in the fact that no finds could be made in the burial cairn at Söderviken, Västanfjärd since any possible finds there would probably have been from the Iron Age. He chose his excavation sites in various parts of the island of Kimitoön which suggests that his aim was to make a representative regional cross section of the cairns on Kimitoön and the archipelago of Hitis. The emphasis he laid on large cairns

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15. Map sheet 2012 02, x = 6660 03, y = 2426 57 (± 50). Inv. report by Planting 1933: 1 (NBA). Inv. report by Tuovinen 1985, no. 42 (TYA). Excavation report by Högman 1886: 65, 116–118 (NBA). Artefacts: NM 2503A: 24. Cleve 1942 b: no. 116.

16. Högman detected also a few rectangular stone settings on the island of Örö, Dragsfjärd, and excavated one of them. No artefacts were found, and the construction remained undated. In his report he described the location rather inaccurately, which makes the identification of the site somewhat uncertain. In the southern part of the island there are five rectangular stone settings, probably the same as those reported by Högman. In spite of their small areal size their heights are 0.6–1.3 m, and they do not conform to the general type of burial cairns in other respects, either. E.g., the altitude of the lowest is only 4.2 m, which indicates that they are not likely to be prehistoric remains. See inv. report by Högman 1886 (NBA). Inv. report by Tuovinen 1996, no. 46 (FFPS).

may be accounted for by the fact that he obtained information of most archaeological sites by interviewing people whom he met in the villages. Consequently it was apparently the large and obtrusive cairns (Schiffer *et al*. 1978) that were the first graves to be found. Högman's aim at compiling a representative account expresses itself in his later field studies in the rural community of Rauma, and in the parish of Lappi (Salo 1981 b) where he was more successful than on Kimitoön. These studies, conducted in 1891, included both small and large burial cairns in the vicinity of villages as well as in forests, more than a kilometre away from the nearest road.

Högman's investigations were followed by a more tranquil period. In the 1920s and in the 1930s Olof Appelgren and Hildur Planting did some field work in Kimito and Dragsfjärd at the same time as Svante Dahlström and John Gardberg made excursions in the archipelago and gathered observations of archaeological remains, among other things. Dahlström collected the results of the excursions in his book *Gullkrona* which was published in 1945. In 1935, Ella Kivikoski conducted a rescue excavation in Söderby, Dragsfjärd prior to an imminent road building project.

13. *Söderby, Dragsfjärd* (037)[17]. The grave was located on a slope inclining slightly E, towards the lake of Dragsfjärden, *h* = 24 m. According to Kivikoski's excavation report the diameter of the cairn was about 4 m. Almost half of the circle construction was uncovered. In the middle of the circle there was a one-layer stone setting of cobbles. Some burnt bone and 16.9 g of charcoal were collected from this layer. 7.7 g of the bone fragments could be identified (3.6 g of a *calvarium*): Adult MNI = 1.

The archives of the National Board of Antiquities also include some correspondence from the 1930s and other information of the cairns in the archipelago but until the Second World War the field archaeological evidence of the cairns in the archipelago was, on the whole, rather sparse in comparison with the rest of southwestern Finland. What was known about the locations, sizes, and ages of the graves was almost exclusively based on the results published by the field researchers in the 1880s. In 1918 A.M. Tallgren published a map concerning the distribution of cairns; the points were concentrated on the island of Kimitoön and in Pargas and Nagu with scattered points in Rymättylä and Korpo (Tallgren 1918: 117). The maps published by Tallgren in 1931 propose the same distribution (Tallgren 1931 a: 81; Tallgren 1931 b: 56). According to the evidence available at that time the cairns in Åboland seemed to date from the Bronze Age.

2.2.2 The Augmentation of the Museum Collections

The first reliably documented Metal-Age artefact in Åboland was brought to light in 1878[18]. Inspired by an article he had read in his calendar, Rev. Ludvig Wennerström excavated a cairn at Hammarsboda, Dragsfjärd, and found a narrow-bladed palstave from

17. Map sheet 1034 14, x = 6662 29, y = 1581 02 (± 50). Inv. report by Cleve 1943, no. 93 (NBA). Inv. report by Kuokkanen & Tuovinen 1983, no. 130 (TYA). Excavation report by Kivikoski 1935 (NBA). Artefacts: NM 10108: 1–4. Osteological analysis by Tarja Formisto, University of Stockholm 1987. Cleve 1942 b: 23. In the very vicinity of the grave investigated by Kivikoski, a rescue excavation was conducted in 1979 and 1988 but no prehistoric remains were detected. The site is today under a road. See reports by Matti Bergström 1979 (NBA), and Juhani Kostet *et al*. 1988 (PMT).

the II or III period of the Bronze Age with some bone splinters pertaining to a burial ritual.[19] The bronze dagger from the II period of the Bronze Age, found by Volter Högman during his excavation at Långnäsudden, Dragsfjärd (Edgren 1999b: 1–3) is also one of the early finds. These early finds were published in the 19th century (Björck 1883; Heikel 1890; Hackman 1897), and they indicated that the cairns in Åboland could well be quite old. On the other hand, the Viking-Age C-type axe[20] detected by Högman at Kyrksundet, Dragsfjärd (Hitis) was never published.

A treasure consisting of fifteen Arabian or Anglo-Saxon coins from the 11th century had been found in Pargas prior to 1834. The accurate site of the find is unknown. The coins were kept in a private collection until they were sold to St Petersburg in 1869 (Lagus 1900: no.49; Nordman 1921: 12). At the turn of the century three silver artefacts, which were part of a larger silver treasure[21], were delivered to Alfred Hackman at the Finnish National Museum. The artefacts had been found in the 1870s "i någon skärgårdssocken i närheten af Åbo" (in an archipelagean parish in the vicinity of the town of Turku, *Sw.* Åbo); there is no more accurate information of the site of the find (Hackman 1900). The rest of the artefacts of the find had found their way into the smelting oven of a silversmith in Turku. The three artefacts were: a Viking-Age silver pin belonging to a ring brooch (Cleve 1942 a: 16–19; cf. Kivikoski 1973: fig 723), a massive neck-ring from the late Merovingian period or the Viking Age (cf. Kivikoski 1973: figs 449, 728), and a penannular brooch. The end of the penannular brooch, which has a rectangular decorative field in the middle of a sphere, is faceted. It differs, however, from the faceted type described by Salmo (Salmo 1956: 30–36) on account of its broad pin head. Consequently, the brooch seems to be closer to the 11th-century brooches with thick intermediate parts (Salmo 1956: 65–71; Kivikoski 1973: fig 704).

In 1924 when two villagers of Holma, Dragsfjärd were digging up a cairn on the isle of Stora Ängeskär, they found a whetstone of schist, which had been worn as a pendant, dating from the Viking Age (Dahlström 1945: 52–57). This find was of great significance since it was the first to connect the cairns in the archipelago with the Iron Age. The rest of the Metal-Age artefacts found prior to the Second World War were generally regarded as sporadic finds. Such artefacts included Bronze-Age tubular axes found in Kimito[22] and Västanfjärd[23], the blade of a Bronze-Age tubular axe in Kimito[24], a rhomb-shaped stone axe at Tappo, Västanfjärd[25], an oval striking-stone from the Iron Age at Nygård,

18. Stone Age artefacts are not included here. See Cleve 1942 b, Meinander 1954 b, Myhrman 1990, Asplund 1997 a, Asplund 2000.
19. NM 1910. See Björck 1883: 68-69; Tallgren 1931 b: 111.
20. NM 2503A: 3. Cf. Wuolijoki 1972: 6–7.
21. NM 4464: 1–3.
22. NM 800. Aspelin 1875: 59. Meinander 1954 a: 26. The artefact belonged to the collections of Adolf Lindman (Suistoranta 1982: 41), and the site of the discovery is today unknown.
23. NM 11588. Meinander 1954 a: 26.
24. NM 10816. The artefact was bought by the museum of Sagalund in the 1860s, the site of the discovery being either Makila or Tjuda in Kimito.
25. NM 9749: 1. Asplund 1997 a: 241.

Pargas[26], an X-type sword from the Viking Age at Kila, Kimito[27], and a two-bladed sword with a spherical knob from the 12^{th} century at Björkholm, Nagu[28].

During the six first decades the augmentation of museum collections was thus concentrated on finds from the older Bronze Age and the Late Iron Age in the same regions as the acknowledged cairns, i.e. the island of Kimitoön, Pargas, and Nagu. The finds were, however, rather sparse, and most of the Iron Age was not represented at all. No archaeological excavations had been conducted in Åboland with the exception of the island of Kimitoön. Over the same decades the number of the finds discovered on the mainland of South-West Finland had manifolded, and the material was more complete particularly when it comes to the Iron Age; on the other hand, the number of field investigations on the mainland was manifold in comparison with that in the archipelago[29]. The mainland of South-West Finland, particularly the regions in the vicinity of the town of Turku, Uskela, and Laitila, had become one of the archaeologically best-known areas in Finland as manifested by the monographs published on the subject (Kivikoski 1939; Salmo 1938: 2–24; Tallgren 1914; Tallgren 1931 a; Tallgren 1931 b). With time it became obvious that Åboland had been overlooked in the field research. In 1941 Cleve wrote that the archipelago of Åboland should be investigated systematically to allow the establishment of the possible continuity of settlement from the Bronze Age to the Iron Age.

2.2.3 The origin of the hypothesis concerning the peripheral nature of the archipelago

In the two monographies published by A.M. Tallgren in 1931 he studied the relationship between the Late Neolithic Culture of Kiukainen and the Bronze Age on the coast of southern Finland. The artefacts of bronze and the forms of burial rituals signified in his opinion an essential difference in comparison with the earlier Stone Age culture. Tallgren also observed that land uplift had transformed the environment of the ”stove of beasts” (*hiidenkiuas*) which now was much more mainland-like than it had been at the time of the construction of the cairns. Originally the graves had been constructed in the archipelago, i.e. at the seaside. The finds from the Neolithic Stone Age, on the other hand, were distributed on the coastal zone reaching some distance inland in comparison with the cairns. The archipelago was, according to Tallgren, alien to the mainland population of the Stone Age. ”How could we possibly think that the population of the mainland would have moved to settle down in the barren archipelago where the living conditions were

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26. NM 10958: 2. Asplund 2000: 54–55. The type of the artefact conforms to that described by Salo 1968: 169. The oval striking-stones date back to the Roman Iron Age and the Migration period.
27. NM 7011. The site of the discovery is uncertain. Asplund 1997 a: 261. Cf. Kivikoski 1973: fig. 837.
28. NM 5215. Tallgren 1931 b: 158; Meinander 1983; Fagerlund 1992. Cf. Kivikoski 1973: fig. 1167. Furthermore, there is a blade of a broadaxe, found in Lökholm, Nagu in the 1930s; in the catalogue of the Provincial Museum of Turku this artefact was described as medieval (PMT 12959). It was probably destroyed in the bombardment of Turku Castle in June, 1941. Another possibly historical artefact is the spearhead from Jänessaari, Turku (PMT 20954).
29. See the inventory prepared by A.M. Tallgren of the excavations in Southwest Finland by the year 1931 (Tallgren 1931 b: 6–8).

entirely different from those they were used to? How could those people have made their living?" (Tallgren 1931 a: 93). And in another connection: "…it seems very doubtful that the population should have settled down on islands and skerries which certainly were not very favourable for living, neither for fishermen or hunters nor for farmers" (Tallgren 1931 b: 58).

The finds from the Bronze Age conveyed a cultural otherness which had to be interpreted, and here Tallgren ended up with suggesting alien elements. The constructors of the cairns were immigrants from Sweden who were engaged in seafare and trade with remote regions, and who imposed taxes on the inland inhabitants or dealt with them in furs and victuals. They lived in the archipelago, secure from the possible hostile attacks of the mainland population, and were capable of keeping contact from there with their mother country. Despite the aversions the mainland population gradually adopted the new burial construction (Tallgren 1931 a: 91–94; Tallgren 1931 b: 58; Cleve 1942 b: 7–8). According to Tallgren many crucial problems concerning the Bronze Age were still disputable but for centuries his immigration theory remained, however, as the vigorous one.

It is generally known that the scantiness of the finds from the pre-Roman Age was interpreted as a sign of the annihilation of settlement both on the Finnish mainland and on Åland caused by the deterioration of the climate (e.g. Meinander 1954 a: 208). According to Tallgren South-West Finland became desolate during the centuries preceding the Christian Age. When the area – according to Alfred Hackman's immigration theory (1905) – was resettled at the beginning of the new millennium, the agrarian population from the other side of the Gulf of Finland colonized the mainland regions but not the archipelago. According to Tallgren's idea the archipelago remained a desolate wilderness until the end of the Iron Age (Tallgren 1931 a: 107, 160–161; Tallgren 1931 b: 60–61; 80; 101; Jutikkala 1933: 78–). What had been suitable for the seaworthy and self-sufficient 'Swedish' immigrants proved too barren and severe living conditions for the agrarian Finnic peasants of the Iron Age.

This is how what I call the concept "hypothesis of the peripheral nature of the archipelago" emerged. According to this idea the archipelago was an outlying and barren wilderness when it comes to the agrarian settlement which was the focal point of archaeological research. Its natural resources were scant, and it was exploited mainly for long-distance utilization (*Fi. kaukonautinta*) only[30]. This idea was not shared without reserve by C.A. Nordman and Svante Dahlström, both specialists on the past of the archipelago (Nordman 1936: 30; Dahlström 1945: 19, 31), but the hypothesis remained, however, the prevailing interpretation of the prehistory of the settlement of southwestern Finland. It also deserves mention that the hypothesis was introduced in texts which were mainly intended to be used as textbooks or popular readers.

In the postwar period the hypothesis of the peripheral nature of the archipelago received a new touch as it was connected with the Vikings. Several scholars still regarded the scantiness of the Iron-Age finds in Åboland as evidence of the desolation of the archipelago (e.g. Kerkkonen 1945: 246–247, 251–254; Meinander 1954 a: 116; Gardberg

30. The use of the word *kaukonautinta* (long-distance utilization) in this connection suggests that the author sees an analogy between the prehistoric archipelago and the system of alloted wilderness (*Fi. erämaalaitos*) in the historical age (see Jutikkala 1958: 17–49; Luukko 1967) even if Tallgren does not mention it explicitly.

1955: 28–31; Jutikkala 1958: 15; Meinander 1961: 87; Ericsson 1973: 11; Meinander 1980: 11; Meinander 1983; Suistoranta 1985: 5–6; Hirviluoto 1991: 162; Fagerlund 1992; Luoto & Seppä-Heikka 1992: 24; Orrman 1994 b: 526–527; Orrman 1999: 379–380; Asplund 2000: 67)[31]. The summery fishing and hunting trips of the coastal inhabitants, and the transito traffic of the Vikings on the southern Archipelago Sea seemed to have been the only human activity in Åboland in the Iron Age. Gabriel Nikander searched for explanations to the scantiness of the finds in factors which might have dispelled the settlement. According to his idea the Vikings were so dangerous to Finnish peasants that the island of Kimitoön could not be populated due to this risk. Referring to the farmland areas at the end of the Middle Ages he came to the conclusion that the arable land on Kimitoön was insufficient for the peasants in the Iron Age (Nikander 1942: 30–31).

The scantiness of finds is always relative. Nils Cleve, for instance, compared the then absence of Iron-Age finds in the southern archipelago of Åboland with the multitude of Bronze-Age cairns. In his view it seemed impossible that a few obviously Iron-Age graves on the island of Kimitoön could have filled the settlement vacuum of centuries in the Iron Age; instead he wanted to give these graves another context, the Vikings and their voyages to Russia. This was evidenced by the Viking-Age cairn on Stora Ängeskär, and the apparently late grave of the same type on Långfuruholm found by Högman (Cleve 1948: 502). Iron-Age cairns, if there were any, had been constructed by sailors from the west, not by local islanders. Aino Naert, the philologist, discussed the number of Iron-Age finds in the archipelago of Åboland compared with that on the mainland coast of South-West Finland and the mainland of Åland (Naert 1995: 92)[32]. These simplified comparative studies did not display any attempt to take into account the regional differences in field research situations.

Ella Kivikoski emphasized the significance of the eastern trade route introduced by Vikings for the mutual contacts of goods exchange between Finland and Birka. The trade route, which, according to her view, followed with great certainty the waterway mentioned in the medieval so-called Danish itinerary, invigorated the activity of the trading places on the coast of the Gulf of Finland. Nevertheless, the coasts of Uusimaa remained uninhabited and desolate apart from the supposed fishing or hunting seasons and market days. Kivikoski assumed that the archipelago of Åboland was during the Viking Age and the Crusades inhabited by a Swedish Christian population, which, on account of its burial rituals without any material objects, had remained archaeologically invisible (Kivikoski 1964: 193–220; 295). Kivikoski did not give any statement of what kind of relationships she thought had prevailed between the Vikings and the Swedish inhabitants of the archipelago but in all likelihood we may assume that she considered them peaceful. C.F. Meinander (1983: 231–237) for his part thought that the reason for the scantiness of archipelagian finds was the absence of sedentary population caused by the threat caused by the Vikings, and the necessity of the mainland population pursuing slash-and-burn cultivation to rule over huge uninhabited wildernesses[33].

31. See also the settlement maps, for instance Jutikkala 1949: 10; Kivikoski 1964: 294; Luukko 1967: 185; Orrman 1991 b: 5).

32. Naert refers to Cleve and Kivikoski when discussing this matter but the comparison with mainland finds is her own.

When discussing the prerequisites for establishing the monastery on the island of Kökar Jarl Gallén concluded that one of the reasons for the settlement vacuum on Kökar in the Migration period and, above all, in the Viking Age was the waterway to the east, running past Kökar and making life there menaced. To pursue archipelagian sources of livelihood and to settle the archipelago required peaceful political conditions which were not possible until the Swedish colonization in the 12th century, and eventually after the peace of Pähkinäsaari (Nöteborg) between Sweden and Novgorod in 1323 (Gallén 1989: 18; Gallén 1998: 113).

The original ecological argument suggested by Tallgren, the harsh natural conditions in the archipelago, has thus gradually been set aside[34]. This may account for the fact that the old hypothesis concerning the peripheral nature of the archipelago was never re-evaluated although Meinander in 1969 demonstrated that Finland was not desolated in the Pre-Roman Iron Age (Meinander 1969). The hypothesis had shaped itself into varying thoughts of the danger caused by Vikings, the poor conditions to pursue agriculture, the early Christian burial customs in the archipelago, and the political controversy between the East and the West. These thoughts are partly contradictory; for instance, the idea of Vikings being a danger to the islanders is not in accordance with Kivikoski's idea that the islanders were of Swedish origin. It is, however, more essential that the ecological approach suggested by Tallgren was never discussed critically.

2.3 Field work projects 1943–1973

The archaeological surveys of the Archaeological Commission (the predecessor of the National Board of Antiquities) in Åboland were started again after the first investigations but only after the inception of the hypothesis of the peripheral nature of the archipelago.

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33. Some time between the writing and the publication of this work, the licentiate thesis of Henrik Asplund was submitted at the University of Turku (Asplund 2001). The author, continuing the tradition of the periphery hypothesis, proposes a new reason for the alleged Iron Age abandonment of Åboland: changes in social organization brought about by a shift towards a more agriculture-based society. Agricultural and military centers, archaeologically visible through clusters of cemeteries, emerged on the mainland after the end of the Early Iron Age. Among the advantages of the new socio-political units would have been better cooperation and predictability of subsistence and a more efficient strategy for defence and military force. The centres would have begun to control the isle of Kimitoön inhabitants, eventually forcing them to leave their dwelling places and move to the mainland. This process would have left Kimitoön deserted for centuries, and supposedly no traces of human activities earlier than the Viking Age can be seen there. According to Asplund, this is true even for the more archipelagian areas of Åboland. The number of Iron Age burial cairns in Åboland (and the chronology of burial cairns on the whole) is obviously a crucial question for the idea of moving to the mainland. However, although Asplund has clearly used some field archaeological data collected by me and included in my studies related to archipelago cairns (this can be inferred from the maps illustrating the distributions of Bronze Age and Iron Age cairns, though the author does not explicitly mention the source of these data), the results of these studies are completely ignored (cf. Tuovinen 1985; Tuovinen 1991; Tuovinen 2000b; cf. also Zilliacus 1994). Therefore, his argumentation remains defective and it will not be discussed further here.
34. However, Anna-Liisa Hirviluoto suggested that the microclimate in the river valley of Halikonjoki was more favourable for agriculture than the microclimates in the archipelago (Hirviluoto 1991: 162). Unfortunately, she gave no climatological data to support the idea.

Inventorial projects were conducted by Nils Cleve in Dragsfjärd in 1943, Georg Mickelson in Pargas and Nagu in 1954 and 1955, Kerttu Itkonen in Rymättylä in 1963, Marja Kopola in Korpo in 1971, and Torsten Edgren in Houtskär in 1973[35]. By the year 1980, 301 archaeological remains from the prehistoric or historic period had been registered, more than half of them cairns. The reports of the Archaeology 2000 Committee and the Prehistoric Protection Management Review Committee reveal, however, that the survey situation in the parishes of Åboland was still more defective than in the rest of the parishes in the province (KomM 1984: 48; KomM 1993: 5). One of the consequences of the uneven distribution of the field research situation was that some scholars hastened to compare the number of finds in the archipelago with the number of finds on the mainland; no notice was, however, taken of the fact that the frequencies were not comparable.

In Salo's opinion the field research situation in the archipelago is largely a problem of accessibility: inventorial work in the archipelago requires special arrangements and boat implements (Salo 1990). While the scholars of the older generation, such as Volter Högman and Hildur Planting, travelled at least partly by boat, the work of the postwar field archaeologists took them largely to locations which could be reached by car or by ferryboat. This entailed among other things that the middle and the outer archipelago zones remained largely out of reach – it was this very same region where the absence of finds convinced Cleve to emphasize his argument of the desolation of the archipelago in the Iron Age. But also in general, the archaeological activity in the archipelago of Åboland has been neglected to a certain extent because the antiquarian supervision of land use projects is concentrated on the mainland.

2.3.1 The Investigations of the National Board of Antiquities in Houtskär 1978–1986

A series of excavations was implemented by the National Board of Antiquities in Houtskär in the years 1978, 1979, 1981, and 1986.

14. *Houtskär, Trollberg* (087)[36]. This monumental cairn is located on the top of a high precipitous rock outcrop, at its highest point, h = 36.7 m. According to the report by Aarni Erä-Esko (1978), the length of the cairn was about 15.3 m, the width was 13.5 m, and the height 1.8 m. The cairn had been damaged, which, according to Erä-Esko had possibly led to the destruction of the stone cist. During the excavation a ground form aiming at a circle, which in Erä-Esko's opinion was likely to be the original shape of the construction, was discovered. There was a clearly discernible circular dry-stone wall which was 9.0–9.3 m in diameter. The dry-stone wall had been constructed of red sandstone slabs or, at places, covered with them, and it seemed to have been filled with boulders up to the brim. Under the stone layer there was a more

35. Reports by Cleve 1943, Mickelson 1954, Mickelson 1955, Itkonen 1963, Kopola 1971, and Edgren 1973 (NBA).

36. Map sheet 1032 09, x = 6677 04, y = 1521 63 (± 50). Inv. report by Edgren 1973, no. 1 (NBA). Inv. report by Kuokkanen & Tuovinen 1983, no. 99. Excavation report by Erä-Esko 1978 (NBA). Osteological analysis by Tarja Formisto, University of Stockholm, 1987. Tuovinen 1991: 52. Tuovinen 1997: 18–19. Jungner & Sonninen 1983: 72.

indistinct construction, possibly an inner concentric circle, which did not differ from the rest of the construction as to the colour or the type of the material stones. The rock surface was encountered after the removal of the stones. It was covered by a thin layer of soil which contained some charcoal, burnt bone, eight quartz flakes, and a quartz scraper. The bone sample consisted of 330.1 g of burnt bone, 231.8 g of which was identified (32.1 g of *calvarium*): *Juvenilis/Adultus*, MNI = 1. After the investigation the excavation team reconstructed the cairn in the shape which, according to their assumption, must have been the original. The cairn shaped itself into a regular mound, 12 m in diameter, lined by a circle of heavy boulders.

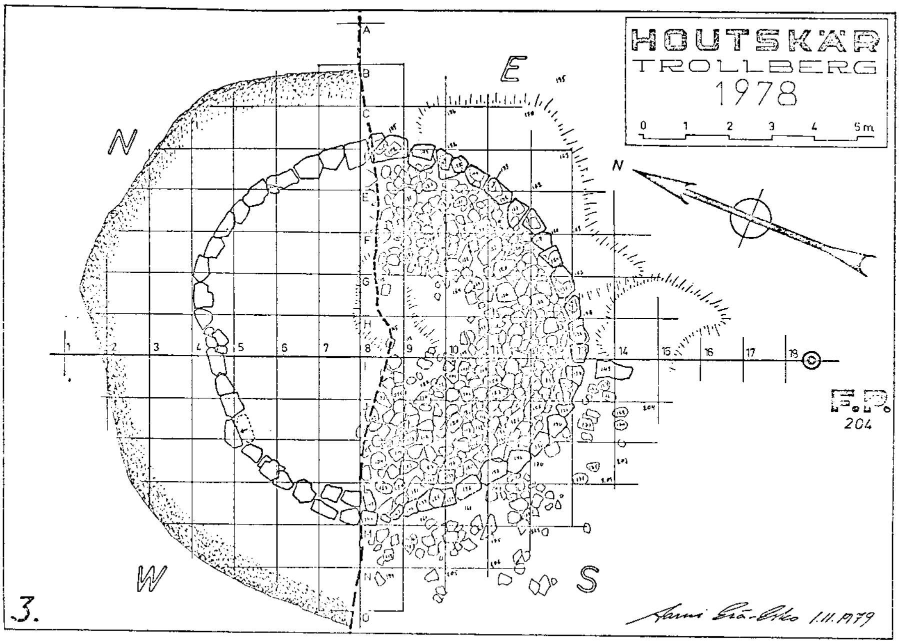

Fig. 3. Trollberg, Houtskär. The NW part of the cairn has been removed to reveal the inner circle. A combination level plan of the excavation in the year1979, drawn by Aarni Erä-Esko. The National Board of Antiquities.

Fig. 4. **The Trollberg cairn can be distinguished in the distance when climbing up the SE slope to the top of the rock outcrop. Photograph by the author.**

Fig. 5. **The cairn of Trollberg is well known. In Houtskär it has been endowed a great significance since it is said to symbolize the whole prehistory of the locality. The guide board on the parking place of a boat restaurant tells the visitors the way up to the cairn which is on one of the highest rocks in the region. Photograph by the author.**

15. *Houtskär (Houtskari), Furunabb* (088)[37]. This cairn belongs to the cemetery of Furunabb (Tuovinen 1991: 57–59; Zilliacus 1994: 36), located on a plane rock outcrop near the shore, *h* = 15.0 m. The cairn 088 is a rectangular construction, built mostly of rounded stones and boulders (about 1–100 kg), the side lengths of which are 8.3 m (W–E) and 7.7 m (N–S), and the height 0.7 m. The sides are fairly accurately oriented towards the cardinal points of the compass. The outer frame of the cairn is built of large boulders. In the middle there is an edged vertical stone slab, a centre stone, orientated N–S on its long side. The height of the centre stone from the surface of the cairn is 1.7 m, the width at the base 1.4 m, and the thickness 0.2–0.3 m. Seen from aside, the centre stone resembles an asymmetrical polygon. In an excavation conducted by Tapio Seger in 1986, it was discovered that the proportion of small stones mixed with large boulders was greater in the filling layer than in the surface layer. Many of the small stones had become brittle by action of fire. In the filling layer, a well-preserved skeleton was found; according to Seger, the skeleton was one of a small dog, and of recent age. It is noteworthy that in course of the excavation the amount of small stones decreased in the deeper-lying layers. On the rock surface there was a layer of humus, 2–3 cm thick, without any finds. The total height of the centre stone was measured to be 2.25 cm. According to L.W. Fagerlund, the centre stone whose height was seven feet (2.08 m), had been erected only 30 years earlier, i.e. in the middle of the 19th century (Fagerlund: 1878: 293).
16. *Houtskär, Furunabb* (091). A shallow stone setting, consisting of two layers of stones, excavated by a team led by Päivi Pykälä-aho in 1981. The altitude was *h* = 14.8 m. According to the excavation report, the length of the construction was 4.1 m, the width 3.9 m, and the height 0.5 m. 280 g of burnt bone fragments were found under a five-centimeter-thick humus layer on the rock surface.
17. *Houtskär, Furunabb* (092). A shallow triangular stone setting, consisting of stones in two layers, excavated by a team led by Pirkko Höysniemi in1979. The altitude was *h* = 12.5 m. The length of the stone setting was 2.8 m, and the width 2.5 m. A ferrule of iron was found in the thin humus layer on the bottom of the stone setting.

37. Furunabb in Hyppeis, Houtskär is a cemetery of 12 stone settings. Inv. report by Kuokkanen & Tuovinen 1983, no. 76–88 (TYA). Eight of the cairns were excavated by the National Board of Antiquities in the years 1979, 1981, and 1986. Map sheet 1032 06, x = 6678 55….6678 60, y = 1514 73…1514 75 (± 50). Cairn 088. Excavation report by Seger 1986 (NBA). Cairn 091. Artefacts: NM 21157: 2. Excavation report by Pykälä-aho 1981 (NBA), no. 5. Cairn 092. Artefacts: NM 20576: 1-7. The particles of bone reported by Pirkko Höysniemi (1979, no. 6, NBA) were identified as charcoal and stone (Tarja Formisto, University of Stockholm, 1987). Cairn 094. Artefacts: NM 21157: 3. Excavation report by Pykälä-aho 1981 (NBA). Cairn 096. Excavation report by Pykälä-aho, no. 10. Cairn 097. Artefacts NM 21157: 1. Excavation report by Pykälä-aho 1981, no. 11 (NBA). Cairn 098. Excavation report by Pykälä-aho 1981, no. 12 (NBA). Cairn 099. Excavation report by Pykälä-aho 1981, no. 13 (NBA). Other sources: Fagerlund 1878: 293; Tuovinen 1991: 57–59; Tuovinen 1997: 19–20; inv. report by Edgren 1973, no. 2 (NBA).

Fig. 6. Furunabb, Houtskär. To the right the cairn 088. Photograph by the author.

18. *Houtskär, Furunabb* (093). A shallow stone setting, the length of which was 4.7 m, the width 4.3 m, and the height 0.5 m. The altitude *h* = 16.3 m. The eastern part of the stone setting was lined by boulders, possibly remains of an outer circle. According to the excavation report by Päivi Pykälä-aho, the cairn had two bauta stones. Under the stones, in a five-centimeter-thick humus layer, 68 g of burnt bone was found within an area of 20 cm in diameter.
19. *Houtskär, Furunabb* (094). A shallow stone setting with no distinct structure in one layer. The length was 4.6 m, the width 3.9 m, and the height 0.4 m. The altitude *h* = 17.0 m. Under the stones there was a three-centimeter- thick humus layer.
20. *Houtskär, Furunabb* (095). A stone setting with no distinct structure. The length was 2.4 m, the width 2.1 m, and the height 0.3 m. The altitude *h* = 17.0 m. On the rock surface there was a fissure with 10 g of burnt bone fragments in the humus.

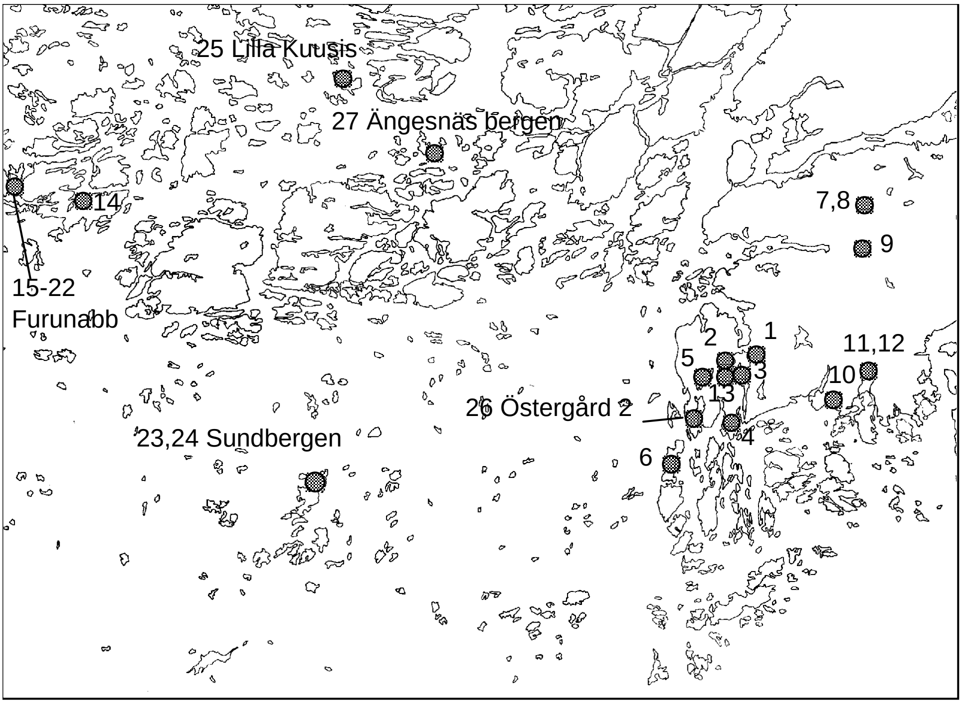

Fig. 7. The excavated burial cairns in the archipelago of Åboland. 1. Labbnäsåsen, Dragsfjärd. 2. Jordbro, Dragsfjärd. 3. Långnäsudden, Dragsfjärd. 4. Rövik, Dragsfjärd. 5. Hammarsboda 108, Dragsfjärd. 6. Nämanön, Dragsfjärd. 7, 8. Tjuda, Kimito. 9. Jättekastberget, Kimito. 10. Söderviken, Västanfjärd. 11, 12. Lillskogen, Västanfjärd. 13. Söderby, Dragsfjärd. 14. Trollberg, Houtskär. 15–22. Furunabb, Houtskär. 23, 24. Sundbergen, Nagu. 25. Lilla Kuusis, Nagu. 26. Östergård 2, Dragsfjärd. 27. Ängesnäs bergen, Nagu.

21. *Houtskär, Furunabb* (096). A stone setting of one stone layer, the length of which was 1.8 m, the width 1.6 m, and the height 0.3 m. The altitude $h = 15.3$ m.
22. *Houtskär, Furunabb* (097). A stone setting of one stone layer, the length of which was 3.7 m, the width 2.6 m, and the height 0.5 m. The altitude $h = 14.8$ m.

The excavation at Trollberg, Houtskär, in 1978, and particularly the excavations at Furunabb in 1979, 1981, and 1986 produced substantial new evidence of the chronology of the cairns. The layer containing charcoal in the grave at Trollberg was radiocarbon dated to the Bronze Age (2990 ± 140 uncal BP, Hel-1143[38]). The characteristics of these cairns emphasize the differences between the graves from the Bronze Age and those from the Iron Age because the Trollberg and Furunabb cairns represent both morphologically and topographically almost opposite features.

38. The date is 2990 ± 140 BP, which gives, according to the *A*-method of Stuiver & Reimer (1993), the calibrated date 1 σ : cal BC 1425 (1212, 1199, 1192, 1138, 1132) 974 (Hel-1143; Jungner & Sonninen 1983: 72).

2.3.2 New finds

2.3.2.1 Early Metal Age

In the last few decades the number of the Metal-Age finds in the archipelago of Åboland and Kimitoön has increased rapidly thanks to research projects and amateur activity[39]. Three Bronze-Age or pre-Roman dwellings have been found on the island of Kimitoön: Hammarsboda 3, Dragsfjärd; Tappo, Västanfjärd; and Makila, Kimito. Maybe even Jordbro, Dragsfjärd, found by Nils Cleve in 1943, could be included in the list.

At Hammarsboda, Dragsfjärd, the ice-marginal formation of Salpausselkä III traverses a valley between two rocky areas of elevated land. Here the ice-marginal formation formed in the second pre-Christian millennium a dry gravel isthmus which on both sides was lined with arms of the sea towards the south and towards the north (figure 8). There are Subneolithic dwellings in this area down from the height of 30 m, possible trapping pits, and six cairns, four of which date back to the Bronze Age with relatively great certainty. To judge from the height, the youngest dwelling is Hammarsboda 3, which was located on the isthmus, and was thus particularly well sheltered against heavy seas but, on the other hand, in immediate contact with the outer archipelago and the open sea. In the north, there was a long (4.5 km) arm of the sea, opening in the west into the outer archipelago; in the south there was another arm of the sea (1.2 km), also opening into the outer archipelago. The location of the dwelling reminds of the Bronze-Age seal hunting site in Otterböte, Kökar (Gustavsson 1997). The excavation in 1991 revealed stone artefacts and pottery typical of the Kiukainen-culture[40]. During the excavation some surface artefacts were collected, and their elevations were measured tacheometrically. The elevations obtained indicated that the site had been inhabited when the surface of the earth was as much as 18 m lower than today, i.e. in about 1300 BC. The Kiukainen-ceramics does not exclude the dating of the dwelling to the early Bronze Age as it seems to have been in use until about 1000 BC (Carpelan 1979).

The dwelling at Tappo was located, in the period of its usage, at the farthest corner of a long and shallow cove, not far from arable fine-grained sediments and at some distance from the shore (figure 8). The excavation in 1989 led by Henrik Asplund brought to daylight a relatively big amount of burnt clay in regard to the investigated area; the clay displayed grooves made by twigs or branches, possibly remains from a wall built of intertwined branches. The ceramics is Epineolithic, and the dwelling can thus be dated back to the younger Bronze Age or the Pre-Roman Iron Age. In the bone material only one seal bone was recognizable (Asplund 1997 a: 255–258). There are three medium-sized cairns in the vicinity of the dwelling, one of these with a high centre stone (331, 332, 333).

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39. Part of the finds have been published with general regional surveys. See Koivunen 1982; Tuovinen 1984; Nyberg 1985; Suistoranta 1985; Myhrman 1990; Tuovinen 1991; Fagerlund 1992; Laukkanen 1995; Tuovinen 1997; Asplund 1997 a; Tuovinen 1999; Tuovinen 2000 b; Fortelius 1999: 1–3; Asplund 2000; Myhrman 2000.
40. Excavation report by Tuovinen 1991 (TYA).

The dwelling site at Makila, Kimito was located, in its period of usage, at the farthest corner of a cove opening towards the east, not far from fine-grained sediments (figure 8). Test pits were dug and a phosphorus mapping was performed on the stony hill of moraine limited by cultivated fields and hilly moraine terrain in 1990[41]. The finds include pieces of Morby ceramics, burnt clay, and burnt bone. There is also a cairn on the hill (154). The lower limit of high phosphorus contents in the terrain is about 18.0 m. The dwelling dates back to the Bronze Age or the Pre-Roman Iron Age. A cairn was investigated in 1997 on the cliff rising north of the dwelling. It was discovered to be surrounded by a structure laid of stones intended to even the ground around the cairn (Asplund 1997 a: 258–259).

Jordbromalmen is a dwelling site from the period of the Kiukainen-culture; its shoreline lay, according to C.F. Meinander (1954 b: 64), at the height of 19.5 m. Thus it is slightly older than the Litorina V- shoreline, and the dwelling might have been in use as late as the Bronze Age. The site is located on a gently inclining S and SE gravel slope with a view towards Dragsfjärd, an open stretch of the sea opening below the slope, today contracted into a lake. During the excavations made by Nils Cleve and C.F. Meinander in 1946 and 1947 a 25–40 cm thick culture layer with scattered soot stains and fire-cracked stones, at least partly remains of fireplaces,was uncovered in the sandy terrain. Three foundations of dwellings, oblong low stone structures laid on the ground, and traces of wooden upright props were discovered on the site. Ninety per cent of the pottery showed no decoration, but the decorated sherds refer to the Kiukainen-ceramics (Meinander 1954 b: 61–65). The rest of the dwellings belonging to the Kiukainen-culture (Östermark, Kimito; Branten, Kimito; Knipäng, Dragsfjärd; Hammarsboda 2 and 4, Dragsfjärd; Alistalo, Rymättylä; and Sydmo malmarna, Pargas) are of older origin, according to the evidence available today[42]. In Satava, Turku, a quartzitic artefact having the shape of a bear-head was found, but it seems to be a stray find[43]. According to Christian Carpelan it originates from the Neolithic or the Early Bronze Age (Carpelan 1974).

41. Excavation report by Asplund 1990 (TYA).
42. Asplund 1997 a: 240–241; Meinander 1954 b: 64–66; Koivunen 1982.
43. NM 13439. See field report by Tuovinen 1979, no. 4.10 (PMT).

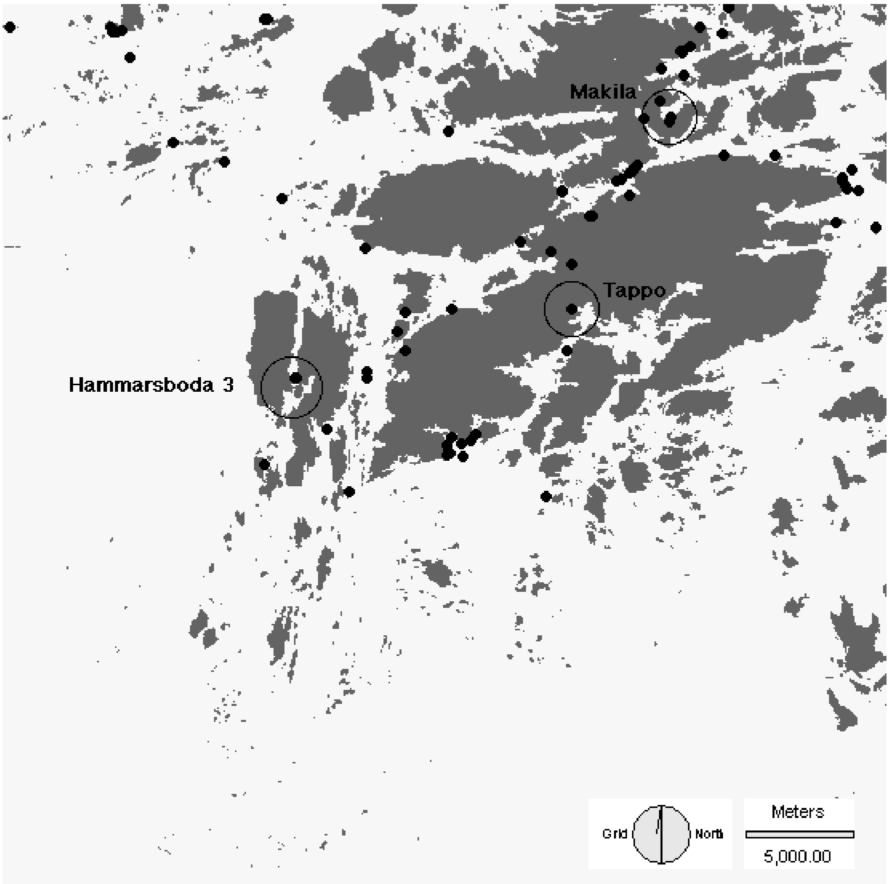

Fig. 8. The dwellings from the Bronze Age and the pre-Roman period (encircled), and the cairns of the Bronze-Age type (Group *P*, see chapter 7) on the island of Kimito. The shoreline corresponds to the height of -17.5 m, i.e. approximately 1200 BC. Several long straits divided the island of Kimito into parts, and the firth-like inlets added to the diversity of the topography. As early as 1948 Nils Cleve observed that a considerable part of the graves follows an ancient firth through the island of Kimito (Cleve 1948: 492–493). © The National Board of Surveying, License n:o MAR/103/98.

2.3.2.2 The Iron Age

Even the dwelling at Kyrksundet, Dragsfjärd (Hitis) belongs to the new finds. The rich material found at the excavations in the 1990s consists of weights, coins, and keys etc implying that the dwelling has been used as a trading place. The material indicates contacts with the Finnish mainland, the Baltic region, and Europe. The find also includes bronze bars and other artefacts associated with metal casting, suggesting that there has been a bronze foundry at the site. Most of the artefacts can be dated back to the period 900–1100 AD. Remains of a medieval chapel, a bell tower, and a graveyard have been found in the vicinity of the dwelling (Nordman 1940; Edgren 1995 a; Edgren 1995 b; Edgren 1996; Edgren 1997 a; Edgren 1999b: 7–18).

At Jungfrusund, Dragsfjärd, there is natural harbour, which was used from the Middle Ages to the 18th century. Four vessels of Slavic ceramics (also known as Vend or Baltic ceramics) were found on the bottom of the sea outside the harbour in 1987. In all probability they had been used in the 11th–13th centuries (Dahlström 1945; Ericsson 1979; Kallberg 1990; Edgren 1997 b). The site is located 14 km north-northwest of Kyrksundet. A piece of an East Scandinavian runic stone, probably dating back to the late 11th century, was found at Stora Ängesön, 7 km north of Kyrksundet, on the bottom of a reedy flad cove (Åhlén *et al.* 1998 a; Åhlén *et al.* 1998 b)[44]. The rest of the newer Iron-Age stray finds consist of a barbed spear head, found at Malmen, Pargas and dating back to the Migration Period or the Merovingian period[45], a Viking-Age iron axe found on Jermo, Pargas[46], an oval striking-stone found at Helgeboda, Kimito[47], and a wedge axe from the Viking Age, found in Hirvensalo, Turku[48]. Furthermore, two cup-marked stones are known to have been found in Åboland, one at Galtby, Korpo, and the other at Berga, Kimito. Both of those have become demolished (Tuovinen 1991: 70–71; Asplund 1997 a: 261).

Also the rocky fortified island of Borgholm, Iniö can be included in the Iron-Age finds. It is a wooded islet of 15 hectares, its top reaching the height of 28 m. The gently inclining southern slope is encircled by a 450-metre-long stone wall whose lowest point is at the height of 8.1 m. On account of the height it can be established that the fortified islet has not been in use before the Viking Age (Tuovinen *et al*. 1992). Another known fortified islet in Åboland, Bårnholm, Nagu is a granite dome with sharp and steep features rising to the height of 30 m; the area of this island in the inner archipelago of Nagu is less than two hectares. The shore cliffs all around the island are steep or vertical, and can be ascended only with great difficulty. A double wall constructed of heavy granite boulders has been built on the southwestern slope which is gentler than the others. No investigations have been carried out on the island, and the age of the wall is unknown (Nordman 1936; Dahlström 1945: 63–67; Tuovinen 1991: 71–73). The numerous place names with an initial *borg*-, *lin*- or *linna*- may refer to fortified islands. The rocks or cliffs with names with an initial *borg*- in Houtskär have been assumed to be Iron-Age refuges but no walls have been found on them. The names with an initial *borg*- occasionally refer also to islands with sheer shores (Pitkänen 1985 a: 271–273; Orrman 1991 a: 222; Zilliacus 1989: 56; Zilliacus 1994: 38; Zilliacus 1997: 43; Valtavuo-Pfeifer 1998: 46–47; cf. also Montin-Tallgren 1910; Tallgren 1931 a: 171).

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44. A flad (*Sw. flada*) is a shallow bay formed by the land uplift, often partly isolated from the sea. See, e.g. Numminen 1999.
45. NM 13619. Cf. Salmo 1938: 215–216; Cleve 1943: 133–134; Kivikoski 1973: fig.551; Lehtosalo-Hilander 1982: 21–22; Pihlman's type R1 (Pihlman 1990: 122–126). Asplund 2000: 56–57.
46. Asplund 2000: 58–59.
47. NM 30444. Asplund 1997 a: 261–262.
48. PMT 15740. Cf. Wuolijoki 1972: 26; Kivikoski 1973: fig. 882. Inv. report by Tuovinen 1979, no. 4.15 (PMT). With reference to an axe of the same cuneiform type in Estonia, Henrik Asplund suggests that the artefact originates from the Early Iron Age (Asplund 2000: 62). Whichever is the true date, the axe has originally fallen to the clayey bottom of an inlet, since the altitude of the shore where is was found is only 3–4 meters.

In the field investigations of recent years, constructions laid of boulders confining a round or rectangular floor space have been discovered. A vertical rocky wall sometimes forms one or two of the walls of the dwelling. The area of the floor space is approximately 4–30 square metres, frequently cleared and levelled. The wall may be fairly low, almost on the level of the ground, or a dry-stone wall of the height of a few boulder tiers. The remains have not been investigated but their structure and location are suggestive of a *tomtning*, i.e. remains of a temporary shelter for fishermen and seal hunters overnighting near the fishing grounds. More than twenty *tomtning*-remains have been found in Houtskär, Korpo, Nagu, and Dragsfjärd (Tuovinen 1991: 78–80).

Tomtning-remains have been discovered also in the archipelago of Åland (Karlsson 1990). By 1993 as many as 1259 *tomtning*-remains had been recorded solely on the east coast of Sweden (Norman 1993: 30). The coasts of Norrbotten and Västerbotten are particularly rich in *tomtning*-remains used by ancient seal hunters; these remains are mainly from the Viking Age or the Middle Ages, the oldest from the Migration Period as evidenced by radiocarbon dating. According to Peter Norman, the northern *tomtning*-remains display two age layers which are different from each other in terms of location and construction. Medieval *tomtning*-remains are located on the utmost skerries at the edge of the zone of solid ice, and often in clusters of dozens of shelters. Those from the Iron Age have been built closer to the inner archipelago at the height of 10–30 m above sea level (Norman 1993: 39–40, 47–48; Broadbent 1987; Nilsson 1988; Olofsson & Lindström 1990).

In the archipelago of Åboland there are a few *tomtning*-remains located in sheltered terrain at the height of 10–26 m, and their distinctive features are very much the same as those of the Iron-Age *tomtning*-remains on the Swedish east coast. These remains may be fairly old. Most of them are, however, located on rather low sites in the outer archipelago, and date probably from the historical period (Tuovinen 2000 b). Memorized knowledge of overnightings on the outer fishing skerries in simple constructions of stone has been recorded particularly in the archipelago of Åland in the 20th century (Andersson 1938: 119; Törnroos 1980: 97–98; Högnäs 1984; 1989; Karlsson 1990; Slotte 1990: 165). The number of Metal-Age archaeological finds in Åboland has increased rapidly but the field research situation is still defective in certain respects in comparison with that on the mainland coast. For instance the investigations of dwellings have been fewer resulting in a fairly small number of registered Metal-Age dwellings. It may be, however, more significant that the ecological fundamental assumption in Tallgren’s hypothesis concerning the peripheral nature of the archipelago, i.e. the unfavourable natural conditions in the archipelago, still remains unfounded. The evidence acquired through field archaeology has been far too little to be of any help in discussing the hypothesis. The nature of the archipelago is, however, rather diversified rather than scanty, as alleged at the beginning of this chapter. For this reason I will discuss the hypothesis of the peripheral nature of the archipelago again in chapter 9.

2.4 Interpretations of Coastal Cairns

2.4.1 Immigration or Cultural Contacts

In his work *Die Bronzezeit in Finnland* (1954) C.F. Meinander was inclined to support the idea that the construction of cairns and the bronze artefacts should be understood in terms of cultural contacts rather than as evidence of an immigration of Scandinavian settlers. Meinander demonstrated among other things that the finds from two dwelling sites, which had been known in Tallgren's days, included artefacts from the Bronze Age. These sites were Toispuolojannummi, Paimio and Isokylä, Uskela. The finds from the former site were previously considered to date from the period of comb-ceramics (Europaeus 1930); pottery from the latter site were known since the beginning of the century but they were regarded as grave finds from the Roman Iron Age (Europaeus 1914). It was thus evident that there was Bronze-Age settlement on the coast of the mainland. As new dwelling sites belonging to the Neolithic Kiukainen-culture were discovered on the islands and on the coast, the populations of the Kiukainen-culture, and the later cairn builders could not be regarded as entirely separate communities any longer. Nevertheless, in his *Bronzezeit*, Meinander does not entirely oppose to the old idea that people from Sweden settled down on the Finnish coast in the early Bronze Age. The cairns were, according to Meinander, of religious significance. The graves constructed on low-lying land were located in the vicinity of settlement and cultivated fields, suggesting that beliefs concerning harvest were an essential part of the burial ritual. The cairns constructed on high rocks reflected the desire of the communities to have a contact with nature, the sea, the sun, and the subterranean powers in the rocks (Meinander 1954 a: 93–94; 196–201).

Unto Salo has presented a further development of the interpretation of new settlers. The accurate homology between the pattern of cairns on the Finnish coast and that in Scandinavia – both in terms of morphology and location – speaks for the immigrant theory. The cairns are utterly different from the traditions of the population of the Neolithic Kiukainen-culture. The new burial ritual signified such a deep-going social and religious phenomenon that it must have been adopted from immigrants, and through long-term and intensive contacts. The immigrants settled down in the infertile rocky coastal regions in Åland and South-West Finland, which were suitable for fishing, seal hunting, fowling, and, occasionally, for clearing woodland for new cultivation. The number of immigrants was, however, small, and there was no organized immigration. The development of the relationships between the immigrants and the old population representing the Kiukainen-culture was fairly favourable which is demonstrated by the fact that the new burial ritual was adopted among the population of the Kiukainen-culture. The Scandinavian immigrants gradually became incorporated in the original population, and, in course of time, the archaeological differences vanished (Salo 1981a: 16–21; Salo 1981b: 424–437; Salo 1984 a; Salo 1984 c: 85–94; Salo 1988: 89–92; Salo 1995).

In Southern Scandinavia an advanced bronze technology evolved in the beginning of the second millennium BC. It was based on imported raw material, and therefore it was crucial to establish an exchange network in the northern and eastern Fennoscandia. According to Christian Carpelan some of the Scandinavian traders settled in the Finnish coastal areas to form a kind of superstratum, an upper class living among the population of the Kiukainen-culture and at its expense. The immigrants lived at the same sites as the population of the Kiukainen-culture, and therefore there are no visible archaeological differences. The upper class traded in natural products which were conveyed to Scandinavia where there was a need for commodities to be bartered for metals from the south. It took some time before the immigrants had settled in the country for good, and the new burial ritual was adopted among the population of the Kiukainen-culture only after this development (Carpelan 1982; Carpelan 1999: 271). Tapio Seger's version of the upper class in the Bronze Age is based on the idea of chiefdom communities suggested by Service and Sahlins characterized by ranked social structure, organized redistribution of production, increased population size, territoriality, and centre-periphery relations. In his opinion the construction work of the cairns was so toilsome that it required extensive co-operation and redistribution of production to feed the labourers. The social structure was strictly ranked. The crucial factor in the development of the social structure was the increased stock of seals (Seger 1982 a).

2.4.2 Adopting a Landscape Approach

Since the very first days of research it has been well-known that cairns have been preferably constructed on elevated hills with good visibility over the surroundings. The reason for this was – as put by Aarne Äyräpää – "to allow the deceased to see even from his last place of rest his dearest field of work, the sea" (Europaeus 1922: 186).

Of the Finnish scholars Unto Salo is the one who has the most thoroughly studied the connections between the cairns and the landscape. According to his idea, the visibility from elevated grave sites was of two-way nature. On one hand, the view from the grave site represented the great unity of nature, eternal and infinite. On the other hand, the grave preserved the memory of the deceased, "and it was best preserved if the cairn could be seen, at a visible site, particularly from the sea" (Salo 1981: 125). The graves which were constructed on rocks with good open view over the surroundings were family monuments heralding its position and status. The graves gave a visual proof of the power of the family as a land-owner: the range of vision opening around the grave drew the borderlines of the territory ruled by the family, which was not to be trespassed upon by strangers. The power was necessary to protect the cultivations, cattle, and natural resources of the family against rivals and competitors (Salo 1981: 122–130). The grave monuments were indicators of the homesteads and cultivations of the deceased ones and on the other side they were signs in the landscape telling outsiders that the land had been taken in somebody's possession. Consequently, the graves consolidated the internal social practices of the community, and were, at the same time, signals directed at any rivals coming from the outside world[49].

In his general reviews of the Metal Age, Unto Salo has outlined a theory concerning the tradition of cairns; the ingredients of this theory are the sign language of the graves,

49. The idea of territoriality and the control of the landscape has been adopted by many Finnish scholars (e.g. Seger 1982; Asplund 1997 b: 42–43; Pihlman 1999: 65, 73).

the family, the land possessions, and the peasant house. According to him, the Bronze-Age cairns had a symbolic function in preserving and protecting the family. The size of the grave was the crucial factor. The greater the number of the deceased family members buried in the same cairn, the bigger the size of the cairn. A large cairn indicated simultaneously the strong aspiration of the family and the house to demonstrate their right to the land as well as the authority, freedom of will, and competitiveness induced by such land proprietorship. The right to land meant a state of unshared possession effected by the work done in the originally non-possessed piece of ground; its permanence required a continuous use of the possession, and, on the other hand, protection against any possible rivals. Changes in the aspirations to demonstrate the proprietary right to land resulted in changes in the size of the graves. For this reason the size of the cairns became smaller in the V period of the Bronze Age, if not earlier, and reburials and grave enlargements were substituted by individual cairns in the graveyards or cairn clusters. By the Roman Iron Age the proprietary rights to land had stabilized, and, as a result, the proprietary right did not involve any longer very strong social tensions or conflicts of interests; consequently the monumental nature of the cairns was no more necessary. This fact, on the other hand, led to constructing smaller and smaller cairns (Salo 1981 b: 125–, 201–204; 1984 a: 133–139; 1984 b: 89–90; Salo 1997: 87–93).

The tendency towards a change concerning the other aspect of monumentality, the choice of the natural location as a grave site, is concretized in Satakunta on the shores of the ancient coves at Panelia and Nakkila. The results of the excavations, particularly at Rieskaronmäki in Nakkila, are a good example of the fact that, towards the end of the Bronze Age, the grave was not located any more on a high, frequently rocky site of view; instead, it was constructed on a lower ground in the moraine terrain and in the vicinity of the homestead. Also the choice of grave sites in itself indicates the development from individual graves towards cairn clusters, or groups of several cairns. The development is, according to Unto Salo, closely associated with the beginning of sedentary agricultural settlement in the Bronze Age (Salo 1981 b: 127–150; Salo 1984 c: 89; Salo 1987; Salo 1997: 14; cf. Carlsson 1983).

The stabilization of power and competitiveness which, according to Salo, is manifested in the development of the cairn tradition, can also be interpreted as a change in the concept of power from acquired power to inherited power (cf. Thomas 1995). In the early phase of sedentary agricultural settlement the cairns represented an expression of power acquired through competition, in the later stages of development they legitimized the inherited power by demonstrating the symbolic relationship between the social order and the ancestors. In his literary production Unto Salo has made it clear that the landscape as a cultural construction is an inevitable aspect in understanding the burial ritual of the Bronze Age and the Early Iron Age. This approach to landscape and monumentality is the point which the present work wishes to augment with additional point of views.

2.4.3 Coastal Cairns in Sweden

In some respects the Swedish research of coastal cairns follows the same lines as the Finnish. Evert Baudou demonstrated in his work *Forntida bebyggelse i Ångermanlands* *kustland* (1968) that the cairns were located in certain altitudinal zones not far from the ancient coastline. The sedentary Bronze-Age settlement on the coast of Ångermanland consisted of clustered settlement units which, according to Baudou, were apparently inhabited by extended families. The graves were located at sites which offered an unobstructed view towards the sea: on the shores of straits between islands or between islands and the mainland looking out towards the open sea. The best explanation of the great number of small scattered single graves is the function of the cairns as signs of propriety and as landmarks. In the Bronze Age of Ångermanland, Baudou does not see any traces of class society since the finds of artefacts were rather few, and most graves are so small in size that they cannot possibly be interpreted as indications of chiefdom. Any of the graves in Ångermanland may have been built by extended families (Baudou 1968: 89–90; 124–152).

Baudou's observations of the graves looking out towards the open sea have been confirmed by Örjan Hermodsson's (1987) and Lars Forsberg's investigations on the east coast of Sweden. Forsberg established that late Neolithic and early Bronze-Age graves had been located at the upper ends of coves. Later in the Bronze Age there was a tendency to construct graves closer to the open sea, not exclusively, however, since cairns were still erected also on the shores of straits. At the same time the expansion of cairn construction to many different areas was obvious (Forsberg 1999).

The idea of the function of cairns as signs of land proprietorship has emerged in Sweden at least on the same scale as in Finland. According to Dan Carlsson, for example, the cairns on Gotland were constructed to be signs of land proprietorship with the development of agriculture from slash-and-burn cultivation into sedentary field cultivation. Such signs had to be permanent monuments which were visible from far away. The bigger the monument, the smaller the risk of its becoming annihilated. The legitimation of acquired land proprietorship was materialized in the cairns of ancestors. The locations of the graves in the unobstructed landscape of Gotland indicates that they were meant to be visible; the external signs of proprietorship were erected to function as landmarks and information to outsiders (Carlsson 1983).

The recently published monograph by Dag Widholm deals with the Bronze-Age grave monuments in Småland, in southern Sweden. He differentiates between the regions characterized by ritual reproduction of ideology and religion and those subjected to agricultural production. The most significant graveyards can be interpreted as central ritual sites; in these, according to Widholm, there were graves of people from a larger area than the very neighbourhood and individuals belonging to various social categories. Such central sites consisted of areas with several graves, typically quadrangular cairns, and ship tumuluses. Individual graves, on the other hand, are to be found in more marginal regions. One of the most significant observations made by Widholm is that the grave sites are locations used for lengthy periods for repeated rites (Widholm 1998: 39).

3 Land, Sea, and Burial Sites

3.1 Death: a Crisis within the Community

Death causes a crisis in those members of the community who had had close emotional links with the deceased. Death also affects those who were socially, economically, or psychically dependent on the deceased, those who took care of his/her children, fished with him/her, and those who could share the knowledge, skills, or other cultural capital he/she had acquired. The familiar routine of the day is shattered, and the community is compelled to solve problems concerning the present and the future. The cultural practices concerning the transition from life to death or the period of transition between life and death, are called mortuary rituals. In various cultures, the mortuary rituals act as indispensable means of the community to cope with and try to overcome the absence of balance and psycho-social crisis caused by the death of a member in the community. The beliefs concerning death suppress fear, and contribute to returning safety and order in the community (Malinowski 1960: 53–56, 64–68).

Death rituals express, cope with, and suppress disorder in the community when a member of the community dies. They tend to take care of the deceased, supply his needs, satisfy the wants of those left behind, protecting them simultaneously against supernatural forces. Taking care of the fate of the deceased as well as of the settling of the mutual relationships of those left behind, is, as observed by Aili Nenola, ”a symbolic way of expressing the process through which the living, those left behind, gradually get rid of the social, psychic, and emotional ties to the deceased”. On the other hand, there is empiric knowledge of the fact that all the essential features of the mortuary ritual are reserved, in general, only for the authoritarian members of the community whose death really jerks society out of its balance, and who have died in a habitual or permitted way (Nenola 1985: 185, 202).

The religious notions associated with death offer an explanation to what happens at death, and give a myth-based pattern to be followed when facing death. Everywhere people have made an effort to adapt to the crisis caused by death by creating culturally uniform, analytical answers to the challenge of death (Pentikäinen 1990). The formality recognized by both anthropologists and archaeologists which prevails in the methods of handling the deceased, is thus made very understandable (Pader 1982: 36–40). The corpse and the ways of handling it contain a strong symbolic means expressing the transition from life to death (Barrett 1996).

Mortuary rituals may involve one's ancestors who participate in rites concerned with the living, i.e. *ancestor rituals* or they are *funerary rituals* that are specifically concerned with human burial (Barrett 1996: 397). Mortuary rituals are rites of passage meant to locate the deceased conclusively and permanently in the other world, the realm of death. They are not merely ceremonies which put an end to life, possibly visualized by a grave construction to be discovered by archaeologists, but they also represent a formal turning point which makes a new existence possible after death (Kaliff 1997: 20).

Mortuary rituals often include an ambivalence which is based on fear of death on one hand, and on emotional attachment to the deceased on the other. Estrangement from the deceased is achieved by confronting and handling the corpse in various ways, washing or adorning it or with a wake. At the same time the contact between the deceased and those left behind is maintained through pictures, statues, grave constructions or other images, and symbols. Mortuary rituals help those left behind to create the feeling that the deceased has been bidden a conclusive farewell, that the estrangement is sufficiently effective, and that the deceased is no more among those alive and thus not capable of affecting them (Holm 1997: 67–68).

The final farewell is concretely expressed in the beliefs of Siberian and Saami tribes according to which in the *Totenreich* (the Realm of the Dead) cultural categories like time, directions, body parts, earth and sky, are inverted in relation to the world of the living (Harva 1938: 347–350; Storå 1971: 206–209). According to Uno Harva (Holmberg), this comprehension probably originates from the very experience of looking at one's image on the mirroring water surface (Holmberg 1925). Among the 19th-century Siberian Nenets, objects buried with the deceased were broken to signify that in the other world they were used in a different way from that found on earth. The sledge that was used to transport the deceased to the cemetery, was left there and turned upside down or injured in a special manner that was symbolically linked to the realm of the dead. Those who moved away from the grave, stepped backwards and returned back to the home *choom* by a different route, in order to reproduce the principle of inversion and mislead the deceased, preventing him or her to find the way home (Ovsyannikov & Terebikhin 1994: 48–57). Any archaeologist who found these artefacts afterwards would probably become aware of the intentional damage caused to them, but not necessarily of the ritual significance of these characteristics.

Facing death requires of the nearest friends and relatives of the deceased renewed negotiations concerning the feelings of mutual obligations and solidarity also with regard to ancestors and the supernatural. The process of death actualizes, on the other hand, even the demands concerning social relationships, conflicts, and, for example, the authorization of taking possession of the property of the deceased. The process of death emphasizes the ritual as an expression of exertion of power, and as a means of legitimation of this power. The version of social relationships shown in the ritual is frequently idealized and legitimized through references to the past and the ancestors; it provides a forum on which to disperse and conceal social conflicts (Pader 1982: 36–44; Hedeager 1990: 97–98; Pihlman 1990: 49–50; Kristiansen 1991: 21, 31–35; Bender 1992; Härke 1993). On the other hand, as a social transition the ritual also reveals and expresses fundamental categories, rules, and beliefs. According to Victor Turner, those who participate in rites of passage move from a social state and status to another, proceeding from the separation phase to the liminal phase and the incorporation phase. The liminal phase is characterized by an egalitarian relationship between persons and an absence of conventional status, rule and property (*communitas*, Turner 1969). The ritual includes the opportunity of renewed discussions or repudiations concerning categories and rules thus making transitions between sociocultural categories possible. Consequently, categories are thus defined, overstepped, and redefined (Barrett 1996: 396–397; Anttonen 1996: 34).

When discussing the cherishing of ancestors' memories at secondary interments Koji Mizoguchi emphasizes the actualisation of the cultural power field in the mortuary ritual. Memories and recognition of one's ancestors may serve as exclusive means of power which were, to a limited extent, at the disposal of a certain group – according to Mizoguchi these were likely to be men – to naturalize and justify the power of the group. Interpretations and disputes concerning the ancestors and their authority had a chance of emerging in the specific situation caused by death. Discussions in the power field were subject to cultural norms which were thus submitted to pressures of change. In this respect, the mortuary ritual was a site of continuity as well as of change and discontinuity. People were able to feel that they observed loyally the tradition of mortuary ritual although the surging cultural power field had in fact resulted in changes in the mortuary ritual. Archaeological evidence provides a special opportunity of studying this process over a longer period (Mizoguchi 1996: 231; Pader 1982: 37–39).

3.2 Graves as Markers of What Is Beyond

The autonomous connection of the deceased with the community of the living is disrupted only after the final conclusion of the burial ritual. After that the grave remains as a reminder of the deceased and the incidents connected with his/her death, of the rites, and of the dialogue between the earthly and the supernatural. Contacts with the deceased are frequently controlled ritually, for instance by channelling them to calendar memorial days (Nenola 1985: 184; Holm 1997: 69). Contacts with the deceased may also be maintained with ceremonies formalized by returning to the grave and including a spatial ritualization of the grave site. The grave site obtains significances containing beliefs which make it a sacred site and create a link between the ancestors, the world of the dead, and the world of the living (Cooney 1994), or make the grave site a part of the cyclic circulation of birth, life, and death. The features of the grave accentuating the permanence from the past to the future, the authority of the past generations, and the power of the knowledge adopted from them, can be best understood as symbols of temporal continuity incorporated in the grave. Such features are apt to increase the archaeological obtrusiveness (to use Schiffer's term, Schiffer *et al*. 1978) of a grave construction.

3.2.1 Stone

Stone is a lasting material which endures from the past to the future, and refers thus to something beyond the immediate and temporal world of man's experience. Of all natural materials, stone provides a substance which may involve implications concerning the world view and the cosmological order. Unto Salo puts the idea like this:

> ”The Bronze-Age cairns are (…) in all their stony essence deeply human, and not only human but also things of cultural history: More serenely than any other material, they reflect the growth of temporal dimension which is likely to be the most essential feature in the cultural history of the Bronze Age” (Salo 1981 b: 114).

The permanence of a grave constructed of stone preserves the cultural importance of the grave site to those to whom the maintenance of such importance brings security, power, and identity. On the other hand, it also reminds us of the position of the grave site in the power field of the use of natural resources, and prevents it from being forgotten by those to whom the grave site signifies something else.

Some interesting relationships between stone and fire can be pointed out. When a stone is struck against metal or another stone, a spark appears: stone gives birth to fire. As petrified fire or as a creator of fire, stone thus possesses a sacred existence. It is a part of the symbols in the rites of passage of cremation interments, and during the prehistoric time it may ”have been regarded as an abode for the souls of the deceased, and at the same time a centre of power for the living” (Kaliff 1997: 126). Fire and lithic artefacts were, according to Unto Salo, symbols associated with beliefs concerning the supernatural power of the thunder, which appeared in Finland along with early agriculture (Salo 1990 a; Salo 1990 b).

3.2.2 Monumentality

The cairns in the southwestern archipelago are located in the barren rocky terrain at sites which make them easily discernible. Many graves are very large and protrude from the environment in a way which makes one naturally conceive them as very specific stony marks. When something concrete of a sufficient size and of permanent timeless visibility was produced intentionally in the prehistoric period we are apt to speak about monuments (Criado 1995).

In recent years the megalithic monuments in Europe have been given interpretations based on social constructivism deriving from the significances of the past of the community, and their presentation in artefacts and narratives. The past of the community was materialized and eternalized by preparing durable symbolic artificial artefacts and constructions, particularly megalithic graves. Material culture ”can introduce absent persons or classes of person into social discourse by means of metaphors and mnemonics, thereby influencing the interaction” (Thomas 1993). Monuments were timemarks in the landscape (Holtorf 1997), and carriers of material memory (Neustupny 1998) which were meant to endure to the coming generations. Neolithic monuments marked significant sites, and the memories associated with these sites were expressed, interpreted, idealized, and renewed in oral narratives.

The construction of monuments has required remarkable efforts and concentration of the available labour of the Neolithic community. It is generally thought that the monuments were erected in a period of social inequality, and thus they have expressed power, communicating in a visual signal language. For example, in the chiefdoms of Neolithic Wessex the ceremonial architecture (long barrows, enclosures, and cursus monuments) involved an impressive amount of work, which may be interpreted as a means to establish a social ideology in the material reality possessed and controlled by the chiefs: the economic base provided the stability for the control of labour as the ideology gave it legitimacy (Earle 1991: 98). However, we have to ask if chiefdom was a prerequisite for monument building. Monumentality was not absolute. As a representation of prestige, visibility, and durability, it was inevitably in any community related to its *own* cultural traditions and prevailing socioeconomic and natural circumstances. Monuments do not need to have been materially similar in different cultural traditions although they possessed basically similar symbolic significances.

The interpretations suggested as purposes of the significance of the monuments are not parallel. According to Cornelius Holtorf (1997), the monuments were constructed for the purpose of ”prospective memory”, substantially for a distant future enabled by the durability of the monuments whereas Paul K. Wason sees the monuments as sacred sites which were in active use in the period of their construction, and as means of communicating with ancestors (Wason 1998; see also Parker Pearson & Ramilisonina 1998). Another question concerns the communication itself: are the monuments messages from the constructors or those deceased? Julian Thomas emphasizes the significance of ancestors and ancestry in Neolithic communities, which, as accentuated by Wason (1998), implies that the power was inherited rather than acquired. Without absorbing more deeply in this discussion we can establish that the ideas presented have one thing in common: the grave monument as a physical object exists in temporal reality; it has its past, present, and future. The deceased persons, on the other hand, represent timelessness, independence of the time of those living, and they are materialized, as suggested by Thomas and others, in concrete symbols. At rituals the concealed modality of the timelessness of existence emerges out of concrete symbols. Material culture ”takes on the characteristics of the ritual mode by tangibly making *present* (in the sense of present tense and concretely here) that which is not physically here, is in another ’time’ (non-durational), and at another level of reality” (Pader 1982: 41). An object, a grave monument, a site, or a landscape are – to use the term suggested by Mircea Eliade (1961) – hierophanies, manifestations of a different reality beyond our world in objects that constitute an integral part of ’this’ world.

3.2.3 Morphological Variation

For the archaeological method of cultural research it is significant that religion is inclined to preserve, transmit, and reproduce tradition over long time periods. A religious ritual involves a great amount of repetition to guarantee the form and significance of the ritual to be memorized and thus maintained to the coming generations (Renfrew 1994: 50). Conservatism and long age concerns also the mortuary ritual, and its material remainders, the graves in which the repetition of morphology and the similarity of graves is an expected rule, and variation is often an exception.

Cornelius Holtorf has made an important point concerning sustained life strategies, typical of prehistoric farmers. ”Considerations of the future were certainly not unusual in a Neolithic farming society: both animal husbandry and crop growing have in common that they yield results only through continuing work over a long time period. If farmers thus have to plan their subsistence strategies for one or more years ahead, they may as well have thought about a future which is further away, and perhaps well beyond their own life expectancy” (Holtorf 1997: 48; see also Sarmela 1984: 216–). The idea of thoughts about the future being present in the burial ritual might help us to understand inherent morphological continuums in grave design not only in Middle-European Neolithic contexts, but also further north, among Bronze-Age and Iron-Age fisher-farmers along the coasts of the Baltic Sea, as well. Marek Zvelebil has pointed out that in northern areas, a real neolithization of economy did not occur before the last millennium BC due to the subsistence risks that the northern climate caused for early agriculture (Zvelebil 1985).

Of course, the cairns on the Finnish coasts and in the archipelago do not belong to the same cultural context and time period as the megalithic monuments. Cairns display, however, as mentioned previously, features which equalize them as a cultural category to the Neolithic monuments in Central Europe. Cairns were visual and permanent monuments. They could be visited from generation to generation, and a considerable number of them, at least 10 000 on the whole Finnish coast, have been preserved till our day (Salo *et al*. 1992).

The size of the cairns varies from low stone settings with a diameter of a few metres to really large cairns which were over two metres in height, and more than ten metres (occasionally more than twenty metres) in length. The whole scale of the cairns does not meet entirely the criteria of classical monuments. This does not, however, imply that the cairns would be concealed or difficult to detect in the terrain. A small-sized grave may be located in the terrain so that the topographic conditions will reveal its site. Natural objects which are easily distinguishable in the landscape by their unusual nature, shape, size, or location, and which are linked with narrative tradition, are called milieu dominants by Albert Eskeröd (Eskeröd 1947: 82–83). In the archipelago a milieu dominant may have been, for instance, the peak of a rock or the tip of a cape which revealed the site of a grave to fishers far out on the sea. On the other hand a grave which was erected high up on a rock outcrop was far from spectators and the shore zone, i.e. the zone where people came by boat, from where they departed, and whose details were best visible from the sea. Cairns were thus to a variable extent ambiguous monuments in the sense suggested by Felipe Criado: ”human constructions which are endowed with monumentality through the proximity of an older natural feature which contributes to their spatial visibility and temporal duration but which may be difficult to detect without prior knowledge of the social rationality at work in each specific context” (Criado 1995: 199). Possibly the cairns were inseparable extensions of milieu dominants or, as Katherine Hauptman Wahlgren suggests, artificial rocks, ”created by people to enclose the dead and make them part of the spirit world in the natural rock” (Hauptman Wahlgren 1998: 92).

3.3 The Landscape As a Cultural Construction

3.3.1 Dimensions of the Human Body And the Human Landscape

A recent study by Veikko Anttonen helps us to understand how the meanings of the vernacular terms for ’sacred’ in different cultures are associated with the human body, landscape, community, and their internal and external boundary zones (Anttonen 1996). The sacred was in many languages originally a border category for symbolic limits between the oppositions inside/outside the body and inside/outside the territory. In relation to the human body, human territoriality, and the community ”different times and places, things, and phenomena, people and animals etc.” were regarded as ’sacred’, and linked to ”values of central significance to the order and continuity of the life of the community and their ritual representations”. Using etymologies of the words for ’sacred’ as well as selected ethnographies from Finland, Ob-Ugrian peoples, and Morocco, Anttonen shows that the terms for ’sacred’ are ”linguistic indices, the semantic scope of which has varied in time, by which a given language group draws distinctions between persons, animals, things, objects, phenomena, topographical landmarks, events, experiences, etc., and sets them up as symbols of its boundaries, values and ideals”. In Finnish place names, the word ’*pyhä*’ (’sacred’), originally denoted the outer border of an inhabited region, and marked where the wilderness began. Later, with the advent of Christianity, the meaning of the term changed, and obtained the Christianized significations of Lat. ’*sanctus’*. The word ’*pyhä*’ appears in more than one hundred names of lakes, rivers, rapids, hills, headlands, bays, and fells in Finland – as well as in Estonia – in many cases as an appellative of topographically prominent milieu dominants (Anttonen 1996: 209–218; Anttonen 1993 b; Anttonen 1993 a).

The character of ’*pyhä*’ as a symbolic marker for borders is somewhat different from the liminal zone between this world and the other world, which, according to Edmund Leach (1976) is the core area of the sacred and of ritual activity. As noted by Ilkka Pyysiäinen, this is though the case in literary religions and abstract theological belief systems. In non-literate (or preliterate) ethnic traditions, however, like the one reflected in old Finnish place names, religious symbols were understood rather concretely in terms of various objects and phenomena in nature, unlike the ”theologies” that locate the sacred border zone between this world and an ontologically different other world (Pyysiäinen 1996: 24; see also Salo 1990 a).

The Finnish word ’*pyhä*’ and its conceptual counterparts among Ob-Ugrians and Moroccoans lead us to cross-cultural abstractions of space and orientation, such as the interrelationship between the body and the landscape. There is a fundamental continuum between the human body, the consciousness, and the landscape. The experience of the landscape, the earth, is established in the body itself, the scale that the human sensory faculty and the physical capabilities of the body provide (Tilley’s ’*somatic space’*, cf. Tilley 1994: 14–16). For instance, in many Indo-European languages, the names of the cardinal points of the compass are defined according to the body orientation in relation to sunrise, thus giving the directions ’in front’ for the East, ’behind’ for the West, ’left’ for the North, and ’right’ for the South. The Earth is something that provides man with life, subsistence, and identity, but, on the other hand, it is also the place where man goes after death (Pyysiäinen 1996: 27–30; see also Bowie 2000: 39–44).

Elements, objects, and natural phenomena thus provide a basis for significant cultural symbols and categorizations of the world. This idea is relevant for interpretations of archaeological remains in contexts where they can be understood as being related to the ritual, or, ultimately, the sacred. For example, Colin Richards has demonstrated parallels between the architectural forms of late Neolithic stone henges in various parts of the British Isles and the topographies surrounding the monuments. These homologies of landscapes indicated the dominant natural elements of the landscape, the water and the hills, and constituted a symbolic representation of the perceived world. The symbolic significance of water probably reflected its very physical qualities. Water created topographical zones and divisions of the landscape; water also flowed forward in the form of rivers and streams, signifying movement and transition. The purifying quality of water was probably associated with cultural notions of 'clean' and 'unclean' (Richards 1996 a). The basic link between natural elements and their cultural representations is that the essence of natural elements, in that it is independent of human beings, significantly influences the symbolic meanings attached to nature. For instance, stone is durable, hard, and weighty in comparison with wood. Thus, the temporal level of stone is different from that of wood, which decays in the end as well as other vanishing organisms, including human beings (Parker Pearson & Ramilisonina 1998).

Knut Helskog follows the same lines of thought when discussing the Stone-Age carvings along the coast of Norway, the Gulf of Bothnia, and the Karelian lakes. They are located in shore zones where water, land, and sky merge. According to him, the carving sites were locations where the cosmological worlds had counterparts in the elements of nature, and where these realms met in spatial and symbolic oppositions. The imagery of the carving panels suggests that the sites were liminal places where people participated in rites of passage, moving from an existing state to one of reappearance, endowed with certain changes in status, position, or cultural knowledge. (Helskog 1999.)

A further issue which the semantics of the Finnish word '*pyhä*' provides us with is the idea of a set of parallel linguistic terms denoting symbolic territorial division of the landscape and attaching social values and ideals to the landscape. In other words, a cultural category established a link between the landscape and the religious context of symbolic meanings. Given that such (pre)historic links can be traced using onomastic and ethnographic evidence, it is meaningful to examine if the archaeological record, in a comparable way, indicates patterns which can be understood as sets of spaces and places that once possessed cultural significance. However, in the case of graves in the Finnish SW archipelago this hypothesis refers to the burial sites and the landscape rather than to any border zones between inhabited areas and the wilds. Since the distribution of burial cairns in SW Finland indicates a concentration of settlement along the coast and in the archipelago (Salo *et al*. 1992), there is no specific reason to assume that we are dealing with something we may regard as wilderness in the sense of cultural history.

3.3.2 Approaches to Meanings Embedded in the Landscape

In the tradition of Nordic geography, landscape has been defined as an entity created through the interaction of nature and culture where nature is ever present in some way or other but adapted to human activity (e.g. Hustich 1982; Sporrong 1994: 297). In the literature of the last years of the 20th century landscape has been seen more and more frequently as a sociocultural construction which has been examined from varying angles with an emphasis on the meaning of the landscape, the textuality of the landscape, or the landscape as a memory. New cultural geography has adopted a view emphasizing description and representation, which is often interested in the individual experience of a place, and its social context. For instance, the changes in the significances of the Orthodox Church in the landscape have been discussed in a Finnish study (Raivo 1996). Landscape has actually become a way to see and to analyze one's cultural environment. Thus landscape always contains subjects which produce and renew the significances and discourses of landscape (Raivo 1997). Simultaneously, archaeological landscape research has widened, and the concept of landscape has received more multiform significances. For instance, the question of subjectivity and individuality has been posed (Boaz & Uleberg 1995: 251–252; Llobera 1996). The three main angles of research may be called: landscape as ecology (dynamic ecology at local level), landscape as a palimpsest (sequential cultural modifications of an inscribed surface (Küchler 1995; Barford 2000), and landscape as a meaning (Stoddart & Zubrow 1999). The conceptual contents of the landscape have obtained an ever increasing number of significances. When discussing a certain or several certain significances one should – as suggested by Henrik Bruun – use a more accurate terminology (Bruun 1998). The ancient landscape studied in this paper might be labelled as 'symbolic landscape'.

The work done during the past generations and the social co-existence involved tend to reshape the landscape. Technical practices are intertwined with socialness. Tim Ingold uses the term '*taskscape*' to describe the integrated whole made up of work and socialness: "just as the landscape is an array of related features, so – by analogy – the taskscape is an array of related activities". According to him, the landscape equals to the taskscape in its embodied form. The forms of the taskscape are a result of labour, arising alongside with those of the landscape; on the other hand, neither of them is ever complete since they are in a constant process of change and mutual incorporation (Ingold 1993: 158-162). This aspect is very much the same as what Fisher and Thurston call the recursive link between humans and their landscapes (Fisher & Thurston 1999).

Stories are another contributor to the landscape. Finnish narrative research has demonstrated that oral narratives were organized in nature as tradition territories that were frequently connected with patterns of livelihood, and pertinent values and roles. Specific places in nature – often milieu dominants – were centres of the localization of tradition where a "translation of tradition into perceived nature" took place (Honko 1981 a; Honko 1993: 52). The idea of narratives incorporated in natural features was introduced in archaeology during the 1990's. In his *A Phenomenology of Landscape* (1994), Christopher Tilley connects moving in the landscape and narratives. When strolling along a path through the landscape one faces impressions which disappear and are replaced by new ones. The significances of the places are interpreted in relation to each other and as sequences continuing along the paths or routes connecting those places. In terms of understanding the significances of the place, the act of moving may be as important as arriving at the place or staying there. The sequence of experiences is a narrative metaphor in itself but what Tilley suggests is rather the fact that a real understanding of the landscapes requires close interpretation, going from one place to another, transforming the experience, and sharing it in the form of a narrative. Legends bind ties between places and persons, and ”become sedimented into the landscape”, producing thus a dialectical relationship of construction and reproduction between places and narratives (Tilley 1994: 27–33; see also Chapman 1997; Huuskonen 1995). Narratives constitute oral history combining place, movement, and landscape into an amount of knowledge which endows man’s environment with a sensible array, safety, and a synthesis of his living milieu.

The significances of places compile the landscape into a sort of memory, a culturally interpreted material record which consolidates the ties between the past and the present, the earthly and the supernatural. Tradition, experience, and description structure the landscape while the landscape imparts a structure to tradition, experience, and description. In Western tradition, there is a predominant conception of landscape as a memory which is historically connected with mapping and landscape painting whereas in many non-Western cultures the landscape is a part of the process of remembering (Küchler 1995; Thomas 1995). According to Tilley’s view of archaeology, the landscape is composed of a continuum of historical events which constitutes both the medium for and the outcome of action, movement, and memory, and previous histories of action, movement, and memory. The landscape is nothing less that ”a means of conceptual ordering that stresses relations” (Tilley 1996: 162; Tilley 1994: 23, 34).

When places receive historical significances and their strata in the narrative tradition, collective memories are simultaneously assorted, selected, and possible idealized. Permanent significances receive symbolic shapes, and are – at least partly – solidified, materialized, and guaranteed against new interpretations. Incidents which have been materialized and become symbolic are thus more real than those which have not been materialized because an incident may exist without time and place when it has received a symbolic shape. Landscape may thus include realities surpassing the process which created the landscape (Smith 1994; Morphy 1995: 188–189). Such realities may belong to persons of a specific status: the control over the knowledge of the landscape may become a means of acquiring power, or reproduction (Tilley’s double bind, Tilley 1996; see also Tilley 1995; Thomas 1995; Morphy 1995: 190). The significances of landscape must be learned in socialization through which social realities are expressed in the landscape. On the other hand, although landscape is produced and renewed socially, it may be simultaneously described to be a natural formation, exterior, and independent of man. This endows landscape with an aspect of power legitimation because social order can be presented as a normative and undeniable natural order. The specific way of monuments to create order in space and time is accounted for by the fact that they represented man’s desire to change landscape, and to materialize the authority of ancestors both in architecture and in topography.

In Neolithic Britain, megalithic architecture displays forms which imitate the adjacent topography or its prominent features (Richards 1996 a; Richards 1996 b; Bender 1992; Tilley 1995; Nash 1997). In Cornwall the long axes of some barrows point towards hills whose tops are crowned by *tor* formations, i.e. weathered stone towers (Tilley 1996). At times, astronomical alignments in the layout of some monumental constructions also seem to have emphasized social order by making it appear to be part of the natural order (Bradley 1991: 53–54). Monuments created connections and reciprocities with the milieu dominants. I use the term '*spatial reference*' for signs indicating directions, distances, shapes, heights, or other spatial quantities in landscape.

Presumably spatial references have been originally articulated and addressed verbally, and the places with which they were linked have been named. We cannot, however, know what places were named and how, millenniums ago. Consequently, names cannot be used as archaeological indications of landscape despite Tilley's argumentation. He characterizes the landscape as an interrelated set of named places (Tilley 1996)[50]. It seems rather probable that prehistoric people named places in their environment in the same way as people did in the historical period (Kiviniemi 1990; Pitkänen 1990; Zilliacus 1990), but as far as archaeologists are concerned, they have to seek for the understanding of the sense of place in material and spatial hints which can be interpreted as part of giving significance to places. In doing this one should examine how systematic and finely divided the spatial references indicated by the monuments are. When discussing this aspect Ezra Zubrow has emphasized the linguistic relativity hypothesis, i.e. the notion that diverse languages influence the thoughts of those who speak them (Lucy 1996). This implies, for instance, that ”the more relevant a spatial category was to a culture, the more finely divided and more marked the terminology was” (Zubrow 1995: 42). Detailed vocabulary can be found, for example, in ethnographic records of the traditional ice terminology used by the inhabitants of the Finnish archipelagoes. Their vocabulary encompassed virtually all qualities and characteristics of the ice, the development of the ice cover during the winter months, and terms related to moving on the ice, fishing, seal hunting, passages and routes, all crucially important knowledge for maritime subsistence (Storå 1985: 194–196; Storå 1992).

Approaches emphasizing the cultural meanings of landscape have sometimes been considered to be subjectivistic, and they may tempt one to make rather far-reaching interpretations of the configurations of features in landscape, or of objects, elements, and phenomena in nature. In a discussion concerning criticisms of psychological approaches to religion, E.E. Evans-Pritchard wrote: ”Primitive peoples show remarkably little interest in what we may regard as the most impressive phenomenon of nature – sun, moon, sky, mountains, sea, and so forth – whose monotonous regularities they take very much for granted” (Evans-Pritchard 1965: 54). Simon Stoddart and Ezra Zubrow suggest that a direct access to the interaction between landscape and man is possible only through historical sources or ethnographic analogies. Demonstrating features or shapes in landscape, which are then imitated in cultural monuments is, according to them, only a partial solution when searching for significances (Stoddart & Zubrow 1999: 687–688). It

50. There is another problem in Tilley's argumentation. He criticizes the New Archaeology concept introduced in the 1970s concerning space as an abstract dimension where objects are determined by using geometric quantities such as Cartesian coordinates (Tilley 1994: 9–10). This is not how non-Western small-scale societies understand the surrounding spatial reality. On the other hand, some early achievements in geodetics and astronomy, or traditional navigation on the Pacific Ocean, which was independent of western technology, challenge all attempts of explanation if the geometry of space is denied (Kirch 1986; Kirch 1988; Keegan & Diamond 1987). Consequently, one should adopt the idea that a culturally defined topology of space *may* be based on geometry or comprise some of its ingredients, but formal geometry is, however, only one possible language in which to express locations, relations, and other quantities.

should be added, however, that partiality in solutions is nonetheless linked with the quality of the evidence as in general in empirical research. If it is possible to demonstrate in the landscape patterns or configurations of monuments, which cannot be explained as pure coincidences or as consequences of formation processes or the distribution of field archaeological efforts, it makes sense to try to find their interpretation in what we have learned, in different contexts, about the way of traditional small-scale communities to structure cultural categories attaching to environment, landscape, and natural resources. This kind of cross-cultural interpretation is particularly relevant for the most intrinsic part of ”native” belief systems, the realm of ancestral beings (Parker Pearson & Ramilisonina 1998). In this respect, the interpretation of the evidence does not differ from other interpretations of archaeological material. Our understanding is attached to our own sociocultural reality which we are not able to legitimate by referring to the original and the ”real” hidden in the past. The freedom of movement of understanding is substantiated in the pluralism of possible and defensible interpretations (Olsen 1991).

3.3.3 The Landscape of the Prehistoric Archipelago

The prehistoric landscape of the southwestern Finnish archipelago was composed of a mosaic of land and water with a small-scale variation of biotopes (see e.g. fig. 22). The high geodiversity together with short distances implied numerous fishing, hunting, and foraging places, land for cultivation and grazing, harbour and landing sites within relatively small areas which were accessible by boat. On account of its mosaic nature the landscape was also a unique composition of land and sea with an abundance of different small-scale forms of reefs, skerries, islands, peninsulas, rocks, shores, forests, straits, inlets, and stretches of open sea; many of these were appropriate landmarks, and some of them were milieu dominants. We can assume that the cultural importance of natural objects and elements as symbols charged with religious significance was particularly conspicuous in this environment. The land, the rocks, and the sea were the dominant material elements of the physical world which provided the inhabitants of this region with subsistence and dwelling, and especially favourable natural habitats due to the diversified small-scale topography. In addition, the land and the sea were the basic substances of the culturally constituted nature, a representation of a symbolic order of the world. Therefore the visual imagery of land and sea provide a key factor in understanding cultural constructions of the early archipelago landscape.

The starting point in building a visual imagery of the landscape and its elements, is the physical pattern of the mosaic of land and sea. To accomplish en empiric analysis of the landscape it is necessary to construct a well-argumented model of the outward appearance of the landscape in the prehistoric period. Any observations and interpretations of archaeological remains can be attached to this model. The landscape thus comprises the aspects and phenomena in nature, which are independent of man: animals, plants, land, sea, sky, celestial bodies, natural phenomena, and antagonisms (light – dark, calm – stormy, warm – cold etc.); briefly, the biosphere. But the material nature also includes the human body, its kinetics, and activities, the focal point in nature, which serves also as a metaphorical object of comparison, how man’s awareness is linked with nature.

Simultaneously materiality produces the scale of landscape: it is the scale of sensory perceptions. In the boat, on the field, or on a rock man hears and sees, feels the temperature of the wind, the humidity of the air, and the fragrances it carries along. In serene weather one can see as far as the horizon, during optical mirages even beyond it; in a fog one's range of vision may be less than a few hundred metres, but one can hear the sounds from a distance, or smell the damp forest from far; the smell of decaying seaweed makes one perceive the proximity of the shore.

In the text below the prehistoric landscape in the archipelago will be discussed as a material space confined by sensory perceptions. This space consisted of places and their mutual relationships, it was constructed by the biosphere, and the cultural knowledge, structures and objects made by man. The cultural knowledge associated the significant places with the incidents of the past and their narrative interpretations, i.e. the tradition. It made the presence of monuments and the past generations understandable, and provided people with skills and knowledge of the places which were part of the use of natural resources, subsistence, boating, techniques, and rituals. As a cultural construction the landscape was related to the community while individuals may have differing experiences and interpretations concerning various places. The concept of landscape aims thus at making sense in empiric research and material rather than at seeking for prehistoric man's internal models of the landscape. In the world of prehistoric man, culture and nature have frequently been assumed to be one integrated unity (cf. Ingold 1993: 162; Bender 1992). Anthropological case studies indicate, however, that indigenous and traditional societies embrace a wide range of relationships to nature, varying from oneness with nature as part of the experience of the world, to societies where people see themselves as separated from nature (Milton 1998; cf Núñez *et al*. 1997: 33–36).

The excavations, surveys, sampling projects, boulder investigations, and weathering studies conducted for this work will be discussed in the next few chapters. The purpose of the excavations was to determine the ages of the graves, to analyze the consistency and origin of the construction material, and, eventually, to penetrate what possible changes have occurred in the stone settings after the date of construction. In other field archaeological investigations I aimed at completing the material of observations collected mainly in the 1880s, the 1930s, and the 1950s, at enlarging the distribution area of cairns, at acquiring knowledge of the nature of the sites in the terrain where grave constructions have been erected, at determining the quality, origin, and possible selection of the material in the stone settings of the graves, and at studying anomalies in the weathering environment of the cairns. These discussions are followed by a review of the morphological variation of the cairns, and the reciprocal positions of the graves. The information obtained during the field investigations is used as initial data in the discriminant analysis which aims at establishing the typical morphological and chorological characteristics of the cairns from the Bronze Age and the Iron Age. In this manner we will be able to classify the graves into two main groups which, as closely as possible, are in accordance with the graves which on the basis of available dating results are known to be either Bronze-Age or Iron-age constructions.

Questions of the location of the graves in prehistoric archipelago landscape will be rediscussed after the empiric analyses. This will be done by studying the land and sea areas visible from the cairn sites, the perspectives and depths of the views, and he extents of the visible areas. I hope that these reviews will contribute to illustrating the character, changes, and continuity of the Metal-Age burial ritual in the southwestern archipelago, the solid connection between the graves and the landscape as it is expressed particularly in spatial references, and to approach in this way the symbolic significances incorporated in the mortuary ritual.

4 The Field Studies

4.1 What is a burial cairn?

4.1.1 The grave as an empirical category

The question of what stone formations are prehistoric burial cairns and which must be regarded as some other remains has been frequently discussed at archaeological seminars. The National Board of Antiquities organized a seminar to deal with this and other questions at the National Museum of Finland in 1991 (Purhonen 1993). Assessments of the possibilities to define or identify a pre- or early historical burial cairn by means of outer characteristics – without excavation – have ranged from cautious pragmatic optimism to critical pessimism. The variation of the assessments is natural because the question whether a burial cairn has any external characteristics to distinguish it from other stone and boulder formations in the ground has not been studied systematically.

The identification of a burial cairn by means of external characteristics should be based on a sufficient amount of representative and well-documented cases in which the cairn has been indicated to be the concealment of the remains of one or more deceased human being. The identification as a grave is not nearly always possible because the excavation techniques in use today are not always able to detect the remains of the deceased or his/her equipment. A ”findless” cairn can be findless because nobody has ever been buried there or the remains of the cairn have disappeared to the extent that they cannot be discovered by the conventional excavation techniques for each particular age. Thus, a sufficient number of cases for determining the characteristics of a cairn is always smaller and, for practical reasons, even considerably smaller than the total number of possible cairns in the area investigated. However, more crucial than the amount is the question of representativeness of the supposed cairns chosen to be excavated, their generalizability: how well they cover the variation of the preserved formations in size, structure, manner of interment, location and other morphologic-typological and spatial attributes.

The archaeological field records accumulated during the past decades do not facilitate the question of identifying burial cairns. The stone cairns, -heaps, -piles, -mounds and other stone settings presented in field reports cover quite a range of graves, but their standard of documentation varies a great deal and comparing them is not always possible. The same diversity applies to records in other countries, too (e.g. Kaliff 1997: 27). The inadequate knowledge of the formation processes of the burial cairns continues to blur the overall pattern of their morphological variation. The structure of the cairn 2 in Sundbergen, Nagu, to be discussed further in this study, resembles greatly the mounds on Åland, which cover a shallow stone cairn. The observation made by Helena Edgren (1983) that burial cairns and grave mounds appear on Åland side by side in the Late Iron Age, gives reason to doubt whether there really are any non-continuous boundaries in the morphological variation of the cairns. The diversity of the formation processes is probably yet a contributory factor in the variation of the present-day appearance of the cairns.

Little attention has been paid to the influence of antiquarian assessment and decision-making on archaeological field practises and terminological conventions. The official decision whether a recovered human construction has to be regarded as such an archaeological site as is referred to in the Finnish Antiquities Act, includes judicial implications. For this reason, the arguments supporting the decisions go partly beyond scientific questions of classification, because they have to support the general trustworthiness of decision-making in questions of archaeological heritage management which concern essentially the interests of landowners. Decision-making includes the possibility of mistake, which is often regarded as a risk especially in a case where an erroneous decision would result in the protection of a non-archaeological site as an archaeological one (e.g. Jussila 1993: 85). The influence of the landowner's interest causes pressure comparable to the presentation of proof into decision-making (Tuovinen 2000 a). Since research and heritage management are regarded as parallel and supporting professional areas of know-how (e.g. KomM 1993:5), antiquarian administration, regardless of its execution as an organization, cannot help influencing the practices of field archaeology.

In a way the ”objective” identification of a burial cairn is an absurd task. Our knowledge of mortuary rituals thousands of years ago is rather insufficient, and it has been acquired basically through material remains. We cannot trust that all mortuary rituals will have resulted in building and preserving of the very formations we regard as burial cairns or that these formations will always contain or signify material remains of the mortuary ritual which we can expect. The word ’grave’ itself contains an archaeological interpretation. It carries a connotation confined to our own language(s) and culture(s) which is not necessarily anything close to ’graves' and beliefs concerning the realm of the dead in non-western cultures and early epochs (Kaliff 1997: 68–70). For us, the cultures of the Bronze and Iron Ages are foreign cultures. So we have to see our understanding of the ’grave' as the material remains of mortuary rituals and associated cultural traditions in the context of a moderately far cultural distance. The question of the nature of a heap of stones is not merely a biological or geological task of finding out how molecules on the surface of the Earth were reorganised by people in the past, and it is not ultimately or comprehensively unfolded by means of osteological, geochemical or other natural scientific accuracy.

4.1.2 The field archaeological criteria

When using the term *burial cairn* I refer to stone settings which have been proved reliably – through excavations or otherwise – to contain remains of a deceased human being, *or* stone- and boulder formations resembling them externally. The external characteristics of a burial cairn are bound to vary regionally according to size, location, soil, type of forest and the method of field studies. In a thickly moss-covered spruce forest or in a brushwood area cleared of timber, it is difficult or practically impossible to detect or identify a shallow stone setting, whereas on a glacially smooth-worn rock outcrop of the archipelago, even a pile of a few boulders can easily be detected. On the other hand, the cultural context of similar remains in different surroundings can be different. For instance, part of the stone heaps on the Same sacrificial sites in Northern Norway (Vorren & Eriksen 1993) bear an outward, and, as to the topography, a striking resemblance to the burial cairns in the south-western archipelago of Finland.

Juha-Matti Vuorinen has published observations based on a large recorded material, how empirical perception affects the decision making of a field archaeologist (Vuorinen 2000 c). According to him, small stone settings, possibly soil-mixed, situated on a moraine slope, have caused specific hesitation in the central question of defining whether they are burial cairns or not. In the southwestern archipelago, it is in general relatively easy to detect and identify burial cairns because the rocky terrain and the plain vegetation do not hide the heaps as the moist habitats on the mainland zone do. Also in the archipelago, there are, of course, moist habitats with rich vegetation (e.g. Lindgren & Stjernberg 1986 or Lindgren 2000), but the known cairns are rarely situated in such places. On the rocks, hundreds of different stone heaps can be seen containing two, three, twenty – or so many boulders that one feels tempted to talk about a burial cairn unless some other fact than the amount of boulders testifies against this interpretation.

In the prevailing research situation, I chose elimination and subsequent evaluation as the working method in the identification of burial cairns in the field. If a stone cairn has been discovered in the terrain, the first task is to ascertain if the possibility of a prehistorical burial cairn can be eliminated. After this an assessment is made as to whether the outer appearance, structure, and location of a formation in the terrain and in relation to other comparable constructions correspond sufficiently to the general idea that has been formed by field archaeological evidence in the South-West of Finland of burial cairns or other similar remains not determined as something else than cairns. Thus, we are dealing with a subjective impression gathered in the terrain of the nature of archaeological remains.

In the elimination, investigation should be focused mainly on (1) possible traces of natural processes, like earlier Litorina phases of the Baltic Sea, and (2) possible recent traces of human activity in the terrain. Other criteria can also be involved, for instance moraine heaps which are formed through a storm striking down a heavy tree.

(1.) The origin of the formation cannot be explained through the washing or accumulating shore processes of an earlier Litorina phase. Boulder fields and ancient shores have been washed out of the till in the process of glacio-isostatic land uplift. Usually they can be morphologically separated from burial cairns despite the fact that shore displacement has long ago changed the shores into dry slopes. In order to ascertain

the identification in some cases, observations must be made on the local factors influencing the formation of ancient shores, such as loose materials on the slopes, the distribution of open sea effects in different directions and the inclination of the slopes (Pyökäri 1976). Boulder fields identified as ancient shores are often – but not always – situated on southern and south-eastern slopes (cf. Miettinen 1991: 89). This direction is connected with the prevailing direction of glacial boulder transport in the South-West of Finland (NW-SE or NNW-SSE), and to the exposition constituting a precondition for the formation of a raised shore formation (Salonen 1986; Glückert 1976: 13–16). Most of the tips from the public that have proved to be something other than burial cairns, have concerned raised shore formations. Some burial cairns have also been constructed on raised shore formations by gathering together rounded boulders (e.g. Nämanön in Dragsfjärd (006)).

The pressure of waves and especially of ice pushes and heaps accumulation boulder rims (boulder ramparts) onto shores. The strength of the pushing force depends on the fetch and the effect, respectively, on the size of the blocks and the morphology and the friction of the shore (King & Hirst 1964: 30–31; Mansikkaniemi 1970; Mansikkaniemi 1976; Glückert 1976: 13–16; Pyökäri 1978). The boulder ramparts, lifted high up on the ground by land uplift, can sometimes resemble burial cairns if regular rims along the shore have been developed[51]. On rock outcrops, boulder ramparts seem to be formed mainly in places where a steep rock stair or bank or a boulder field higher up on the shore supports the stones against waves and ice. The friction of a smooth-polished rock surface is so low that the pressure of ice is able to move the boulders until they are stopped by some barrier in the shore zone. In the formation of the morphology of the elevated shores, the influence of the open sea has been greater than on the present shores of the archipelago (Pyökäri 1976: 12–24). If there are no barriers on the rocks, the possibility of an accumulation boulder rim can often be eliminated.

The stone and boulder deposits worked up and sorted out by shore processes, are characterized by the homogeneity of the material compared with human constructions. For this reason, I regard the presence of both rounded and edged boulders – possibly clearly varying in size – in the same construction as a sign of the participation of the human hand in the formation process. In principle, orientation measurements (Pyökäri 1976: 7–11) should be able to verify such a determination, but so far there is no practical evidence of this.

The tops of the rock outcrops have been most exposed to wave and ice action, since at the time when they emerged from the Litorina sea, there was a strong effect of the open sea. On the tops, the soil and the stones have been washed away while boulders and naked rocks remain in place (Pyökäri 1976; Granö *et al*. 1999: 15). Thus, burial cairns located on hill tops can often be easily identified. However, this is not always the case with graves located in tills and eskers.

(2.) The origin of the formation does apparently not relate to other human activities than burying. Features to be considered here include structures discernable in the stone formation (e.g. in stone ovens), the location in the terrain in relation to places suitable for cultivation or building, the mutual position of stone constructions, and information from

51. For instance, on the island of Furuskär, at Elvsö, Korpo (Finnish Basic Map 1032 09, x = 6671 60, y = 1525 30).

some source about the possible origin of the construction in question. There are many possibilities: clearance cairns, fireplaces, border marks, landmarks, foundations and other stone constructions pertaining to buildings, stone fences, boulders gathered together for transportation in the winter by sledge, different stone abutments for surveying, navigation and military purposes[52], quarrying waste and heaps of stones formed through excavating pits in boulder fields[53]. Especially in the outer archipelago, there are a great number of small stone piles which cannot be or in all probability are not burial cairns, and whose origins are unknown. In the so-called area of combined activities of the Southwestern Archipelago National Park, they can be found practically on every island and skerry.

The border heaps are generally easily distinguisable from the burial cairns. They are located in places where the borders of villages or farms meet, they are frequently marked by vertically posed stone slabs, and they are high in relation to the diameter of the construction. A border stone heap can, however, be simultaneously a burial cairn: for instance, in the villages of Bendby, Böle and Syvälax in Korpo, a burial cairn (202) has been chosen to serve as a boundary stone.

Clearance cairns are found everywhere in the inner, outer, and skerry zones. Their material is often heterogeneous, typically consisting of both edged and rounded small stones, sometimes mixed with sand, clay or silt, lifted from a field near by. Agricultural and clearance cairns are sometimes located on slopes (cf. Selinge 1978: 80–82), which is rare for a burial cairn. – Other constructions to be mentioned here are stone ovens, landmarks out of use and various stone settings related to fishing and hunting, like *tomtning* dwellings used by fishermen as temporary shelters, landing places for boats,[54]and stone walls used in sea bird hunting[55] (Tuovinen 2000 b).

The stone ovens are fireplaces constructed of stones and boulders, used for making food, possibly also for drying. The walls of the ovens are assembled of large flagstones, the cover is arched or composed of horizontal stone slabs, and on one side there is an opening. No mortar has been used. Most ovens have collapsed, and surface damages caused by heat expansion can often be discerned. Sometimes the ovens have been built alongside a vertical rock surface the rock serving as a sidewall for the interior cavity.

The stone ovens are often located in groups detached from the villages, but near waterways and natural harbours in the inner and middle archipelago zones. They can be found on small rocky isles but most of them are, however, located on large wooded islands. Svante Dahlström was the first to connect these remains with the military operations of the Russian galley navy during the Great Northern War 1714–1721, and the War of the Hats 1741–1743 (Dahlström 1937); hence the older name ”Russian oven”. Recently ovens have been found in the outer and skerry zones, for which a local origin is more likely. The outer archipelago ovens are sometimes situated aside from sea routes on

52. Concerning military stone-built remains from World War II, see e.g. Auvinen 1995 (Korpo), Silvast 1985: 71 (Hangö) or Maaranen 2000: 191 (Ekenäs).

53. Such pits may result from digging temporary storage for food, from ore-searching, or from fetching stone for the purpose of building (Jarva & Okkonen 1993; Gestrin 1994); according to Meinander (1977: 22), pits were dug during fox hunting, too. See also Maaranen 2000: 188–189.

54. In Åboland they are called *uppdräkta,* in Sweden *båtlänning* (Norman 1995: 29–31), the Finnish name being *valkama* (Mäkivuoti 1994).

55. *Sw. vettaskåra*, *Fin. paahus, koija* or *koju*. See Sirelius 1919: 80; Vilkuna 1935: 19–20; Norman 1995: 66.

islands around which it is practically impossible to anchor any large vessels. (Tuovinen 2000 b; see also Broadbent 1987: 39–41; Olofsson & Lindström 1990: 19–26.)

There is some evidence of burial cairns built after the prehistoric times in Uusimaa, on the southern coast, and in Ostrobothnia, on the western coast (Europaeus 1922; Siiriäinen 1978). However, none of the stone settings in Åboland that I regard as burial cairns, is located on a level whose shore zone age is later than AD 1000. The isle of Birsskär, in the village of Kälö in Korpo, may serve as an example of stone heaps which are definitely not prehistoric graves. On this isle, whose area is 29 hectares, there are at least 13 heaps of stones with a diameter of 2 to 5 meters, and in addition a group of smaller ones. Some of them are low in height, only distinguishable from a short distance, while others are prominent conical stone heaps. Some of them can be discerned in the profile of the isle from the sea. The lowest altitudes are 2.4 and 2.6 meters[56]. These stone heaps are probably remains of fire places or some marks associated with navigation. North of Birsskär there is a sea route which Hans Hansson registered on his sea chart in the 1650s (Ehrensvärd & Zilliacus 1997: 36). The route can be regarded as possible evidence connecting the stone heaps with navigation.

The size of the stone setting does not provide a satisfactory criterion either. Many cairns are smaller than typical natural or man made constructions. According to Unto Salo, the diameters of the Bronze Age cairns in Satakunta range from 1.5 to 35 meters. In Uotinperä II, Nakkila, for instance, there are several small stone settings which have with certainty been identified as graves (Salo 1970; Salo 1981 b). When the cemetery of Furunabb, Houtskär, was excavated, the smallest stone setting identified as a burial cairn, was constructed of only 50 stones. In the archipelago, one can come across several cairn-like stone settings, consisting of even less material.

Although burial cairns are usually easily identifiable in the archipelago because of the rocky terrain, there are, of course, questionable cases. The most awkward task is to distinguish small stone settings in moraine terrain from occasional stone formations on raised shores dating from early Litorina phases. Sometimes it is difficult to distinguish these from various man-made settings of indeterminable age. Therefore, I have included in my material a number of stone settings which could be characterized as cairn-like settings (*Sw. röseliknande stensättning*). It seems that low, not easily discernible burial cairns are underrepresented in the material (Tuovinen 2000 a). It is probable that structures resembling the ground-level graves excavated in the archipelago of Stockholm in Sweden (Äijä 1991) will occur in Finland, too.

On the rocky islands of the archipelago one can clearly observe a continuum of stone-built structures from those consisting of some boulders laid on a granitic surface to burial cairns of the height of the human body or more, containing thousands of stones. All these are man-made anomalies in the terrain representing a long period from prehistoric times to our days with various functions and cultural contexts. Notions of at which point of the continuum it is relevant to draw the line between burial cairns and other stone settings vary from one field archaeologist to another, at least to some extent.

56. Report by Tuovinen 1995 b, nr 3 (FFPS).

4.2 Levellings and the shore displacement of the Baltic Sea

4.2.1 Measuring methods

Altitude is a central topographic quantity in determining the changes in the landscape and the surroundings of a cairn and the maximal age of the cairn. In determining altitudes and their variations, the estimates can mainly be based on Finnish national basic maps (1:20000) and digital elevation models (DEM) derived from them. Their accuracy is, however, not always sufficient. Especially the altitudes of cairns located on low levels should be determined more accurately because their maximal ages have particular significance in the chronology of the graves of the archipelago. Therefore, I have levelled the most important altitudes, which were measured from the ground level at the lowest edge of the stone setting.

The levellings for excavations were made using a spirit level or a theodolite equipped with an EDM (Santala 1987). The levelling runs were started from a benchmark or the sea level, closed to the same benchmark and adjusted. In the survey, only the lowest altitudes were measured by levelling or barometrically, while most of the altitudes were determined roughly using topographic maps. The barometric levellings were made using an aneroid (altimeter), closed and adjusted in the way given by Pekka Lehmuskoski (1979). The closing errors suggest that if the observations aim at the same or better accuracy in comparison with the elevation contours of the topographic maps – not more than ± 2 meters – the interpolation time should not exceed two hours (cf. Honkasalo 1955; Gray 1983: 117–118).

The elevations measured from the sea level were computed to the theoretical mean water level in the Finnish N60 system by a linear interpolation connecting the readings of the nearest exact hour of two or three tide gauges. The tide gauges used here were the mareograph stations of the Finnish Institute of Marine Research in Hangö (Hanko), Degerby, Ruissalo (Runsala), and Rauma (Vermeer *et al.* 1989). The interpolation was based on the assumption that the sea surface is a plane that can be fitted within two or three points. This is, however, only an approximation. The mareograph in Ruissalo is situated in the inner zone where the large archipelago forms a buffer towards the Baltic Sea delaying the variation of the sea level. Most of the measurements have, however, been made from the water surface in stable weather conditions when the variation of the sea level is slow. Waves and breakers at the shoreline make another source of error. The levellings were made from the leeward sides of isles, from inside the reed vegetation on the shore or from other places unaffected by the waves. If the standard error in determining the sea level at the shoreline is assumed to be ± 2 cm, the standard error caused by the variation delay of the water masses in the inner zone ± 3 cm and other random errors (surface tension on the levelling rod, instrumental error etc.) on average ± 2 cm, the standard error of the levelling run is $sm = \sqrt{2^2 \quad 3^2 \quad 2^2} = \pm 4.1$ cm in the inner zone and somewhat less in the outer zone. Since the edges of the burial cairns are irregular, the uncertainty concerning the level of the lower edge of the cairn is more than ± 4.1 cm. Altitudes levelled from the shore line can thus be regarded as accurate enough.

4.2.2 Dating shore level zones of the Litorina Sea

If the age of a shore level zone is not too high – not more than a few thousand years – it can be calculated by extrapolating retrogressively using the rate of apparent land uplift measured by Finnish tide gauges. The apparent land uplift or shore displacement is the amount of uplift in relation to the theoretical mean sea level. According to Martin Ekman, it is possible to go backwards in the dating to about AD 800 with reasonable accuracy. He gives the height *H(t)* in relation to the geoid

$$H(t) = H(1960) + (1960\text{-}t)(Ha + 1.0) \times 10^{-3},$$

in which *H*(1960) is the local height difference between the geoid and the theoretical mean sea level, caused by the topography of the Baltic Sea. This constant has to be added to the mean sea level N60, because it does not coincide with the geoid. The height difference is $H(1960) \cong 0.15$ in SW Finland (Ekman 1993: 16; later GPS measurements have given slightly lower figures (Kakkuri & Poutanen 1997), but here the above mentioned value is being used). The sum $H\,a + 1.0$ is the estimated average land uplift (mm/yr) in relation to the mean sea level, in which 1.0 is a constant due to the decrease in the land uplift.

By resolving the year *t* in Ekman's formula, we can determine the age of a shore level at a known height. In this way, I have calculated the maximal ages of cairns situated on relatively low levels. The rates of apparent land uplift have been estimated from the isobase map of the Fennoscandian shield by Juhani Kakkuri (1997). Of course, this provides a general figure and does not consider isostatic anomalies (Kakkuri & Vermeer 1985), or local variations due to sedimentation. Sedimentation increases the rate of shore displacement in the inner zone, particularly at the farthest corners of inlets and in estuaries (Granö *et al*. 1999).

According to Ekman, the influence of the eustatic effect need not be considered in a time span of a little more than 1000 years. The eustatic variation beginning from AD 550 has varied from -1 to +2 mm/yr; however, on the average it has been close to zero (Ekman 1986; Punning 1985; Eronen 1983; Eronen 1987; Kakkuri 1994 a).

Ekman's formula is based on the mareograph records of Stockholm and Amsterdam beginning from the years 1774 and 1700. The standard error is approximately

$$s = 0.1 + (1700\text{-}t) \times 0.4 \times 10^{-3}$$

from the year 1700 backwards. The standard error of the two standard deviations is 0.2 m in 1700, 0.5 m in the Middle Ages and 0.8 m in the Viking Age. The inaccuracy in estimating the average rate of land uplift during the last millennium is a possible source of error[57].

According to the estimates by Erkki Kääriäinen (1953) and Marjatta Okko (1967), the rate of land uplift has decreased a little more than one per cent per one hundred years. This gives a possibility to make estimates further back from AD 800. On the basis of Kääriäinen's and Okko's results, the land uplift can be regarded as a backwards

57. A possible source of error is also caused by the cold period of the 15th and 16th centuries AD during which low sea water levels prevailed, possibly due to northern winds (Wahlberg 1994). However, it does not affect earlier dates deduced from shore displacement.

accelerating movement with a constant acceleration rate. Thus heights can be calculated from a geometrical series starting from today, the decrease of land uplift being regarded as acceleration. Such an extrapolation does not, however, make it possible to acquire reliable results concerning ages over 2000–2500 years. In the region of Turku, the land uplift seems to have retarded more linearly than elsewhere on the SW coast (Hatakka & Glückert 2000; Glückert 1994: 72).

Combining altitudes on raised shores with the stratigraphy of a number of peat bogs yields shore level zones that can be radiocarbon dated using samples from organic sediments (cf. Everard 1980). Where burial places are located at high altitudes in the terrain, I have applied the shore level zones of the Litorina Sea as dated by Gunnar Glückert (1976). However, conventional radiocarbon dates do not follow the same time scale as dates based on extrapolation of land uplift. The calibration of radiocarbon dates for ages under 2500 years BP has little effect, but older ages, from the Bronze Age backwards in archaeological chronology, are deferred from 50 to 200 years backwards on calibration (Eronen *et al*. 1993: 18). For example, on the basis of radiocarbon calibration the grave of Trollberg in Houtskär (087) can be reckoned among the oldest cremation burials of the Finnish Bronze Age known so far. Lassi Hatakka and Gunnar Glückert have recently published a calibrated shore displacement curve, the accuracy of which is ± 1 m, corresponding to ± 200 years. The altitude of a shoreline of a given age can thus be estimated at a precision of 1–2 meters (Hatakka & Glückert 2000).

Archaeological dating based on the shore displacement of the Baltic Sea is always related to how the archaeological feature to be dated was located in comparison with the mean shore level of the time of its building and use. The relation of burial places to shore levels and the topography of the coastline has recently been examined by Jari Okkonen in a study concerning the cairns of the Central and Northern Ostrobothnia, Finland. He compared the altitudes of burial places with the altitudes of shore level zones (Okkonen 1998). Earlier scholars, too, have discussed the relation of the burial places to the shore levels (e.g., Meinander 1977: 23; Siiriäinen 1978; Salo 1981; Hermodsson 1987).

There is an unpublished paper by Anders Bergvall and Jesper Salander pertinent to this question. It has been reviewed by Lars Forsberg (1999: 256–258). Using levelling, Bergvall and Salander showed that in Vebomark, Swedish Västerbotten, 21 out of the total 25 Late Neolithic or Early Bronze Age burial cairns located along several kilometers of raised shorelines, lie within an altitude range of only 1.8 meters. This is an obvious indication that they were built roughly contemporaneously not many meters above the sea level. However, the fact remains that, as yet, we cannot say very much in general about how far from the shore zone and how high up in the terrain the burial cairns were built. The datings of the graves are not accurate enough to make it possible.

In the archipelago of Åboland, determining the distance and altitude difference between the burial place and the contemporary shore is possible in rare cases only, as we will see later on. These cases indicate that the burial place varied in relation to the shore. Some graves were built near the shore, while others were placed on the tops of rock outcrops. It is justified to assume that the cairns were placed high enough from the shore so that the peaks of high sea level did not cover the stones and to prevent the ice pushing from the sea colliding against them. Given this assumption, the minimum height from the shore, by time of the construction of a cairn, can be approximately determined on the basis of the present-day records of the annual and seasonal sea level variations of the

Baltic Sea. The highest annual sea level peak in the SW archipelago is at most little more than 50 cm (Stenij & Hela 1947). Storms may, however, raise the level a great deal for a short period. In the annual fluctuation of the sea level of the Northern Baltic, high water levels mostly occur in the windy autumn and winter seasons (Vermeer *et al*. 1989), so the high level is often combined with strong surging and/or the pushing forces caused by ice. The total effect of these factors varies from place to place according to the fetch, the quality, and the openness of the shore (Niemi 1969; Mansikkaniemi 1970; Mansikkaniemi 1976; Pyökäri 1978; Pyökäri 1979: 86–88). In normal conditions, the height of 1.0 m above the mean sea level can be regarded as a practical lower limit for the zone above the shore processes (c.f. Forsberg 1999: 257), especially in the inner archipelago zone. Due to annual and local variations, it can be regarded as an estimated average. For shore vegetation, the level of one metre above the mean sea level pertains to the shore zone, because for instance the pine (*Pinus*) does not grow below 1.5 meters from the shore (Varjo 1964: 65).

When the altitude of each burial place is diminished by 1.0 m before estimating the shore displacement dating, we obtain the *shore zone dating* for a cairn. The date estimated on the basis of merely sea level data is called the *mean sea level dating*. The time differences between shore zone datings and mean sea level datings are about 200–250 years. Shore zone datings are thus more conservative (in the sense that they yield later datings) than the conventional datings deduced from the mean sea level.

The table 1 presents the apparent land uplift or shore displacement in different parts of the archipelago of Åboland from 2000 BC to AD 1400. Because the earth crust in the area inclines towards SE when raising, synchronous shore level zones are lower in Hitis, in the SE of the area, than in Iniö, in the NW of the area. The difference in altitude is 1–4 meters.

Table 1. The shore displacement of the Baltic Sea in Hitis (the SE part of the archipelago of Åboland), in Lohm, Korpo (the central part of the archipelago), and in Iniö (the NW part of the archipelago). The Litorina shore level zones are given in conventional radiocarbon years according to Glückert (1976, Appendix I) and the estimated mean sea levels with the standard errors in AD 800 and AD 1400 according to Ekman (1993) and Kakkuri (1997).

Place	L IV 2000 BC	L V 1300 BC	L VI 600 BC	L VII AD 200	AD 800	AD 1400
Hitis	22	18	14	9	5.0 ± 0.9	2.5 ± 0.4
Lohm, Korpo	24	20	15	10	5.8 ± 0.9	2.9 ± 0.4
Iniö	26	22	16	11	6.6 ± 0.9	3.3 ± 0.4

4.3 The excavations

For the present study, four burial cairns were excavated in Nagu and Dragsfjärd in 1988, 1990 and 1993. The excavations were a part of the excavation programme of the Department of Archaeology, University of Turku.

4.3.1 Sundbergen, Nagu

There are nine known cairns on Nötö and its neighbouring islands Mjoö and Granholm. Nils Cleve received some possible clues about cairns on Nötö (Cleve 1948: 493), but it was not until 1987 that they were verified to be archaeological remains (see fig. 9). A group of five cairns were located on the top of a rock outcrop of Sundbergen, at the northern end of the isle of Nötö in Nagu. The cairns and their location resemble the three cairns in Piiloinen, Vehmaa (70 km to the north), excavated by Unto Salo in 1959, and dated to the Early Roman Iron Age (Salo 1968: 67–69), but the Sundbergen cairns seemed to match into the *hiidenkiuas* category, typical of the Bronze Age, as well. Two of the cairns in Sundbergen were excavated in 1988[58]. The aim was to date the graves and possible secondary interferences, to determine the construction material and its relation to stones in the surrounding boulder fields, and to acquire osteological samples.

Sundbergen 1 (258). On the SE edge of a rock outcrop there is a roundish burial cairn with a pit in the middle. The length of the cairn is 9.2 m (N–S, originally probably a little smaller), width 6.0 and height 0.5 m. The altitude *h* = 27.6 m and the area of the cairn is 33 m². The surface consists of rounded, relatively even-sized stones.

Sundbergen 2 (259). A little more to the NW there is a low cairn with somewhat indefinite edges at the altitude of 29.9 m. The length is 4.5 m, width 4.3 m and height 0.4 m. The surface consists mostly of rounded, relatively even-sized stones.

Sundbergen 3 (250). This round cairn is situated on a terrace in the upper part of the NW slope of the top, on a plane and convex rock surface. The altitude *h* = 24 m. In the middle of the cairn there is a pit. The length is 7.7 m (SW–NE), width 6.1 m, and height 0.7 m. The stones are rounded and fairly even-sized (circa 1–60 kg). In the middle there is a large pit where the stones are entirely covered by lichen.

Sundbergen 4 (251). The cairn 4 is situated on the SE lower slope of the rock outcrop, in a boulder field. The altitude *h* = 15 m. The stone setting is of an indeterminable shape. In the middle there is a pit. The length is 7.2 m (N–S), width 6.5 m, and height 0.4 m. The stones are small (0–20 kg), almost exclusively rounded and probably picked up from the surrounding boulder field.

Sundbergen 5 (252). The cairn 5 is also situated in a boulder field, more to the W, on the southern lower slope of Sundbergen. The altitude *h* = 20 m. The stone setting is indeterminable by shape. In the middle there is a pit. The length is 7.7 m, width 6.4 m and height 0.8 m. The stones are small (0–40 kg), almost exclusively rounded, and probably picked up from the surrounding boulder field.

Mjoö 1 (253). The cairn Mjoö 1 is situated in the northern part of a rock outcrop, on the western upper slope of a plane rock. From the site (*h* = 25 m) there is an unobstructed view in the directions between SW and NW. On an even surface sloping to SW, there is a flat stone setting, a little indeterminable at the edges, the length of which is 4.7 m, width 4.4 m, and height 0.4 m. The stones are rounded and edged (about 1–50 kg). At the W edge there is an edged granite boulder, larger than the others.

58. Inv. report by Tuovinen 1987, no. 37 and 38 (TYA), excavation report by Tuovinen 1988 (TYA), inv. report by Tuovinen 1996, no. 25–33 (FFPS). Excavation team: Lassi Hatakka, Timo Kuokkanen, and the author. Tuovinen 1991: 53–57. Artefacts: TYA 486:1–30.

Mjoö 2 (254). The site is on the top of a rock outcrop, on a plane and flat surface, slightly sloping to the W, at the altitude of *h* = 28 m. The cairn has been placed beside a distal precipitous bank. There is an unobstructed view in all directions except for the south. The stone setting can be characterized as indeterminable in shape with an uneven surface and crater-like profile. The measurements are 4.1 m and 4.0 m. The stones are rounded and edged (about 0–30 kg).

Mjoö 3 (369). The cairn is situated in the S part of Mjoö, on a granite terrace, on an almost horizontal, plane surface (*h* = 11.5 m). There is some visibility to S and W towards the strait, Mjoö sund. On the terrace, there is a flat stone setting, with indeterminable edges and an uneven surface. The length is 5.3 m (N–S), width 3.9 m and height 0.4 m. The stones are rounded and edged, fairly even-sized (mainly about 0–40 kg). The structure is disperse and some stones have rolled down over the edge of the terrace.

Granholm (368). From the top of Granholm (*h* = 28 m), situated to the NW of Nötö, there is an unobstructed view in all directions. Here, on a convex smooth granite surface, there is a cairn, with indeterminable edges, with a length of 7.2 m (SE–NW), width 4.7 m and height 0.6 m. Nearly all stones are rounded, size about 0–40 kg, and mixed with smaller pebbles. In the middle there is a conical pile of large boulders.

The two cairns that were excavated, Sundbergen 1 and 2, are situated at the northern tip of Nötö, on the top of a rock outcrop (fig 10). Sundbergen, Mjoö, and Granholm are among the highest tops in a large area. The landscape around these tops can, in spite of the shore displacement after the Iron Age, still be characterized as an outer archipelago zone with a low relief. The unobstructed view over a large area, mainly to the north, from the top of Sundbergen is only limited by a dry pine forest. On the slopes of Sundbergen, especially on the E, SE and S sides, there are washed boulder fields surrounding the rock outcrop in a large area reaching down to the shore on the NE side. To the SW of the rock area and on Mjoö, there is sand and gravel.

The bedrock consists mainly of granite, migmatite, and granodiorite (Edelman 1956; Edelman 1985). Granodiorite is the prevailing rock type on the NW shore of Sundbergen. The rock changes into granite to SE from Sundbergen, towards the strait Mjoö sund. The microcline granite contains granate as porfyroblasts (Edelman 1985: 21), and magnetite.

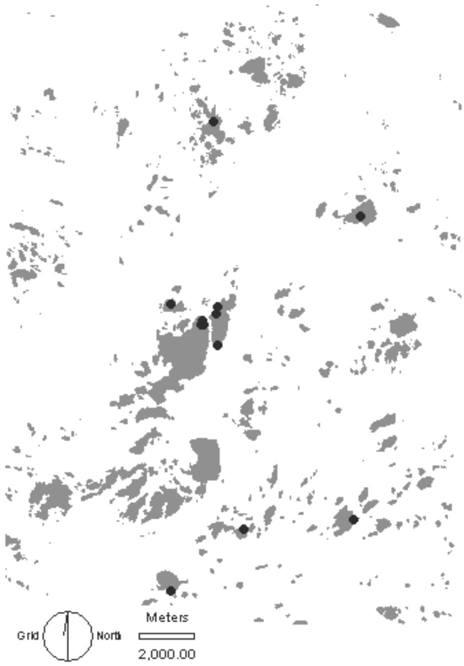

Fig. 9. The known burial cairns in the southern archipelago of Nagu, in the area of Nötö, Boskär, Ådön, Sandholm, Trunsö, and Lökholm. © The National Board of Survey (MAR/103/98).

4.3.1.1 Sundbergen 1

The cairn Sundbergen 1 (258) has been erected on a convex, fairly flat top, only a little larger than the cairn itself. The surface is partly of coarse granite, partly of granodiorite, with biotite-plagioclase schist in small inclusions. The area covered by the stone setting consists mostly of granodiorite. The rock surfaces surrounding the grave are fairly even, so the shore processes have evidently swept away soil, stones and boulders from the top some 4500 years ago. Thus, all of the construction material of the cairn must have been transported to the site. The area, measured along the edges of the stone setting, was 33 m^2. There were 768 boulders weighing at least 0.5 kg, and their total weight was 11.30 tons.

Most stones were rounded and, especially those of the surface layer, rather even-sized. There was a clearly discernible pit in the middle part of the cairn (fig. 11). Below the surface stones, there were a lot of small stones and pebbles, about the size of a fist, which had been loosely wedged in between the larger boulders so that they often fell deeper when the large boulders were being moved. Thus, the average size of the stones and boulders could not be determined on the basis of the surface stones only. Possibly the pebbles were used to fill up the holes between the larger boulders on the surface of the cairn, but due to gravity, a lot of pebbles slid down downwards between the boulders. This gravity effect, the abundance of small stones in the filling layer beneath the surface was also observed by Tapio Seger in the investigation of the cairn 088 at Furunabb, Houtskär, two years earlier.

The soil layer on the ground was covered by litter spilt down from between the boulders. Under the litter, there was a 1–3 cm thick layer of dark humus containing plenty of organic material and angular gravel particles, which were residual originating from weathering. The most gravel was to be found under boulders lying on the granodiorite surface, and in the holes and crevices of the surface. The excavation of the humus layer revealed unburnt bone. On the bottom surface of the pit, burnt human bone fragments were found in an area of 3.2 m^2 (161 g).

Among the fragments of burnt bone, there were two pieces of burnt antler (0.6 g). One of the pieces had been carved into a rectangular and flat artefact. On the smooth-cut 16 mm long face there are two engraved cross-like figures which form part of a longer decorated surface (fig. 12). The rivet hole, too, is visible. The artefact is probably the peg plate of a one-sided comb made up of three parts. This type of comb is rare on the mainland of Finland (e.g. Lehtosalo-Hilander 1982: 65); they are, however, more frequent in in the mound cemeteries of Åland from the Viking Age, such as in Långängsbacken (Kivikoski 1980: 35–38) and, for instance, in Birka, Sweden (Ambrosiani 1981). A comb decorated with a lattice-like figure was found in a Viking Age cairn in Tammenpää, Halikko, on the SW coast of Finland; it is, however, made of bone and two-sided (Hirviluoto 1992: 68).

4.3.1.2 Sundbergen 2

The cairn Sundbergen 2 has been erected on a plane horizontal rock surface inclining slightly downwards from the edges of the stone setting (fig. 13). The rock surface is of smooth-worn granodiorite with criss-crossing granite veins. On the distal side SE, the cairn is bordered by a fracture bank over whose edge boulders have fallen from the stone setting. The area of the cairn, measured along the edges of the stone setting, was 15.8 m^2. There were 458 boulders weighing at least 0.5 kg, and their total weight was 4.34 tons.

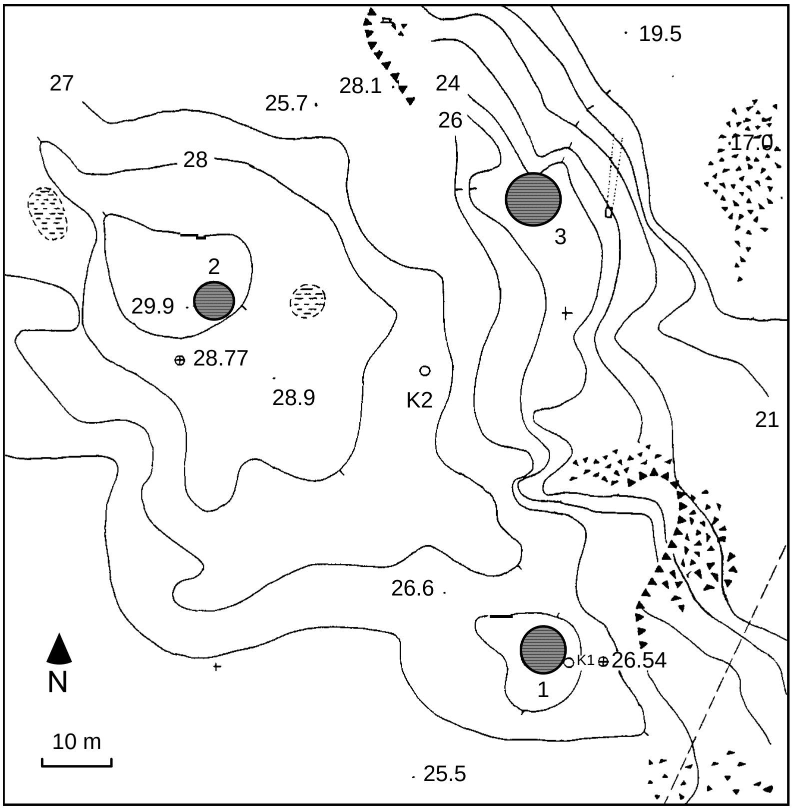

Fig. 10. The cairns in Sundbergen, Nagu. Surveyed by the author (TYA)[59].

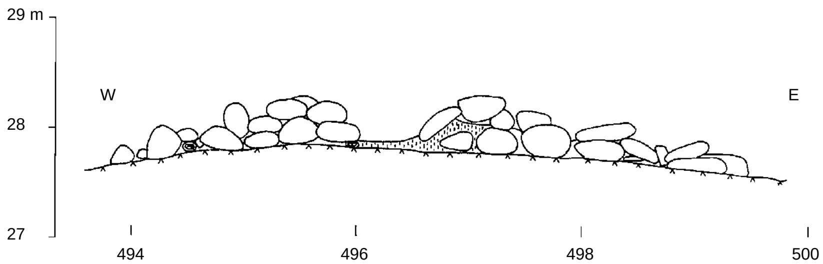

Fig. 11. Sundbergen, Nagu, cairn 1, profile W–E. Measured and drawn by Timo Kuokkanen (TYA).

59. For details, see the excavation report.

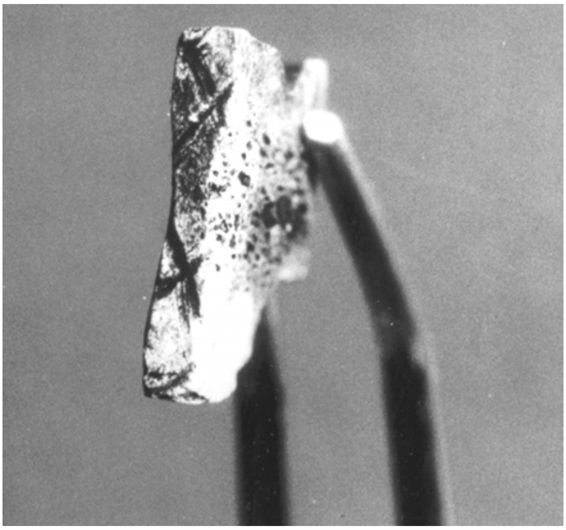

Fig. 12. Part of a peg plate of an antler comb (TYA 486: 23). Sundbergen, Nagu, cairn 1. Size ca 8:1. Photographed by the author.

Fig. 13. The burial cairn Sundbergen 2, Nagu, seen from the west. Photographed by the author.

The stone cover consisted of fairly even-sized stones among which there were more angular pieces than in the cairn 1. After the removal of the surface vegetation and the surface layer of stones, a soil-mixed stone layer was visible. In this layer, the large boulders were mainly rounded. The boulders were in one or two layers above the bottom layer, which was composed of humus soil, with scattered edged and rounded pebbles, organic material, roots, fragments of charcoal and weathering residue. The humus layer covered the rock so that most of the stones were not directly lying on the granodiorite surface, but on an intermediate 3–4 cm thick soil layer. In the soil layer, seven iron rivets were found. In two of them, a rhomb-like piece has been preserved, typical of the rivets used in clinker boat-building. The weight of the rivets was 4.4–14.0 g and length 29–42 mm. Further, two artefacts, best characterized as nails, as well as unidentified fragments of iron, 189 g of unburnt and 1.3 g of burnt bone, a fish scale and pieces of shells were found.

The iron rivets indicate that the cairn 2 was probably built in the Merovingian or the Viking period (Anderson 1963; Raike 1996). As indicated by the boat finds, the Nordic tradition of using iron rivets in clinker boat-building was continued even longer. For instance, the clinker-built boat from the castle of Turku has been radiocarbon dated to the Middle Ages (640 ± 80 uncal BP) (Forssell 1982). In other Nordic countries, there are rivet finds from as late as the 16th century (Westerdahl 1989: 39–42; c.f. Weski 1999).

As far as I know, these are the first finds of iron rivets in the burial cairns of the archipelago. In Sweden, rivets are known in medieval burial cairns in Misterhult (Norman 1993: 112–113); in Klinta, Öland, iron rivets have been found in a cairn dating back to the Viking Age (Schulze 1987: 58–60).

Observations made during the excavations indicate that a layer of soil has at first been brought on the rock, with edged and rounded pebbles combined with some finer mineral material and some organic material. The rivets and burnt bones were buried in this layer. On the top of the bottom layer, there was a heap of rounded and edged stones and boulders of different sizes, and possibly some soil, too. If the cairn had been built on a mineral soil, in a more fertile, humid and grazed place than the top of rocky Sundbergen, the earth layer on the ground would probably have favoured the vegetation to spread out on the cairn so that the stones would gradually have become covered. The result would have reminded greatly of the mounds on Åland with a flat stone setting inside (Kivikoski 1963; Museibyrån 1984). According to Helena Edgren (1983), there is no unambiguous limit between burial cairns and earth mounds on Åland. In many places, they occur side by side in the younger Iron Age. I regard it as probable that, as to the cairns and mounds, it is partly a question of the same type of construction, on which in different ecological habitats different humus and vegetation covers have been deposited during the past millennium.

4.3.1.3 Osteological analysis

The osteological analysis of the bone samples was made by Tarja Formisto, University of Stockholm. The results show that a young person had been buried in cairn 1 (table 2). The human bones were found in the humus soil layer on the bottom, mixed with bird and fish bones, and bones of a small mammal. Nothing indicated that the animal bones would be secondary finds, but in a burial cairn, the possibility of contamination cannot be entirely eliminated (c.f. Okkonen 1993: 6). The animal bones in the filling layer, however, are not necessarily connected with the interment.

Table 2. Sundbergen 1, Nagu. An osteological analysis of the bone samples from the cairn.

Find (TYA)	Determination	Stratification
486:24	143 g burnt bone, fragments of *Ossa longa* incompletely burnt. All human bones. Burnt human bones: 88 g. *Os parietale*, 4 pieces, *Calvarium* 33 pieces, *Costae* 1 piece, 105 pieces of long bones. Age: *Juvenilis/Adultus*, thin *calvarium*; skull sutures not grown together. Sex: –. MNI: 1.	The lowermost humus soil layer, mainly under the pit.
486:25	6.2 g of unburnt animal bones; among others, bones of a bird, small rodents and fish.	The lowermost humus soil layer.
486:26	7 g of unburnt animal bone.	Humus soil in filling layer.
486:27	10 g of unburnt animal bone. A piece of the *humerus* of a bird, and probably a *talus* of a roe deer/deer, young individual.	Humus soil in filling layer.
486:28	10.2 g of burnt bone fragments. Human bone, among others two thin fragments of the *calvarium*.	The lowermost humus soil layer, collected from water sieved samples using a stereomicroscope.
486:29	2 g of unburnt animal bones, among others bones of small rodents, birds and fishes.	The lowermost humus soil layer, collected from water sieved samples.
486:23	Burnt antler 2 pieces, 0.62 g.	The lowermost humus soil layer, under the pit.

In cairn Sundbergen 2 an adult person had been inhumed (table 3). The weight of the bone material was 44 g, mostly originating from a broken humerus. It had been placed on the ground of the construction, into the humus soil layer, near the surface of the rock, and the S edge of the cairn. The rivets and nails had also been placed mainly in the bottom layer, next to the rock surface, but they formed a scattered group about 1.5 m to the NW from the human bones.

In addition to artefacts evidently set in the humus soil layer, bones were discovered in cairn 2 under and between the stones the cairn was filled with. Among them there were five unburnt teeth which have belonged to a person of 30–40 years of age (Juha Varrela, pers.comm.[60]), 1.7 g of other human bones and 201 g of unburnt bones which have belonged to cattle, pig, sheep/goat, cat, bird, fish, and a small rodent. This leads to the question, whether the animal bones were a part of the interment. The human and animal bones could not be stratigraphically separated *in situ* from each other. Large animal bones lying under and between the boulders indicated that they were stratigraphically no more secondary than the human bones. Thus the animal bones are probably part of the interment and of the same age.

60. The teeth (TYA 486:13) are not included in the samples determined by Tarja Formisto.

Table 3. Sundbergen 2, Nagu. An osteological analysis of the bone samples from the cairn.

Find (TYA)	Determination	Stratification
486:14	Unburnt bones 203.1 g. Unburnt human bone: 1.7 g. *Os parietale* 1 piece. Age: Adult. Bones of cattle, pig and sheep/goat 171.3 g. Bones of bird 22.4 g. Bones of cat 6.4 g. Bones of fish 0.7 g. Bones of small rodent 0.6 g.	Stone filling in the middle part of the cairn.
486:15	44 g of unburnt human bones. Piece of the left *humerus*, distal part 23 g. 40 pieces of long bones, 21 g, most of which probably from a broken *humerus*. Age: adult.	The lowermost humus soil layer.
486:16	0.3 g of weakly burnt bone.	The lowermost humus soil layer, near the surface of the rock.
486:17	1 g of weakly burnt bone, *pars petrosa*.	The lowermost humus soil layer, near the surface of the rock.
486:18	1.5 g of unburnt animal bones, among others bones of bird, fish and small mammal.	The lowermost humus soil layer, collected from water sieved samples.
486:19	0.001 g scale of fish.	The lowermost humus soil layer, collected from water sieved samples.
486:20	0.001 g shell.	The lowermost humus soil layer, collected from water sieved samples.

The cattle bones advert to the name Nötö, which refers to cattle (*Sw. nöt*). Kurt Zilliacus has demonstrated that the name *Malmö* in the so-called Danish itinerary, a medieval list of place-names along the Swedish and Finnish coasts (e.g., Cederlund 1988), refers to the present island of Nötö. According to him, the name Nötö came to be used after the 13th century when the people of Nagu started to utilize the island as grazing land for their cattle (Zilliacus 1994: 68). The cattle bones found in the cairn indicate, however, that the use of the area as a pasture probably started even earlier.

Another noteworthy domestic animal among the samples is the cat. Cat bones occur in younger Iron Age contexts, for instance in every tenth of the mounds in Kvarnbacken, Sund, on Åland (Núñez & Lempiäinen 1997; c.f. Hatting 1992[61]). As to the smallest animal bones there is a possibility of contamination. The fish bones, fish scales and shells may have found their way – long ago – into the cairn carried by fish- and mussel-catching sea birds.

What little is left of the inhumation in cairn 2, derives from the humerus and the teeth. Far advanced decomposition might be the explanation for the scarce remains, but it is also possible that the corpse when buried was not complete but in pieces. Parts of the corpse might have ended, as could be concluded from the excavation observations, up in between and mixed with the boulders, not only under the lowermost boulders.

61. See also the osteological report by Paul Wallin (1986, ÅM).

4.3.1.4 Soil analysis

From the spots where human bones were found, samples were taken in order to determine the occurrence of rounded mineral particles, the particle size distribution and the occurrence of pollen grains[62]. The roundness of the particles was determined both from the samples taken for grain analysis and water sieved samples. In the particle size fractions 8, 4 and 2 mm, particles worn by water or wind were searched using a stereo microscope. Particles containing plenty of mica and other dark minerals were recorded since they might indicate the difference of composition between granite and granodiorite. The aim was to determine whether the mineral material was a weathering product originating from the stones and the rock surfaces or whether it had been brought from elsewhere as such or with other materials. In the 8 and 4 mm fractions, no rounded particles were found.

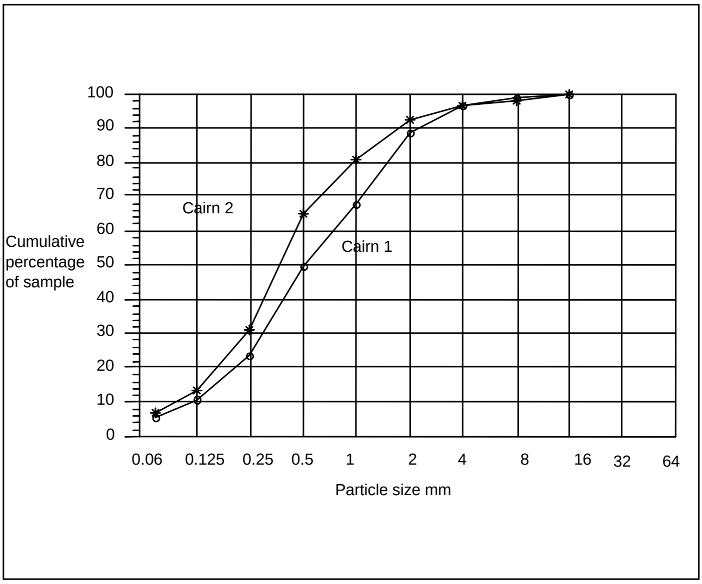

Fig. 14. Sundbergen, Nagu. Particle size curves of soil samples.

For cairn 1, a sample of 4661 g was screened. It contained, in addition to the mineral material, parts of plants, decaying wood, decomposed organic material, chitin shells, 2.0 g of unburnt bones of rodents, fish and bird, burnt bone in small particles (table 2) and 0.3 g of burnt clay. The sample for cairn 2 (3407 g) contained, in addition to parts of plants, decaying wood, decomposed organic material and chitin shells, bone, iron in

62. The determination of particle size, humus content and rock type as well as the pollen analysis was carried out by Lassi Hatakka, Department of Quaternary Geology, University of Turku. The determination of roundness was conducted by Lassi Hatakka and the author. The particle size samples were dried in 105°C and weighted. The organic material was dissolved by cooking the samples in 10 % NaOH, followed by rinsing, and cooking again in hydrogen peroxide. Next, the samples were dried, weighed, and sieved. The humus content was determined from the ignition loss at 800°C.

magnetically recognizable particles, a fish scale and parts of a mollusc shell. From the water-sieved samples, ca 30 g were examined to determine the portion of rounded particles (table 3). The latter samples are not comparable to the amounts of rounded particles in the grain analysis because organic material was not removed from the water sieved samples.

When excavating the stone settings, soil samples were collected from under the lowermost boulders to identify pollen grains and to examine whether it was possible to find recognizable pollen in layers where the soil has repeatedly become dry, and oxidation has been very efficient. If pollen were found, the composition of the pollengrains could yield some evidence of the source of the soil in the cairn. Because the amounts of pollen were small and some of the pollen grains were poorly preserved, the results are presented qualitatively. Especially in cairn 2 the pollen grains were poorly preserved, but the spores, instead, were of better quality. Because the endurance of pollen grains of different species varies, the results of frequency counts would have been difficult to interpret. Positively identified groups are presented in table 4.

Differences in the grain composition of the cairn soil samples were slight but discernible. If shore sand has been brought into cairns as such or among other material, it's proportion is larger in the more assorted sample of the cairn 2. Cairn 1 contained plenty of granite, the surface of which weathers in coarse particles whereas cairn 2 contained more of granodiorite weathering in finer products. This difference is probably reflected in the grain size distributions of the cairns.

Concluding from the roundness and mineral composition of the particles, the mineral material of the soil samples has been mainly produced through the weathering process of the boulders and the underlying rock surface. In both cairns, there was a small proportion of round-worn particles of approximately the same size that have ended up in the cairns being most probably attached to the boulders or with the soil brought into the cairns. Especially shore material can easily have remained stuck on the boulders when they were carried wet from the shore or from a wet rock cavity. In the dry sieved samples, the mineral composition is somewhat different so that the greater percentage of granodiorite in cairn 2 is reflected as a greater proportion of dark minerals. In the water sieved samples, the mean weight of rounded particles was greater than that of angular ones. The difference can be partly be explained by the fact that rounded particles pass through the water sieve more easily than angular ones. The lower percentage of humus in cairn 2 may indicate that sand has been brought from elsewhere into the cairn, even though different proportions of minerals contribute to different amounts of weathering products.

Table 4. A soil analysis of the cairns at Sundbergen, Nagu.

Cairn	Sundbergen 1	Sundbergen 2
Percentage of humus	17.4	11.7
2 mm dry sieving fraction:		
Weight of mineral material g	400.2	539.4
Percentage of weight of rounded particles	3.4	4.4
Percentage of weight of particles of dark minerals	1.7	13.1
1 mm water sieving fraction:		
Weight of sample g	32.79	32.47
Frequency of mineral particles	5983	4493
Total weight of rounded particles g	0.29	0.23
Per mille (‰) of total weight of particles	8.8	7.1
Frequency of rounded particles	20	19
Per mille (‰) of total frequency of particles	3.3	4.2
Mean weight of rounded particles mg	14.5	12.1
Mean weight, other particles mg	5.5	7.2
Pollen and spore grains	Alnus	Alnus
	Betula	Betula
	Cyperaceae	Cyperaceae
	Ericaceae	Polypodiaceae
	Juniperus	Sphagnum
	Picea	
	Pinus (abundant)	
	Polypodiaceae	
	Sphagnum	

We can assume that the preconditions of deposition and preservation of the pollens of various species are approximately the same in both cairns. However, there are certain differences in the samples. Pollen of pine (*Pinus*) did not occur in the sample of cairn 2, even if the graves are located in the middle of a pine forest. Even if the pollen grains of cairn 2 were in a weaker condition than those of cairn 1, it is difficult to believe that the pine pollen grains would have been destroyed entirely. The stratification of cairn 2 indicates that the rock surface was at first covered with soil, probably containing pollen grains, and subsequently the soil layer was covered with stones. The soil can have been brought from an adjacent rock dell, the deposits of which would represent an earlier phase of land uplift when the island of Nötö was still a rocky skerry in the outer zone with no pine forest. This is further confirmed by the lack of spruce (*Picea*) and juniper (*Juniperus*) as well as the presence of fragments of shellfish. Probably the soil sealed the layer from external pollen precipitation. The studies by Irmeli Vuorela and Terttu Lempiäinen on the Late Neolithic site of Kotirinne, Turku, also suggest that the pollen stratigraphy may not be strongly affected by contamination in soil profiles (Vuorela & Lempiäinen 1988: 36–39). The preservation of the soil layer from contaminations supports the preceding idea that the unburnt human bones, nails, rivets and animal bones belong to the same interment.

The soil layer of the cairn 1 seems to have gone through a different formation process. No man-made soil layer was observed, and the present soil is probably the result of natural humus formation and weathering products.

The preceding analyses support the observations made during the excavation. The results suggest that a young person was buried in cairn 2 during the Late Iron Age, endowed with rivets, nails and domestic animals or parts of them. The cairn 2 has been better preserved from later external impacts than cairn 1. In the cairn 1, an adult person was buried in the Late Iron Age, equipped – at least – with a comb.

More evidence of the formation processes of burial cairns would be achieved by a further investigation into the composition of the building material and the traces of natural processes, for instance pollen stratigraphy. As to problems concerning mortuary rituals, it is essential to learn more about when and to what extent artefacts and ecofacts can be regarded as primary constituents of interments and not related to subsequent external impacts, of human or other origin. The classic problem in studies on burial cairns is the openness of the stone setting. Although this has not been investigated in Finland, I think it is safe to state that under the first centuries after the burial, oxygen, water, water-soluble compounds, and solar radiation were able to alter and destroy the remains of the burial. After the composition of humus soil on the ground or the rock surface, the remains were probably better protected.

It is conceivable that artefacts and ecofacts fallen down between the boulders may have been mixed with the remains of the interment. Animal bones found in cairns have often, indeed, been regarded as secondary (c.f. Salo 1981 b: 178). However, if possible, it should be investigated separately in each case whether bone remains are secondary or not, which requires a pedantic excavation technique. The excavation of a burial cairn involves a risk of contamination. Therefore, care should be taken that turf, litter, roots, and recent soil layers are carefully removed at the very moment of picking up each stone.

Layers of sand and gravel under and between the stones have been documented in other areas of Finland, too. Soil has been used to fill in the cavities between stones and to heap up a layer where the deceased was buried. The soil filling has been considered to be a characteristic that goes back to the Bronze Age (Edgren 1999: 330), and it seems to appear in Bronze Age and Early Iron Age contexts. For example, the Bronze Age cairns in Råckers, Karis, and the Roman Iron Age cairns in Ekeberga, Sjundeå, and Ketohaka 1, Salo, contained layers of sand and gravel (af Hällström 1948; Keskitalo 1979: 14, 36; Schauman-Lönnqvist 1989: 47–50). According to Oiva Keskitalo, the soil filling was a prevailing feature in the Late Roman Iron Age in Ostrobothnia (Keskitalo 1979: 129). The cairns in Piiloinen, Vehmaa (Early Roman Iron Age), contained soil layers, too (Salo 1968: 67–69). Thus, the soil filling in Sundbergen seems to represent a conservative characteristic in the burial tradition.

4.3.2 Lilla Kuusis, Nagu

In October 1984, when examining the terrain of the two islands of Lilla Kuusis, Nagu and Iso-Kuusinen, Rymättylä, I came across a flat stone setting on Lilla Kuusis (245). In 1988, the cairn was excavated[63].

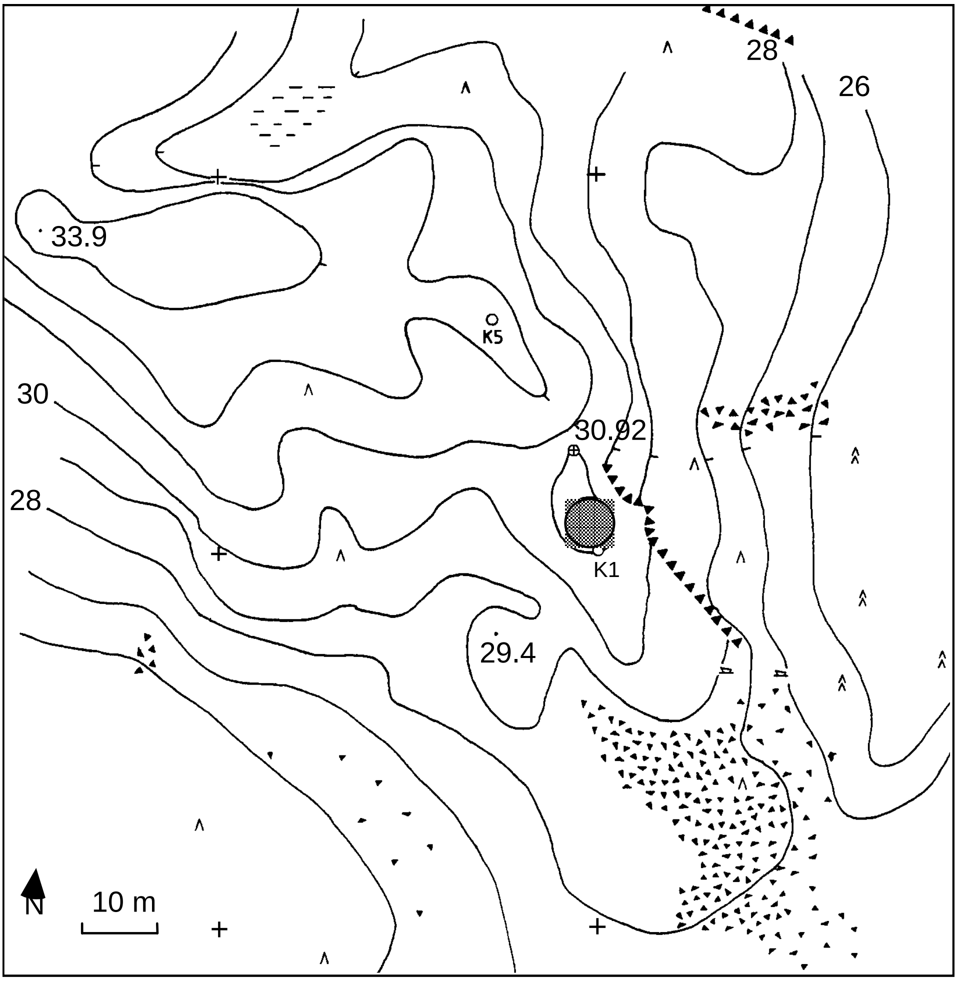

Fig. 15. The cairn on Lilla Kuusis, Nagu. Measured and drawn by the author (TYA).

The cairn is located in the W part of the island consisting of two parts. The W part is connected to the E part by a *tombolo*, the ridge of which comes up to the height of less than two meters from sea level. Consequently, Lilla Kuusis was, at the time when the grave was built, a separate island of Iso-Kuusinen. At the level of -10 meters, the area of the island was 29.4 hectares, and the length of the shoreline was 2.26 km.

63. Reports by Tuovinen 1984 and 1988 (TYA).

The middle part of Lilla Kuusis is a rock outcrop of gneiss granite, the top of which rises up to 39 meters. From the top, a vast view opens in all directions, except for SE, which is shadowed by Iso-Kuusinen. The burial cairn is situated on a flat, smooth-worn ridge in the direction NW–SE, 160 m to SE from the top of the rock outcrop (fig. 15). On a level a little lower from the ridge, there is a zone with wave-washed boulder fields, which are possibly the source of some of the stones in the cairn.

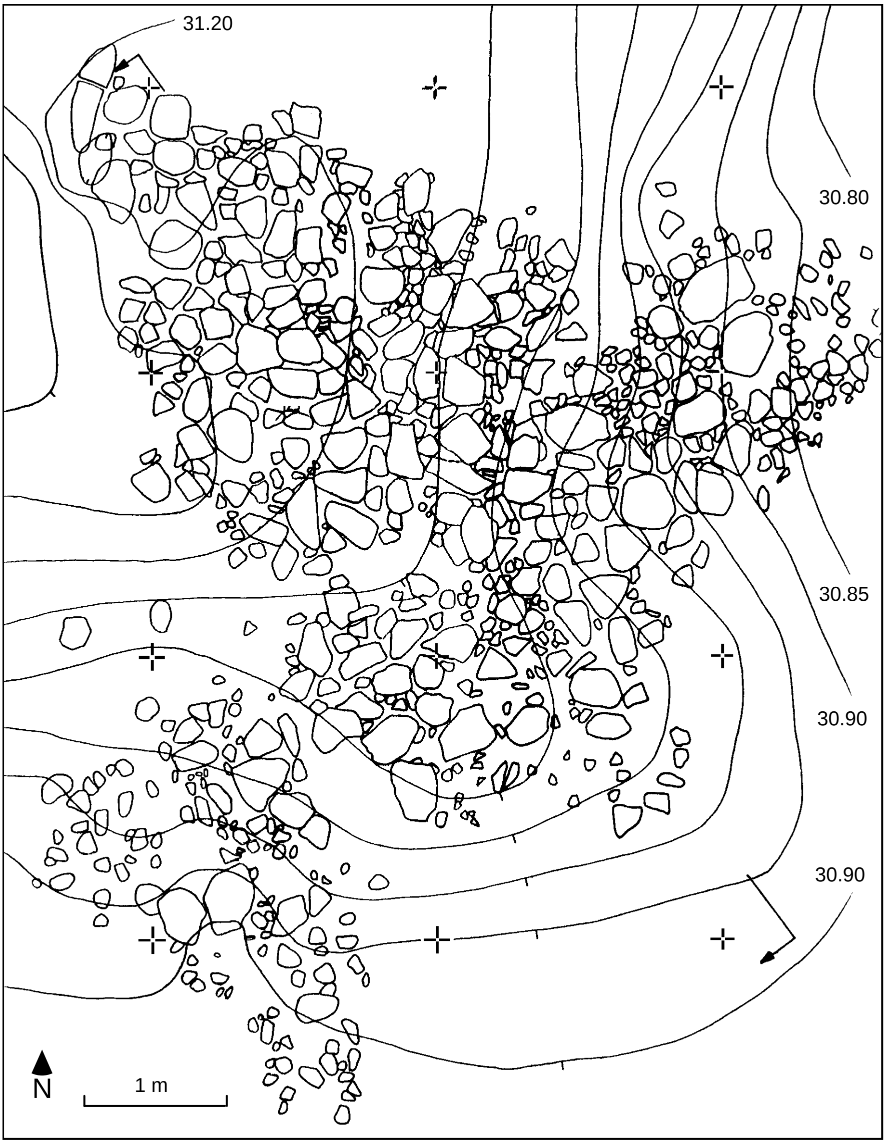

Fig. 16. Plan of the cairn Lilla Kuusis, Nagu. Contours at 5 cm intervals. Measured pantographically by the author, Tommi Vuorinen and Timo Vuorisalo (TYA).

The cairn which can be characterized as a flat stone setting, is situated on a rock surface slightly inclined to SE. Some stones along the E and SW edges of the stone setting have probably slid down along the surface because they lie where the rock surface is slightly grooved (figure 16). The length of the stone setting was 7.8 m (NNW–SSE) and width 7.0 m. The area, measured along the edges of the stone setting, was about 22 m^2. There were 774 boulders weighing at least 0.5 kg, and their total weight was 2.78 tons. The stones, mainly edged and relatively small, had been arranged on the rock surface in one or two layers. Under the stones, there was a 1–3 cm thick layer of dark soil containing decomposed organic matter, fine grained mineral material, and weathering products. Although no artefacts were found, it is obvious that the stone setting could not be a result of natural processes because the stones were placed on a smooth-polished rock ridge heavily exposed to shore processes at the earlier stages of shore displacement, and therefore, glacially transported stones would have been swept away from the spot (c.f. Pyökäri 1976: 12–24).

4.3.3 Östergård 2, Dragsfjärd

The cemetery of Östergård 2, Dragsfjärd, with seven burial cairns, was discovered by Helena Edgren in 1985. In 1990, one of the cairns (054), was excavated[64]. The cemetery is located on the cape of Purunpää, pointing towards the south off the mainland of Dragsfjärd, in a rocky terrain. The graves are located in a wave-washed till slope inclining to the east, at the altitude of 14.7–16.8 m. Below the slope there is a field which continuing to the south as a bog at the level of 11–12 m. This lowland was once traversed by a long sound in the direction S–N. The water formed a shallow but well-protected bay which opened to the west to a stretch of open sea, the present-day Gullkrona fjärd. Due to the land uplift, the sound became shallow, and finally drained by the end of the last millennium BC.

The length of the cairns varies from 1.6 to 3.2 meters, and width from 1.3 m to 2.0 meters. They are round and constructed of fairly even-sized stones up to ca 40 kg. The stones are mainly rounded and, consequently, probably collected from the shore.

The burial cairn selected for excavation was number 9. The surface was covered by moss and litter. After the vegetation had been removed it turned out that the cairn had clearly discernible edges. The stones and boulders were mostly rounded, and their weight varied between 0.5 and 72 kg. There were 210 boulders weighing at least 0.5 kg, and their total weight was 1.38 tons. Especially the surface stones were rounded and even-sized, and deeper among the boulders there were more pebbles and edged stones. This is evidently due to the gravity effect, earlier noted in Sundbergen, Nagu.

No artefacts were found, which makes the dating of the cairn cemetery uncertain. The altitudes of the cairns, however, indicate that they must be later than the Bronze Age. The

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64. Inv. report by Helena Edgren 1985 (NBA), no. 11. Inv. report by Tuovinen 1987 (TYA), no 9. Excavation report by Tuovinen 1990 (TYA). Excavation team: Timo Kuokkanen, Henry Malmberg, Solveig Mannerström, Hans Myhrman, Henrik Salomonsson, Christina Sundberg, Bruno Södergård, Sven-Erik Söderholm, Henning Westberg, and the author.

lowest points of the cairns reach the altitude of 14.7 m, which is about the same level as the local shore level zone Litorina VI, 600 BC uncal ^{14}C (Glückert 1976).

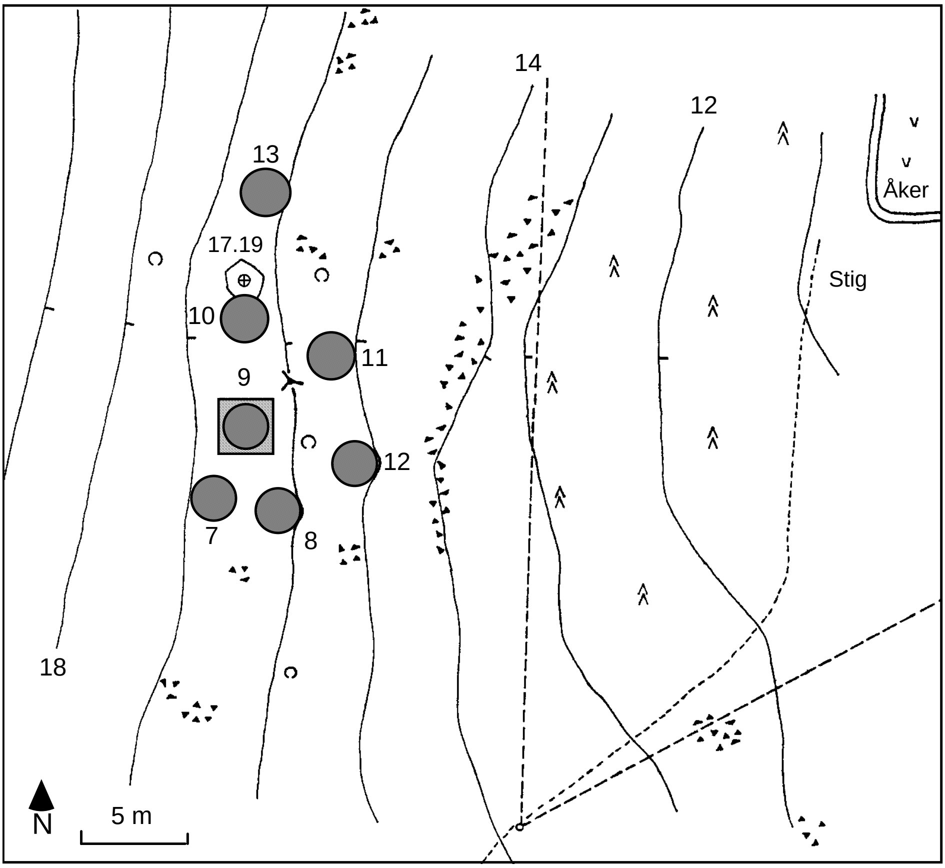

Fig. 17. The cemetery of Östergård 2, Dragsfjärd. Surveyed and drawn by the author (TYA).

4.3.4 Ängesnäs bergen, Nagu

During a survey in 1983, a cairn was discovered on the top of a rock, named Ängesnäs bergen, on the island of Själö (*Fi.* Seili), Nagu (217). The initial hint of the grave was given by Mr. Birger Wikström, laboratory foreman in the Archipelago Sea Research Institute of the University of Turku. The research station of this institute is located on Själö. The excavation of the cairn in 1993 was part of a course in excavation techniques, University of Turku[65].

65. Reports by Kuokkanen & Tuovinen 1983 (TYA), no. 17, and Tuovinen 1993 (TYA). Ann-Christin Antell, Marja Anttila, Markus Kivistö, Terhi Mäkirinta, Virva Paavola and Jouni Taivainen participated in the excavation team.

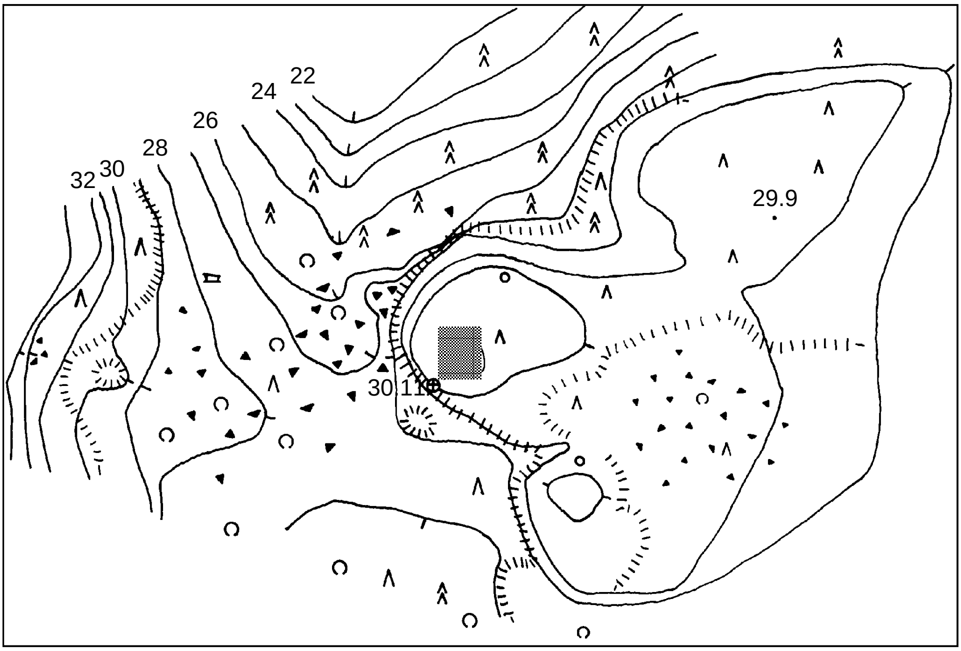

Fig. 18. The topography of the top of Ängesnäs bergen, Nagu. Surveyed and drawn by the excavation team and the author (TYA).

Fig. 19. The cairn on Ängesnäs bergen, Nagu. Photograph by the author.

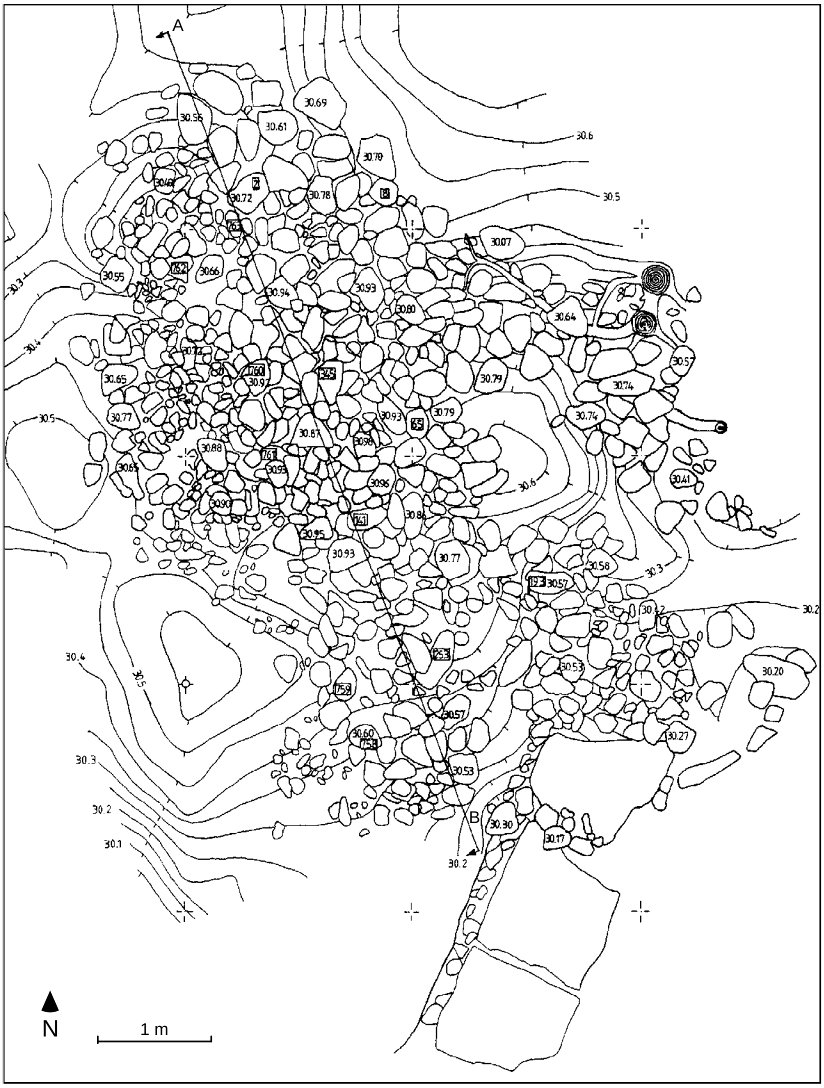

Fig. 20. Ängesnäs bergen, Nagu. Plan of burial cairn, measured and drawn by the excavation team and the author (TYA).

There are two top points on Ängesnäs bergen, the western 35.3 m high, and the eastern, the highest point of which is 30.7 m high. The grave lies on the SE edge of the eastern top, at the altitude of 30.2 m, on a pitted horizontal surface which on the SW side forms a bank (fig. 18). The surface is of mica gneiss, which is migmatitic at places, and contains pegmatite veins here and there. From the highest points of the rock there would be an unobstructed view in to the surroundings, but for a stand of forest in the way.

The stone setting covered an area the length of which was 7.8 m (SE–NW) and width 5.3 m. The area, measured along the edges of the stone setting, was 21.7 m^2. There were 1497 boulders weighing at least 0.5 kg, and their total weight was 8.20 tons.

The cairn was covered with rounded and angular stones and boulders of varying sizes. Under the stones there was a layer of soil consisting of pebbles, gravel, weathering products, charcoal, and organic material. In between the boulders lying on the rock and the rock surface there was only a very thin layer of soil, if any. The holes in the rock had been filled with stones. It seemed that the stones had been set on the bare rock surface.

Samples of the soil layer were water-sieved and examined using a stereo microscope. The mineral particles were almost entirely angular, ungrinded, and many of them were fragile. The abundance of angular particles suggests (table 5) that the mineral material originates almost entirely from weathering but yet there are some rounded quartz and feldspar particles which have apparently come into the cairn attached to the boulders. Another possibility is that they originate from soil brought into the cairn, but, nevertheless, the amount of soil seems to be rather small compared with the Sundbergen cairns.

Table 5. Ängesnäs bergen, Nagu. Rounded mineral particles in water sieved sample, particle size 1–2 mm.

Weight of sample g	34.70
Frequency of mineral particles	7420
Weight of rounded mineral particles g	0.12
Per mille (‰) of rounded particles of total weight of particles	3.5
Frequency of rounded particles	18
Per mille (‰) of rounded particles of total frequency of particles	2.4
Mean weight of rounded particles mg	6.7
Mean weight, other particles mg	4.7

No artefacts were found. However, weathering measurements of the basal and distal surfaces of the cairn, to be discussed later, suggest that the cairn has a considerable age, although the age could not be accurately determined due to the high rate of weathering of the rock surface.

4.4 The surveys

4.4.1 Fieldwork 1983–1998

The area of this study consists of the parishes Iniö, Velkua, Rymättylä (*Sw.* Rimito), Houtskär (*Fi.* Houtskari), Korpo (*Fi.* Korppoo), Nagu (*Fi.* Nauvo), Dragsfjärd, Västanfjärd and Kimito (*Fi.* Kemiö) and the town of Pargas (*Fi.* Parainen), and the islands belonging to the town of Turku (*Sw.* Åbo). The total area is 6384 km^2 including the sea areas (fig. 21). The main part of the material was acquired in 1983–1988 and

1995–1998. The field work of the earlier years was part of a research conducted by Professor Unto Salo, University of Turku, while the latter field working period was part of the field research programme of the Finnish Forest and Park Service within the area of combined activities of the Archipelago National Park (Tuovinen 2000 b).

My first field working period of the survey took place in cooperation with Timo Kuokkanen, University of Turku; apart from this period I have been working alone, with a few exceptions[66]. According to diary and log entries, the field work took three years (report writing not included). In the archipelago, my main vehicle as well as my lodging was the pine-wood motor boat *Snöan*. During the years, several other field archaeologists also participated in projects in the archipelago, the results of which are relevant for this study[67].

4.4.2 Research scheme

The aim of the study was to complete earlier surveys by increasing the number of field observations, including in the field working programme both probable locations of burial cairns as well as locations not likely to have been selected as burial places, and extending the survey to the outer and skerry zones of the archipelago. The present topography of burial places was also studied through a sampling study. Thus, the aim was to obtain a more representative sample of burial cairns.

Although burial cairns are visible and sometimes even easily detected, discovering all or nearly all preserved burial cairns is possible only in an exceptionally intensive survey. In the archipelago, I have naturally been able to investigate only scattered parts of the research area. Thus, the essential question was, how to choose the islands, or parts of them, where field work should be done. This choice largely determines which cairns will be found and which will remain undetected.

In practice, the choice was influenced by several accumulating factors. Islands and parts of islands, the areas of which are from a couple of hectares to hundreds of hectares, were investigated. The largest islands that were examined entirely, were Nötö in Nagu (380 ha) and Högsåra in Dragsfjärd (530 ha). To be selected for examination, each area had to have the size of at least a couple of hectares and to be at the altitude of at least five meters. In all, 1072 areas met these criteria. They cover approximately 3–5 % of the land area of the archipelago of Åboland.

The field work was accomplished by the end of the year 1998. In the material, there are 444 burial cairns, 380 of which with exact positioning and data based on my field observations. Most statistical analyses and other summaries of the data are thus based on

66. See field reports by the author 1979 (PMT), the author and Timo Kuokkanen 1983 (TYA), the author 1984–1993 (TYA) and the author 1994–1997 (FFPS).

67. An area at Ölmos, Dragsfjärd, was investigated for planning purposes by Helena Edgren in 1985 (see report in NBA). Levi Fagerström, Harto Roth, Titta Heikkinen and Jari Näränen (University of Turku) made a survey of archaeological sites in Dragsfjärd in 1991 and 1992. The work was initiated by local tourism industry. Commissioned by the Road District in Turku, Ulla Rajala investigated an area in Nagu and Pargas, in 1992. The work was part of an EIA process caused by a bridge construction project (see Kaskinen 1996). The latter reports are stored at the Dept. of Archaeology, University of Turku.

380 cairns. In a few cases, however, the analyses are based on an older version of the data, consisting of 372 cairns.

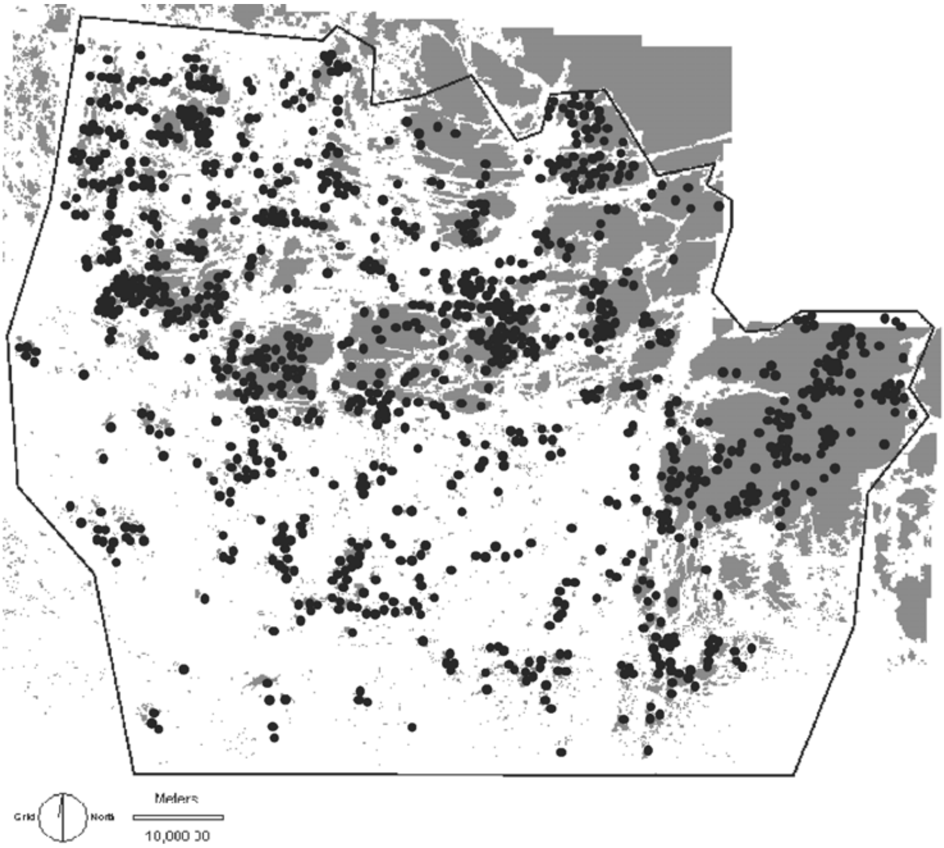

Fig. 21. Areas investigated by August 1999.

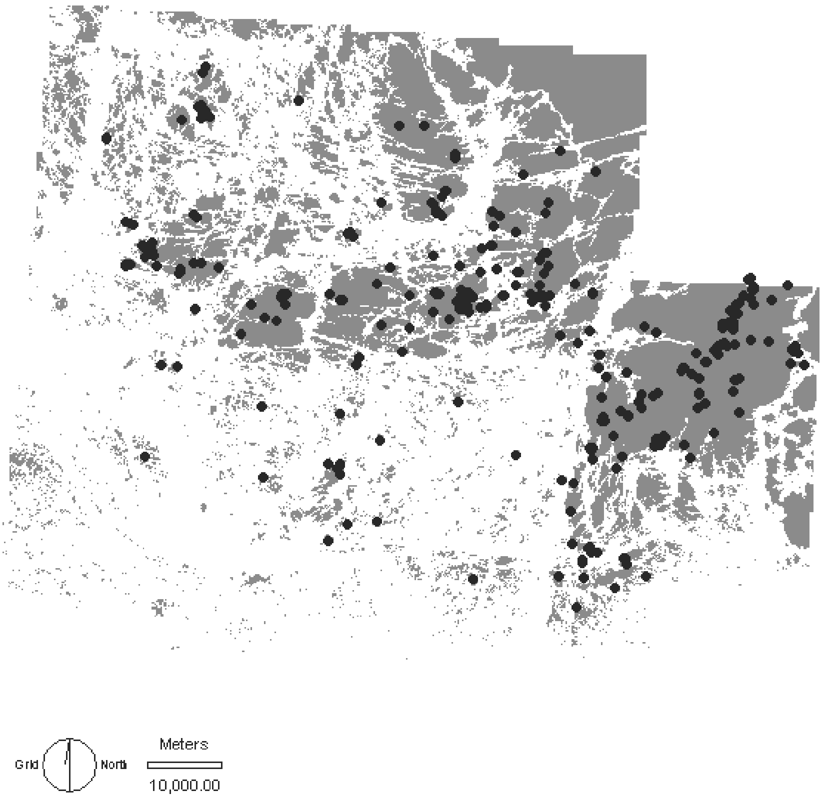

Fig. 22. Known burial cairns in the area investigated by December 1998.

I investigated the chosen areas by walking criss-cross in the terrain, paying special attention to rocky areas and moraines and less to swamps, sea shores, cultivations, courtyards and the densest bush vegetations. In plane terrain, the simplest thing to do was to walk along parallel compass lines in the forest.

The criteria of choice can in broad outline be divided into six categories.

(1). *Burial cairns previously known* from earlier records and literature constitute the starting point for the choice of the areas investigated[68]. Cairns with accurate locational data in the original records were, for the most part, easy to find. Some cairns, however, were found only after the second or third attempt. Volter Högman's positioning data are mainly adequate and accurate but for some cairns mentioned by him, it was necessary to search for a day or two. Some of them remained undetected. For instance, the cairn at Labbnäsåsen, Dragsfjärd, discussed above, can still be identified thanks to the fact that

68. See Björck 1883; Cleve 1942b; Cleve 1948; Dahlström 1940; Dahlström 1945; Fagerlund 1878; Finska Hushållningssällskapet 1979; Gardberg 1955; Hackman 1897; Heikel 1890; Killinen 1885; Koivunen 1982; Sjöros 1887; Tallgren 1902; Tallgren 1906 and Tallgren 1931b. For reviews of cairns in the parishes of the research area, see Grönros 1983; Tuovinen 1984; Nyberg 1985; Suistoranta 1985; Tuovinen 1985; Fagerlund 1992; Asplund 1997a; Tuovinen 1997; Edgren 1999b; Fortelius 1999; Tuovinen 1999; Asplund 2000.

Högman gave the distance from the cairn to a border slab that can still be located in the forest.

(2). *Other items of the previous knowledge*, influencing the choice of the areas to be examined, originate from various sources: place names, older literature and notes, letters and other material in museums and archives.

(3). *Contacts to key persons*. Many inhabitants of the archipelago and experts on local history and tradition contacted me during the field work and gave valuable information on possible archaeological sites. Professionals of science, nature conservation and the archipelago branch in general provided many tips, too. I also sought actively for contacts with people with local knowledge.

(4). *The topographic data of the basic map* may give clues to possible burial places. Matti Huurre addresses this fact when referring to places which, by terrain or soil seem appropriate (Huurre 1973: 35). So does Christian Keller in formulating the fact in Norwegian as follows: ”Jeg har intervjuet flere arkeologer som sier at *de kjenner det på seg* hvor i landskapet de forskjellige ting skal ligge” (Keller 1993: 60, my emphasis). Intuitive choice of location is not easy to report accurately because it not only refers to education and tradition of field archaeology but is also based on experience and – not least – anticipation. The locations I chose intuitively are rocky highlands, hill tops and topographically varying terrains. While searching the sites ’suitable’ in this respect, examination of the chosen areas actually gave some results. Sometimes I happened to catch sight of a cairn on my way to a selected area.

The search of burial cairns by intuition naturally involves the risk that burial places corresponding to expectations are the most likely to be found. To counterbalance this self-supporting strategy, I also chose areas which did not seem to be probable burial places on the basis of the basic map.

(5). Random selection. Two sampling studies have been conducted in which the choice of areas to be examined was randomized. The aim was, first (1983–1984), to estimate the number of burial cairns in the archipelago of Velkua, Iniö and the northern part of Houtskär and, in 1995, to determine the distribution of topographic variables in an area comprising parts of the parishes of Houtskär, Korpo and Nagu.

The number of burial cairns was estimated by means of systematic transect sampling in an area whose length was 31.00 km and width 20.65 km. In this area, there are 711 islands formed before the Late Iron Age. The confidence interval of 80 % of the number of graves was (21,86). The estimate of the mean density of burial cairns was found to be about one cairn per a square kilometer of land area at the altitude of at least 10 meters (Tuovinen 1985: 34–47). The large relative proportion of sea and lowlands in the archipelago of Velkua, Iniö, and northern Houtskär (cf. the hypsographic curve in fig. 2) suggests that the occurrence of burial cairns in the archipelago is not at least less frequent than in the mainland zone.

A practical problem was how to reach an adequate sample size. For sampling, burial cairns are rare phenomena, and they are often located near each other. Thus, their number in each sampling unit theoretically follows the negative binomial distribution, which in turn requires a rather large sample in order to reach a reasonably small standard error (Nance 1983). A total survey would, however, have given little advantage in regard to the amount of work compared with sampling (cf. Kamermans 1995). With a relatively small amount of work, an estimate was achieved for the entire area.

During the years after the sampling, I have found several cairns in the area, mainly thanks to persons living in Iniö. The number of known burial cairns, including some uncertain ones, is 21. The lower limit for the confidence interval has thus been reached and probably at least a fourth of the preserved cairns of the study area have been found. Consequently, it would be a possible and realistic task to find all or nearly all preserved burial cairns in any limited area of the archipelago. – We shall later discuss the latter sampling study concerning the distribution of topographic variables.

(6) *The size of the island* was the main criterion in an archaeological survey that I executed in the area of combined activities of the Southwestern Archipelago National Park in 1994–1997. Islands with an area of at least 15 hectares were investigated, occasionally even smaller islands and skerries (Tuovinen 2000 b).

In 1983, 244 areas were investigated during the first field work period. At the beginning of the field work, a press communication was distributed to the regional bureau of the Finnish Broadcasting Company YLE and to provincial newspapers. This produced 11 contacts resulting in seven previously unknown cairns. Local contacts and interviews led to the discovery of 27 cairns, checking other pre-fieldwork information produced 14 cairns, a selection of probable burial places based on information gathered from basic maps gave another six positive cases, and the sample study resulted in six previously unknown cairns. Thus, a rise from 83 to 143 known cairns in the study area equalled to an increase of 72 per cent. During the following field work periods, the figure was roughly the same. Contacts to key persons led to the highest numbers of new finds, although the frequencies and percentages were varying.

The field studies clearly indicated the significance of the interest of the islanders in archaeology or local history when searching for archaeological sites. Personal contacts between and among professional archaeologists and non-professionals are important[69]. This is especially true of traditional extensive survey strategies in which only a minor part of the area can be examined. The popularity of publishing field archaeology and other humanistic research on the past (e.g., in the quarterly magazine *Skärgård*, published by the Åbo Akademi University) obviously supports the functioning of informal contact nets.

Whatever the criteria of selection, the number and the size of areas are, a total coverage is hardly possible. This is illustrated by the fact that the cairn 3 in Sundbergen, Nagu, was only found after the excavation was begun, although it is a cairn of almost eight meters in diameter and quite near the cairns under excavation, behind some pines growing lower on the slope. The fact that a total coverage is practically impossible to reach is well known within field archaeology (e.g., Plog *et al*. 1978). In this study, my aim has been to acquire a representative sample of islands in different land areas. There are two possible exceptions, the isle of Kimitoön, which is somewhat underrepresented, and the area of combined activities of the Southwestern Archipelago National Park, which is somewhat overrepresented. The former is, however, a target of active early field research (see chapter 2), while almost no previous field archaeology has been done in the

69. For a discussion, see Maaranen & Kirkinen 2000.

latter area, the southern outer archipelago zone. Thus the resulting effect is likely to be a counterbalancing one.

4.4.3 The survey of the area of combined activities of the Southwestern Archipelago National Park

In the Southwestern Archipelago National Park, nature conservation and cultural heritage management cooperate in a natural way, since in the Archipelago Sea – contrary to most other national parks in Finland – man has conciderably changed the nature through the exploitation of natural resources. Dry land as a result of land uplift has in many places been used as pastures, meadows, and cultivated fields from the beginning. One of the aims of the activities of the National Park, in addition to the protection of natural values, is to protect and attend to cultural heritage and monuments and to safeguard traditional ways of nature exploitation (KomM 1987:25: 18). In the development of the National Park, basic knowledge of the cultural remains of the past of the archipelago, their occurrence, context, character, and age is necessary. For this purpose, I was commissioned by the Finnish Forest and Park Service to conduct an archaeological survey in the area of combined activities of the National Park in 1994–1997[70].

There are more than 41000 islands and skerries in the Archipelago Sea. About 8400 of them belong to the area of combined activities containing, in addition to land owned by the Forest and Park Service, also private land and land in military use. The area of the National Park itself is 46000 hectares 2900 hectares of which is land (1.1.1999). Most of the landscape can be characterized as skerry zone or outer archipelago zone: 95 per cent of the area is sea. For practical reasons, it was not possible to examine all islands and skerries. Consequently, I chose islands with an area of at least 12–15 hectares and islands where the advance information, place names, or archival sources suggested that something of archaeological interest might be expected.

I investigated 235 selected islands and skerries, and explored them systematically looking for remains discernible on the surface. In regard to the altitude, almost any of the islands could, in principle, be sites of burial cairns from at least the Late Iron Age. I was especially keeping an eye on shore zones, places beneath rock cliffs and precipices, rocky terrain and boulder fields. Swamps, the thickest and the most difficult bush and juniper shrubs and areas of planted trees remained, however, at least partly univestigated (e.g., on Vänö, Högsåra and Norstö). In addition to archaeological remains, also recent man-made stone constructions, boulder fields and accumulation boulder rims were marked on the map. Altogether, 138 archaeological remains were recorded, most of them sites assumed to date from the medieval and post-medieval period. However, 37 burial cairns of the Iron Age character were also found (table 6).

70. See field reports by Tuovinen 1994–1997 (FFPS); Tuovinen 2000 b.

Fig. 23. Cairn on Kalholm, Holma, former parish of Hitis (present Dragsfjärd). From the burial place there is an open view to Lammörs fjärden, although the altitude of the site is only 17 meters. Photographed by the author 1997.

Table 6. The archaeological remains in the survey of the area of combined activities of the Southwestern Archipelago National Park in 1994–1997.

Burial cairns	37
Temporary lodgings (tomtning) or groups of lodgings	24
Cottage foundations and deserted hamlet sites	14
Remains of chapels	6
Landing stages	8
Labyrinths or groups of labyrinths	11
Rock inscriptions	11
Compass stone settings	2
Stone ovens or groups of stone ovens	15
Unclassified stone constructions	10
Total	138

The smallest known island with a cairn is Kalholm in Holma, Dragsfjärd (fig. 23) the size of which is 7 hectares. In the Early Iron Age the area of the island was about 3–5 hectares, and in the Late Iron Age 5–6 hectares. This indicates that all the cairns in the area of combined activities may not have been detected yet. Although the islands were selected on the basis of the size, the recorded cairns form, however, a representative cross section of the main part of the outer archipelago cairns. Because the survey was the first systematic expedition in the outer archipelago, the data, as mentioned above, counterbalance the spatial distribution of cairns and the outer and skerry zones are no more underrepresented to the extent they were during the past years.

A special characteristic of the outer archipelago seems to be the great number of graves in regard to the restricted land areas. 20 of the 37 burial cairns are situated in places that lay below the sea level of the Bronze Age. Consequently, only a few – if any – of the graves in the National Park date back to the Bronze Age.

4.4.4 The practical routine: finding cairns and making field notes

When trying to come across graves recorded in old field reports, one is often forced to face the fact that the past decades have inevitably won the race. At least 18 cairns documented by Volter Högman and other researchers of the older generation, have vanished. Four of them have been destroyed by road building. In the rest of the cases, the cause of demolition is not known.

Sometimes it turns out to be difficult to find again sites mentioned in old records. Usually the location of the grave was indicated inaccurately, controversially, or based on topographic fixed points previously relevant but later obsolete. In certain cases a grave in the terrain cannot be connected with sites in old reports with certainty. However, there is usually no reason to doubt the quality of old data except for positioning. There were thirty cairns which I was not able to locate again, most of them on Kimitoön.

In the first place it is an economic question to resolve indistinct locational information. In general, I gave up trying to relocate the cairn if I couldn't find it during one working day. With help from people with local knowledge the location of some graves was clarified, e.g., the cairn in Sellmo, Nagu (236), originally found by Juho Sjöros (Sjöros 1887). Several field periods of working made it possible to clarify indistinct information and to make certain corrections.

The following on-site notes were made of each cairn:

1. Position, given in the national grid coordinate system (*kkj*).
2. Accuracy of positioning in meters (as suggested by Rainio 1988).
3. A verbal description of the burial place.
4. Altitude.
5. Soil type(s).
6. A verbal description of soil and topography.
7. Vegetation.
8. Map sketch, if necessary.
9. Shape of the cairn.
10. Profile of the cairn.
11. Possible soil occurrence in the cairn.
12. Main measures of the cairn.
13. Main measures of the cairn given in older records.
14. Direction of the length axis of the cairn.
15. Structures and stone material
16. Damages of the cairn.
17. Possible uncertainty as a burial cairn.
18. History of discovery.
19. Possible earlier records, investigations, artefacts etc.

20. References.
21. Scattered finds in the vicinity.
22. Oral communications and miscellaneous notes[71].

The data were coded and saved into a database[72]. For spatial analyses, coordinates in the 27°E grid (*ykj*) were computed using a built-in FORTRAN module, based on formulae given by R.A. Hirvonen (Hirvonen 1970; Hirvonen 1972: 72–76).

4.5 The topography of burial cairns in Houtskär, Korpo and Nagu

4.5.1 Introduction

In regional archaeological studies, environmental variables – topography, hydrology, geology, vegetation and so forth – in relation to settlement, and burial or other sites are often examined as possible independent variables, factors explaining the locations of sites. This is based on the presupposition that the sites were chosen in relation to their natural environment, and that the sites were assumed to be chosen freely, without any social or territorial limitations, without any preceding history. In settlement prehistory, this presupposition may hold in special conditions: in taking possession of wilderness to practice a new subsistence strategy, during climatic or topographic changes (e.g., deglaciation or shore displacement), or in other similar situations. However, we cannot overlook in general the likelihood that the locations of new dwelling sites may be influenced by the locations of older existing dwelling sites. Because of the cultural meanings of burial sites, it was not unimportant, either, where the graves of the older generations were located.

The varying locations of sites and the significance of the natural environment in this variation is a problem which thus presupposes sufficient knowledge of the ages of the sites. On the other hand, monitoring of the distributions of environmental variables in the entire natural environment of archaeological sites is also necessary. We have to find out where the sites are located as well as where they *cannot* be found (at least as current customary research techniques are used). Probably the total network of the sites can very rarely be recovered and thus, in practice, it is a question of acquiring a representative sample of sites and non-sites. In the following, we will compare known sites with randomly selected places, the latter of which reflect the distributions of environmental variables. The scrutiny concerns morphometrical variables which here are called *terrain variables* whose values can be derived from the altitudes of the locations.

The comparison is based on previous case studies. For instance, on the East Coast of the USA, Douglas Kellogg (1987) compared distances from shell-middens and randomly selected sites with mollusc habitats and water sources. Kenneth Kvamme (1992) analyzed the locations of agave cultivations using a digital elevation model. Herbert Maschner and

71. For a further description of practical routines, see Vuorinen 2000 c.
72. Part of the structure of the database called TYARKTIKA, written by me in 1988, has been presented by Juha-Matti Vuorinen (2000a: 194). See also Salo *et al*. 1992.

Jeffrey Stein (1995) performed a logistic regression in modelling site location, using randomly selected places as a reference set.

Using a randomly selected reference set, we can obtain morphometric characteristics differentiating burial sites from randomly selected places. What constitutes those possible differences? Are there any morphometric differences not directly originating from shore displacement or not detectable by mere visual examination of maps? Were there any signs suggesting that the cairns were built near the shore zone of the building period? If so, the altitude of the burial place could be an indication of the age of the grave. Furthermore, are the grave sites located in relation to each other differently than those chosen randomly?

Because the reference set was generated by randomizing positions, some differences between the groups can be regarded as expected. Since the oldest cairns were erected more than 3000 years ago, land uplift has had time to lift the oldest burial places 15–20 meters upwards. As a logical consequence, burial places are likely to be situated on the average higher than random locations. Another effect of land uplift is that early burial sites are likely to be stochastically on higher elevations than more recent burial sites.

4.5.1.1 The field work

A relatively great number of cairns were discovered in the target area of the sampling study. In the area, the inner and outer archipelago zones are represented. The area contains a large part of the parish of Houtskär, the main island of Korpo and its SW archipelago, the western part of Storlandet, Nagu, and the southern isles of Nagu, extending in the south as far out as Nötö (fig. 24). The area (929 km^2) covers 15 % of the total research area.

64 cairns have been discovered in the target area, in other words 17 % of all the cairns in Åboland. 12 of the graves form a group forming the Iron Age cemetery of Furunabb, Houtskär. Here the cairns – excluding the largest one – remind greatly of each other, and are situated at a distance of a few meters from each other. This clustering is an obvious cause of spatial autocorrelation and interdependence of cases in sampling (e.g. Liedes & Manninen 1975: 13–17). One possibility to avoid this effect would be to calculate the mean value for each terrain variable and treat the cemetery as one grave. However, I think it is more consistent with the data to reduce the weight of the cemetery in the data by excluding some graves which are very close to each other. Thus, four randomly selected graves in Furunabb were excluded. The number of remaining burial places was 60.

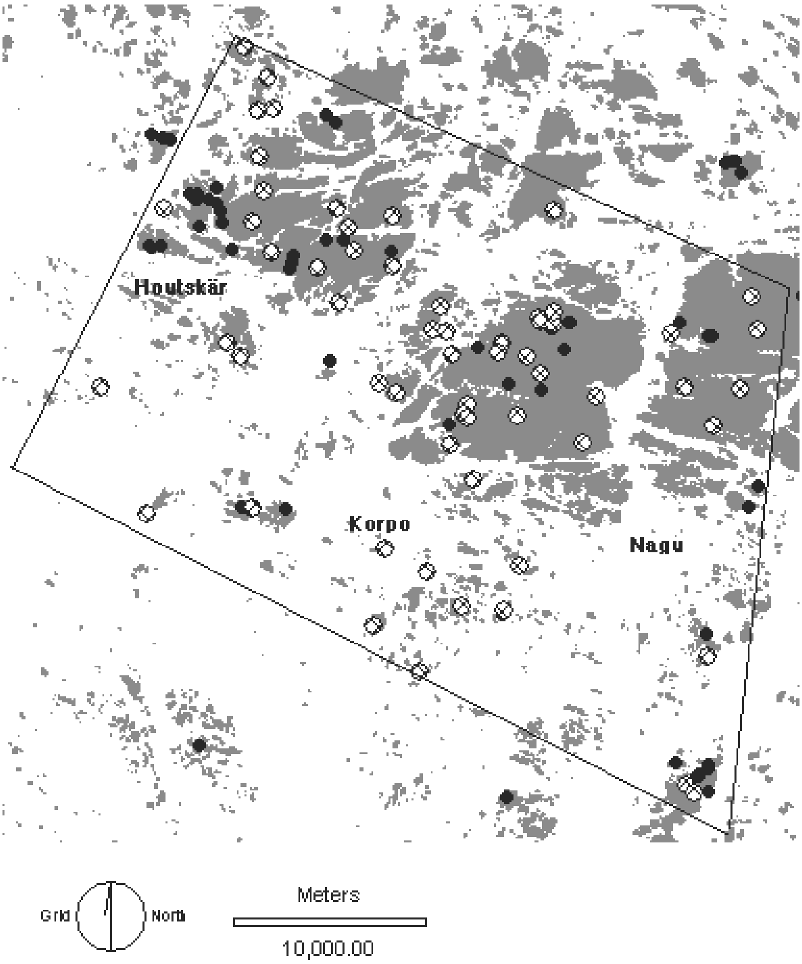

Fig. 24. The target area, the known burial cairns (filled dots) and the reference set (cross-hatched dots). © The National Board of Survey (MAR/103/98).

The reference set was chosen using stratified simple random sampling (Haggett *et al.* 1977: 270–273) so that 15 of the locations were located in the outer zone and the rest in the inner zone. The stratification ensures the outer archipelago zone to be represented in the sample roughly in proportion to the cairns discovered previously. Otherwise the probability of any site in the outer zone to be chosen into the sample would have been rather small because the land areas in the outer archipelago are small. Any random pair of coordinates was accepted, provided that, theoretically, a cairn could have been erected in the place determined by the coordinates. The place had to be located at least 5 meters above sea level, and sites located in water, bog, cultivated land or on steep slopes were excluded.

To maintain a reasonable precision of the sample, the size of the sampling unit was kept relatively small (Plog 1976; Plog *et al.* 1978; Read 1975; Schiffer *et al.* 1978). A radius of 400 m was drawn around each point. The areas falling within the radius were examined for the possible occurrence of burial cairns. No previously unknown graves were found, but one previously known cairn, on Bussö in Korpo (349) happened to fall inside one of the areas of the reference set.

4.5.2 The digital elevation model

The comparison of the burial places with the reference set is based on terrain variables derived from a digital elevation model (DEM) developed by the Finnish National Board of Survey. The DEM is a file of altitude points, interpolated from the height contours and shore lines of the Finnish basic map and recalculated to a network of rectangular cells representing altitudes. The resolution of the model is 25 meters. Altitudes are given at a numerical precision of one decimeter.

On average, the standard error of the altitudes of the DEM is 1.76 m. Of the 90 map sheets acquired for this study, 30 sheets are reported to give a better accuracy than the average value of the country. While examining the material, it is indeed evident that in many cases the altitudes given by the DEM differ from those locally measured. These differences cannot, however, be explained merely by the standard errors of the DEM. Firstly, the altitudes of the DEM do not necessarily denote the same pieces of land surface as the known altitudes. The DEM altitudes represent the average values of the cells while the known altitudes of burial places represent points, either levelled on-site or estimated from the basic map. Secondly, the location of each burial place was determined on the map. Thus, an inaccuracy of graphical origin is involved in the location of each burial place, roughly amounting to the 25 meter side of the cells of the DEM. The correct cell of the DEM does not always coincide with the known location of the burial place. Especially on precipitous slopes the inaccuracy may cause distortion in the relation between the burial place and the cell. However, a detailed look at the data gives the overall picture that the inaccuracies are of minor practical significance. To eliminate the inaccuracies discussed above it is evidently recommendable to use GPS positioning in the future (Ollikainen 1997; Poutanen 1998: 202–204). This applies particularly to emphasizing the sensitive changes in visibility when walking in the terrain (see Tilley 1994).

It is in any case worth while to state a few words about the possible systematic differences between corresponding altitudes obtained from different sources. Table 7 gives statistics on the differences between on-site measured altitudes and corresponding altitudes derived from the DEM, using different measuring methods. Individual height levels may differ distinctly from each other, but the differences are distributed both above and below zero. The differences between altitudes derived from the basic map and from the DEM are relative small on average. The altitudes measured using levelling instruments or aneroids indicate more systematic differences. This may be due to the fact that a saddle point was often chosen when a cairn was erected.

Table 7. Sampling area of Houtskär, Korpo and Nagu. Differences between on-site measurements of altitudes of burial sites and altitudes derived from corresponding cells in the DEM.

Determination of altitude	n	Smallest difference	Greatest difference	Mean of differences	Standard deviation of differences
Examined from basic map	43	-3.8	6.5	0.40	2.24
Spirit levelling	15	-2.5	5.1	1.63	2.22
Barometric levelling	2	0.3	3.2	1.75	2.05
Total	60	-3.8	6.5	0.75	2.27

In practice, the deviations of altitudes affect most conspicuously the cairns located at low heights above sea level. For instance, the altitude given by the DEM for the burial place on Hummelskär, Korpo, is only 4.9 m, whereas the value obtained by using a spirit level was 8.4 meters. The grave of Kistkär, Österskär, Korpo, one of the outermost burial sites in the archipelago, is according to the DEM situated in a cell with a given altitude of 5.7 meters, whereas the altitude obtained from the on-site measurement was 7.5 meters. When shore zone datings are determined for low-altitude Iron Age graves, an error of this magnitude is significant. For this reason, the altitudes of burial places near the shore were determined using a spirit level or an aneroid. In higher terrain, some distance away from the shore, the DEM errors do not have the same significance for shore zone datings, since there the cairns were obviously not built near the shore. Furthermore, the point errors are smoothed when large areas are covered by the model. In the following discussion, I will use DEM altitudes in analyses based on GIS techniques, and on-site measurements in the determinations of shore zone datings.

4.5.3 The distributions of the terrain variables

4.5.3.1 The variables

In the comparison between burial places and random locations, ten morphometric variables are used. Variables such as altitude, height difference in relation to summits, relative altitude, slope, and sum of distances to the nearest neighbours are calculated by comparing the burial site with its topographic surroundings. Other variables are derived from the area around the burial place. The area is defined by a circular window opened in the DEM, with a radius of 500 meters, and with the burial place as the centre (1245 cells). The latter variables are mean altitude, median altitude, standard deviation of altitude, quartile range of altitude and relative proportion of sea area.

To determine the values of the terrain variables, the DEM has to be overlaid with the points representing burial cairns and random locations, the distances between the points have to be calculated and each cell has to be compared with its surroundings using different neighbour functions. These tasks were performed mainly using the Idrisi and

BMDP softwares (Eastman 1997; Dixon 1992). The distances were computed using the NEIG module by Keith W. Kintigh (Kintigh 1987; Kintigh 1992: 41–46).

The values were determined as follows:

1. The *altitude* is the value of the cell in the DEM.
2. The *height difference in relation to summits* equals to the highest altitude within 500 meters subtracted by the altitude of the cell.
3. The *relative altitude* is obtained by extracting, using the cumulative frequency distribution, the relative proportion of the cells with an altitude lower than or equal to the cell in the middle of the circular window.
4. The *slope* can be determined from the DEM by comparing the altitude of each cell with the altitudes in the nearest adjacent cells on the north, south, west, and east sides. The slope indicates the most precipitous slope near the observation point. The slope may obtain a high numerical value, if there is a precipice in the neighbourhood, even if the cell in the center of the circle is on an even ground. The slope cannot directly be interpreted as a slope of the basal surface under the cairn, although that is sometimes the case. The accuracy of the slope depends on the resolution of the DEM and the local topography (Chang & Tsai 1991). Usually the calculated slope is smaller than or equal to the actual slope (Guzzetti & Reichenbach 1994: 59).
5. The *sum of distances to the nearest neighbours* indicates how close the five closest neighbouring burial sites or, respectively, the random places are located. It is defined as the sum of the distances, each of them weighted with the inverse of the square root of the distance

$$n_d = \sum_{j=1}^{5} \frac{1}{\sqrt{d_j + 1}}$$

where *dj* denotes the distances to the *j*:th closest neighbour. Due to the graphical inaccuracy involved in estimating the coordinates of the burial site from the map, apparent zero distances may occur. They are eliminated by adding one meter to each distance.

For the five nearest neighbours, $0 < n_d \leq 5$. The closer to each other the neighbours are located, the greater is the value of the sum of distances. The further away the *j*:th neighbour is from the observation point, in relation to which the distance is measured, the less the neighbour affects the value of the sum. The square roots of the divisors are taken, since otherwise neighbours situated a little further away would not have any significant effect on the value of the variable.

6. 6. The *mean altitude* is given by the mean of the non-zero altitudes of the cells inside the window. The sea surface is thus excluded, since the result of including the sea level in the calculation would reflect rather the amount of sea around the burial place than the actual mean altitude of the terrain.
7. The *median altitude* is given by the median of the non-zero altitudes of the cells inside the window.
8. The *standard deviation* of altitude is given by the standard deviation of the non-zero altitudes of the cells inside the window.
9. The *quartile range of altitude* is given by the quartile range of the non-zero altitudes of the cells inside the window.

10. The *relative proportion of sea* area indicates the percentage of cells inside the window with altitudes equalling zero.

4.5.3.2 The differences of the distributions

The statistics for the distributions of the terrain variables are listed in tables 8 and 9. The locations of the distributions are compared using the Mann-Whitney U-test, completed with Kolmogorov-Smirnov tests for the equality of the location, variation, and shape of distributions. In the latter, the test statistic *D* is equal to the greatest difference between the two cumulative functions to be compared (Conover 1980).

The *altitude*. The burial sites are located on average 7 meters higher than the places of the reference set. The altitudes of the burial sites show a greater variation, too. The differences are statistically significant. At least partly the difference is a logical consequence of the age of the earliest graves: when they were built, the land surface was at least 15 meters higher at present. Contrary to Iron Age burial sites or randomly selected places, the earliest graves cannot be located at low altitudes. However, even a preliminary look at the topography indicates that the differences of altitudes are also partly due to the choice of location of the burial places, the gravebuilder's inclination to choose high places in the terrain. The cairns were, thus, often built on land which had risen from the sea long before the building work. If we applied the shore displacement chronology in an uncritical way in order to date the burial places according to their altitude, we would, of course, end up with too high age estimates. This is evident especially for the classical *hiidenkiuas* graves that were often erected on tops of rocks. Reversely: *on an average, the cairns are later than the age suggested by a superficial look at the topography.*

Table 8. Comparison of the burial sites and the reference set (the means, the standard deviations, the greatest values, and the smallest value for all variables).

Variable	Burial places, *n* = 60				Reference set, *n* = 60			
	Mean	Sd	Max value	Min value	Mean	Sd	Max value	Min value
Altitude (m)	20.335	8.298	38.8	4.9	13.657	6.326	32.3	6.1
Height difference in relation to summits (m)	7.837	6.508	22.1	0.0	11.388	6.242	27.0	0.5
Relative altitude (%)	77.497	24.051	100.0	27.5	70.737	20.166	99.1	16.9
Mean altitude (m)	13.030	4.379	24.869	3.935	10.617	4.551	21.190	3.794
Median altitude (m)	12.680	4.838	25.0	3.7	9.908	4.752	21.3	3.0
Sd of altitude (m)	6.081	1.384	8.8790	2.321	5.312	1.817	10.882	2.404
Quartile range of altitude (m)	4.485	1.350	8.050	1.900	3.903	1.638	8.975	1.700
Relative proportion of sea area (%)	24.173	21.468	93.3	0.0	32.070	32.460	95.8	0.0
Slope (°)	3.754	2.621	12.311	0.115	5.241	3.523	18.783	0.115
Sum of distances to nearest neighbours	0.3004	0.3023	1.1409	0.0471	0.1001	0.0275	0.1724	0.0548

Table 9. The significance levels α of the differences between the terrain variables of the burial cairns and the reference set. The two-tailed Mann-Whitney's U statistic and the two-tailed Kolmogorov-Smirnov's D statistic.

Variable	Mann-Whitney's *U*	a	Kolmogorov-Smirnov's *D*	a
Altitude	2666.5	0.000	0.383	0.000
Height difference in relation to summits	1259.5	0.005	0.300	0.009
Relative altitude	2284.5	0.011	0.267	0.028
Mean altitude	2354.0	0.004	0.283	0.016
Median altitude	2384.0	0.002	0.300	0.009
Sd of altitude	2343.5	0.004	0.350	0.001
Quartile range of altitude	2311.0	0.007	0.367	0.001
Relative proportion of sea area	1700.0	0.597	0.250	0.047
Slope	1309.0	0.010	0.267	0.028
Sum of distances to nearest neighbours	2906.0	0.000	0.600	0.000

Height difference in relation to summits. This difference is statistically significantly smaller for the burial sites – almost 4 meters – than for the reference set. The height difference distribution of the burial sites is clearly more weighted towards small altitude differences than the distribution of the reference set. Five of the burial sites are the highest hill tops within 500 meters and 14 burial places are no more than 1.2 meters lower than the highest summits. The cairns were typically placed in the summit areas of rocks but not, however, necessarily on the highest points.

Relative altitude. The relative altitude of the burial places is on average almost 7 % higher than in the reference set. The Mann-Whitney statistic is significant. The distribution for the burial places is weighted towards great numerical values: five cells contain the full value of 100 per cent, and in 19 cells the relative altitude is at least 95 %.

The differences for *slope* are significant as well, since on burial sites the land surface inclines on average 1.5 degrees less than in the reference set. The variation for the burial sites is also less than for the reference set. Burial sites can thus be characterized as horizontal surfaces not quite near slopes or steeps. The basal surface under the cairn seems to be rather regularly horizontal. The burial site of Storskogen, Korpo, has the highest value of slope, 12 degrees. The high value is caused by a precipice close by on the NW side of the grave. The basal surface under the cairn does not incline steeply.

The *sum of distances to nearest neighbours* has small numerical values and a positively skew distribution in both groups. This is due to the fact that in the archipelago dry land is split up into islands where the places belonging to the samples lie in clusters separated by stretches of sea. However, for the burial places, the sum of distances on average as well as its variation are significantly greater than in the reference set, which indicates that burial places tend to be located near each other. We may conclude that at the time when graves were built, the presence of existing graves on the site was culturally significant.

The *mean altitude* of the landscape around the burial places is significantly greater (2.4 meters greater) than the corresponding statistic of the reference set. The variation of the naighbouring topography is significantly greater for burial places. The differences characterize burial places on rocky highlands in contrast to lower moraines and fine sediment lands.

The *relative proportions of sea area* do not on average diverge significantly from each other. There is, however, a significant difference in the shapes of the distributions. The distributions are skewed towards zero because especially in many locations of the reference set there is no sea at all within the window. Twelve of the burial sites have a proportion of three percent or less while the corresponding number for the reference set is 23.

The summary may be: *the cairns are situated on rock uplands varying greatly in altitude but on the average on high lying places, often in the summit areas, high compared with the adjacent area, on horizontal or little inclining surfaces, often near each other, and near the sea.* The fairly high terrain typical of burial sites can already be observed in an overall survey of the maps; the position is also in relation to shore displacement. Without a systematic scrutiny, it is often difficult to discover that the burial sites are mostly plane terrain and that, nevertheless, they are not primarily among the highest spots in the neighbouring district, and that they are situated in places near the sea with, presumably, visibility to the sea.

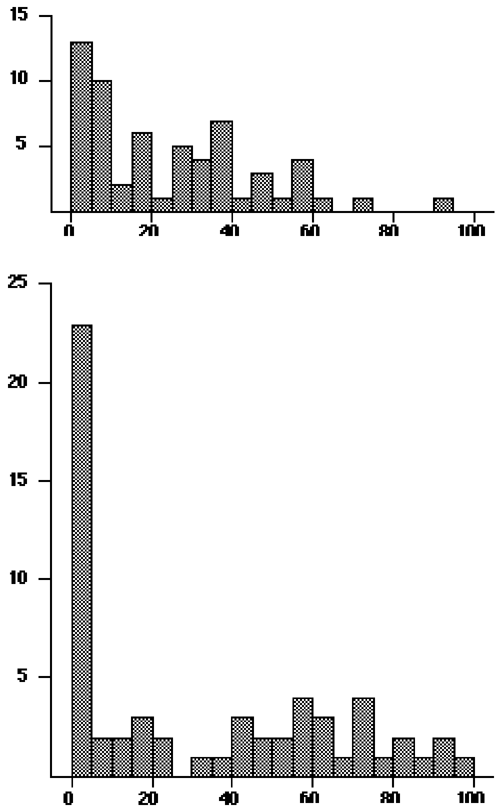

Fig. 25. The relative proportion (%) of the sea area of the window for the burial sites (upper) and the reference set (lower).

The visibility to the sea from the burial site seems to have belonged to the criteria of site choice. Land uplift has, however, weakened the visibility to the sea, and a closer investigation requires dating of the cairns and an analysis of changes of views caused by shore displacement. Visibility to the sea does not imply any certain topographic relation between the burial site and the shore zone at the time when the graves were built; actually there is a certain variety to be found concerning this relation. Some cairns situated on a low level suggest, however, that, at their time, they must have been constructed near the shore zone. The most distinct example of this is the cairn at Djupklevudden (364), Korpo, on a rock rising from the shore to the height of 6.4 m from sea level.

4.6 The boulder studies

4.6.1 The mass of stones and boulders

In the excavations included in this study, the constructing material of the burial cairns was investigated. Observations were made of the mass distribution of stones and boulders weighing at least about 0.5 kg, of the quality and roundness of the stones as well as of the soil filling of the cairn (Sundbergen, Ängesnäs bergen).

The calculation of the total mass of the stone setting gives a possibility to estimate how exactly the actual size of the stone setting can be given by measuring its length, width and height with a measuring tape. When examining the scatter plot (figure 26), it becomes apparent that the tape measurements predict the total mass of the stone setting with reasonable reliability excluding the Lilla Kuusis burial cairn in Nagu, whose mass is smaller than that predicted on the basis of the measures. The cairn, indeed, is a shallow stone setting following the rock surface with stones smaller than on average. In any case, the comparison creates confidence in simple tape measuring as a sensible way of determining the size of the cairn if the borders of the stone setting can be reliably determined.

The mass of stones and boulders has a positively skew distribution. More than half of the stones and boulders weigh less than 10 kg (figure 26, table 10). The largest boulders in the cairns were approximately ten times larger than the average. If all the stones under 0.5 kg had been weighed, the distributions would have been even skewer. This signifies that most of the total mass of the burial cairns was composed of small stones – and not of large boulders dominating the outer appearance of the stone setting and giving the visual impression of the average size of the boulders. The boulders and large stones have probably also in a way concentrated on the surface of the stone setting because small stones are prone to run inside the stone setting through gaps between the boulders. In this way, small stones have disappeared, even if some of them had originally lain on the surface layer of the stone covering.

The dislocation of small stones was verified in the excavations of the Sundbergen cairn, Nagu. In the stone filling under the surface layer, there were small stones which had been wedged in between boulders and larger stones. When the boulders were stirred by excavators, the small stones fell or ran deeper. An observation close to this was reported by Tapio Seger from Furunabb, Houtskär, during his excavation in the year 1986. As an explanation we could assume that stones of different sizes have been thrown on the cairn in random sequences, with some small stones remaining on the surface and, later on, falling inside the stone setting. It is also possible that small stones have been used deliberately to fill up the gaps between the boulders and to even the surface. In the latter case, the stone setting would originally have seemed more even than in its present appearance.

By comparing the measures of the excavated cairns with the distribution of non-excavated cairns (figure 26), we can conclude that the Östergård cairn 2 is a small-sized cairn and, on the other hand, the Sundbergen 1 and Ängesnäs bergen respectively medium-sized ones. Accordingly it can be preliminarily estimated that, in a small stone setting, there are about 200–500 stones and boulders weighing about 1–5 tons, and, in a medium-sized cairn about 600–2000 boulders with a total mass of about 6–15 tons; this estimation is naturally based on the condition that only stones weighing at least 0.5 kg are taken into account, and that the stone setting is not too low.

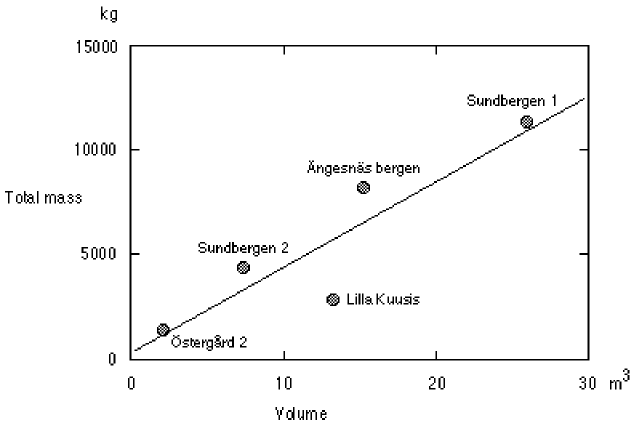

Fig. 26. The tape measures and the total mass of the cairn for stones and boulders weighing at least 0.5 kg. The regression line $m = 331.7 + 410.1v$, in which m is the mass (kg) and v (volume) is the product of the length, breadth and height (m^3).

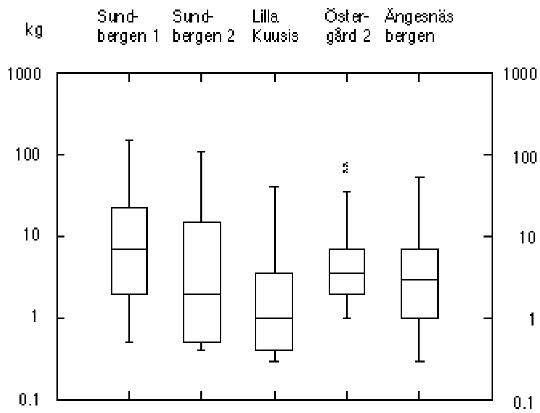

Fig. 27. Boxplot of the masses of stones and boulders of five burial cairns. (1. Sundbergen 1, 2. Sundbergen 2, 3. Lilla Kuusis, 4. Östergård 2, 5. Ängesnäs bergen).

Table 10. The masses of stones and boulders of five burial cairns.

Cairn	Total mass kg	Greatest boulder	Mean	Sd	Median	Quartile range	Skewness	n
Sundbergen 1	11300	150	14.7	18.2	7.0	10.0	2.1	768
Sundbergen 2	4340	106	9.5	13.6	2.0	7.3	2.2	458
Lilla Kuusis	2777	40	3.6	6.3	1.0	1.6	2.8	774
Östergård 2	1385	72	6.6	9.0	3.5	2.5	3.7	210
Ängesnäs bergen	8202	52	5.5	7.4	3.0	3.0	2.7	1497
Total	28002	150	7.6	11.9	2.5	4.0	3.18	3707

4.6.2 The rocks

In South Ostrobothnia and in Satakunta, red sandstone has been reported to occur in places as the covering layer of the cairns (Miettinen 1980; 1986; Salo 1987), or as a construction material dominating the entire stone setting (Kuokkanen & Korkeakoski-Väisänen 1985), which gives the cairn a reddish shade. According to Unto Salo, the sandstone-coated cairns date back to the Pre-Roman and Early Roman Iron Age.

In the archipelago of Åboland, sandstone also occurs in cairns. The most distinct example is the low stone setting on Ådön, Nagu (366). It has been constructed of mainly rounded stones and boulders (about 0–40 kg), among which there are approximately 30 sandstone slabs, while the total amount of boulders in the setting may be about 300–500 pieces. South of the highest top of Ådön, there is a boulder field on whose surface the proportion of sandstone is approximately one per cent. The rest of the stone material is consists mainly of granite, mica gneiss, and granodiorite. The choice of sandstone for the cairn setting seems thus obvious. Another burial cairn containing sandstone is on the boundary between the villages Bendby and Syvälax, Korpo (202); almost all the edged boulders in the setting are red sandstone.

In the excavations at Sundbergen, Nagu, the conditions seemed to be good to find out whether one or some types of rock or mineral had especially been favoured because of colour, glitter or some other physical quality. Particularly we had in mind the possible symbolic meanings of the red colour of rock (Wasilewska 1992; Kaliff 1997: 57, 108; Jones & Bradley 1999; cf. Carlie 2000). Of all the weighed stones and boulders, the type of rock was determined with the greatest accuracy possible in the field, in certain cases verified with a microscope. The determination often requires the stone to be broken in order to expose fracture surfaces. For comparison, a sample of one hundred boulders of the local moraine was taken on the NE slope of the Sundbergen.

The rock on which the burial cairns were built, is composed of granodiorite in its northern part and reddish microcline granite in the southern part. The local common rock types are represented in the samples: granodiorite, migmatite compounds, different kinds of gneiss, pegmatite, and especially microcline granite. The quartz-feldspar gneiss zone running along the southern side of the main islands of Nagu and Korpo, can be seen in the burial cairn samples, not, however, in the reference sample. In the granite samples, granodiorite contacts occur, indicating that the stones are likely to originate from the adjacent terrain.

The burial cairn 1 was built on a granodiorite surface. In the rock type distribution, the main rock is granite, and the proportions of the common rock types are much the same as in the reference sample. The occurrence of rarer rocks – such as amphibolite, quartz-feldspar porphyry, aplite, alkaline vulcanite, rapakivi granite, diorite, gabbro and diopside gneiss – is probably due to the sample size which was larger than in the other specimens because the rock types mentioned do not greatly differ in appearance from the main rock types, apart from weathering granite, dark amphibolite, and diorite-gabbro. In the lowest layer of the cairn, an unworked piece of granite with unusually bright and sparkling muscovite crystals was found. It is conceivable that the ornamental stone was chosen deliberately.

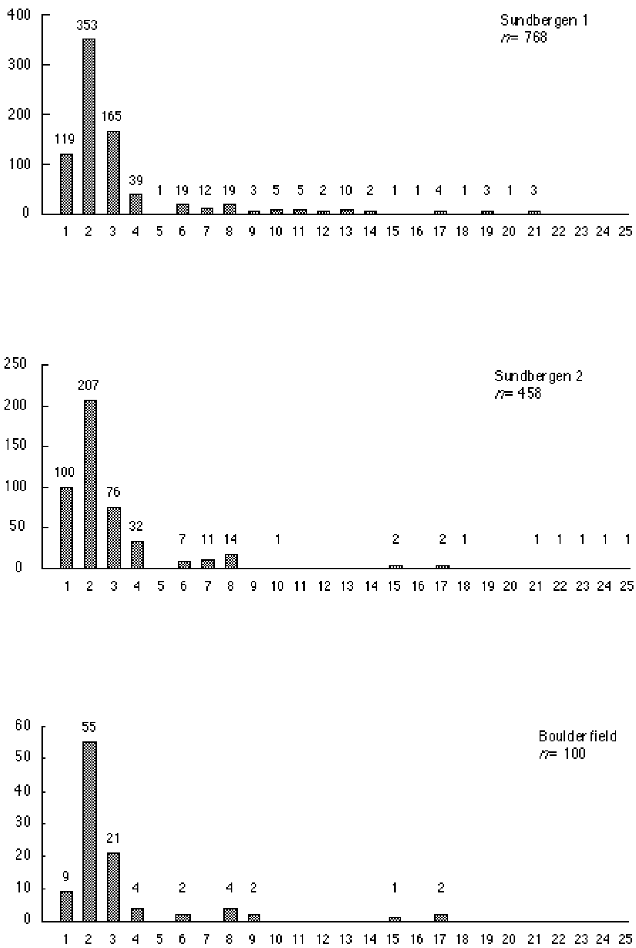

Fig. 28. The rocks of the Sundbergen 1 and 2 burial cairns and the sample from a boulder field.

The frequencies of the rocks were plotted in figure 28. The rocks were classified as follows:

1. Granodiorite, quartzdiorite, trondhjemite
2. Granite
3. Migmatite
4. Mica gneiss
5. Uralite porphyrite
6. Pegmatite
7. Quartz-feldspar gneiss (leptite)
8. Sandstone
9. Diabase
10. Amphibolite
11. Quartz
12. Quartz-feldspar porphyry
13. Aplite
14. Alkaline vulcanite
15. Quartzite
16. Rapakivi granite
17. Biotite-plagioclase schist
18. Porphyry granite
19. Diorite and gabbro
20. Diopside gneiss
21. Hornblende gneiss
22. Hornblende pegmatite
23. Porphyry granodiorite
24. *K*-feldspar
25. Limestone

The basal surface under the burial cairn 2 consists of granodiorite, with granite veins. Among the stones, granodiorite is also relatively common, even though granite is the main type. Many of the rare rock types in the cairn 1 are not present, instead hornblende pegmatite, porphyry granodiorite, *k*-feldspar, and limestone were found. In hornblende pegmatite, hornblende is seen as large scattered granules together with feldspar; in porphyry granodiorite, large *k*-feldspar granules were found respectively. Pure *k*-feldspar occurs in large crystals, which may have been split off from pegmatite. Hornblende pegmatite, porphyry granodiorite, and *k*-feldspar thus occur sometimes in separate pieces with a special appearance, and it is possible that they have been chosen in the burial cairn for their very appearance.

The reference sample, however, did not present unambiguous reference as to the choice of rock type. Jotun sandstone occurred both in the burial cairn and in the comparison sample in a fairly ample amount but it was not overrepresented in the burial cairns. However, a deliberate choice is suggested by the fact that dark and sparkling stones have been brought into the burial cairns to the extent that there are clearly more of them in the cairns than in the boulder field.

The rock type distributions suggest that the stones and boulders of the cairns have been picked from a bare-washed stone field in the adjacent terrain, possibly on the shore, preferring stones of a special appearance. The burial cairn 2, whose lateral and basal surfaces are of granodiorite, contains more granodiorite than the cairn 1, which is surrounded by surfaces dominated by granite. This fact implies that part of the construction material of the cairns originates from the stones and boulders in the very closest neighbourhood, distracted from the rock surface by scaling or exfoliation. Possibly these boulders have been used first and the rest have been retrieved from boulder fields and shores farther away. On the top of Sundbergen, there are, indeed, very few scattered boulders lying on the ground.

4.6.3 The roundness of the stones and boulders

4.6.3.1 Roundness score

Stones and boulders transported by the continental glacier have been washed off from the smooth-worn rocks and especially from their tops at the latest when the tops have emerged out of the sea to be exposed to the effects of the waves and ice. The boulders lying scattered on the top areas have been formed by exfoliation and scaling from the exposed rock surface and no natural forces have been able to round their edges (King & Hirst 1964: 19–29). Thus, by means of the roundness and its distribution on the boulders their origin can, depending on the terrain, be examined to some extent.

The *roundness score* of the stones and boulders was determined by the eye using a five-step scale when they were weighed. The roundness score is based on the roundness scale by Powers (Powers 1953; Shackley 1975: 47–49). The score 1 equals a piece with no wearing signs on the edges, and the score 5 a piece with worn edges, approaching a round or rotation-elliptical piece. The roundness of partly broken stones was estimated according to the assumed original form. Estimation by the eye is dependent on the estimator and uses the same estimation scale for rock types different from each other as to their breaking and wearing qualities. On account of this, the roundness score has to be regarded as semi-quantitative, and the scores of its distribution as approximate.

The roundness score distributions indicate that the burial cairns consist of mixed material – unlike the natural stone fields. This suggests that all the construction material on the site has been made use of, including both edged material split off the surface of the rock, and more or less rounded material of the washed shore zones. The mean values of the roundness scores are close to each other, yet the shape of the distributions varies (table 11, figure 29). The cumulative frequency curve in the Sundbergen 2 burial cairn, Nagu, is not steep, which means that boulders of different grades of roundness are evenly represented. The difference in relation to the Sundbergen cairn 1 curve is distinct and verifiable by field observations: the stones and boulders in the latter were mainly rounded.

Table 11. The frequencies of the roundness scores 1...5 of stones and boulders weighing at least 0.5 kg in the excavated burial cairns.

Grave	1	2	3	4	5	n	Mean	Sd	Skewness
Sundbergen 1	66	82	135	166	319	768	3.77	1.32	-0.75
Sundbergen 2	84	53	126	103	92	458	3.14	1.36	-0.22
Lilla Kuusis	22	110	312	318	8	770	3.23	0.81	-0.66
Östergård 2	3	13	41	100	53	210	3.89	0.90	-0.76
Ängesnäs bergen	52	244	701	460	40	1497	3.13	0.84	-0.33
Total	227	502	1315	1147	512	3703	3.33	1.07	-0.30

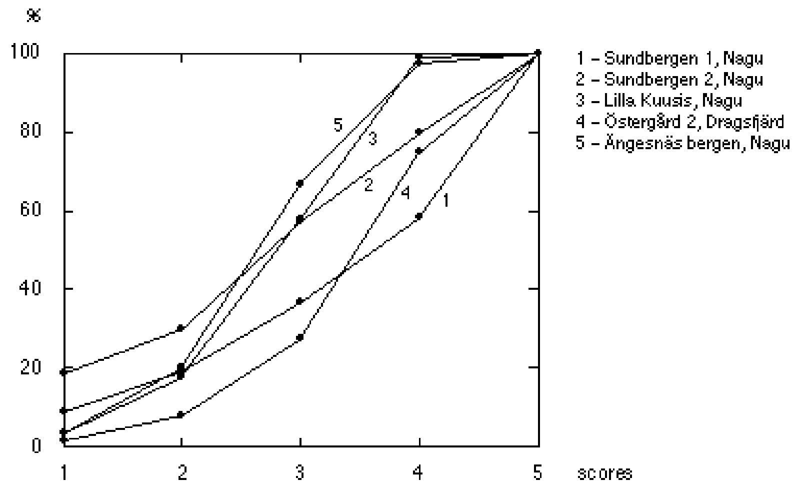

Fig. 29. The relative cumulative frequencies of the roundness scores in the excavated burial cairns.

4.6.3.2 Roundness proportion

When the roundness scores of the stones and boulders cannot be assessed, the *roundness proportion* can, however, be estimated, that is, the relative proportion of rounded material among the stones visible in the cairn. I estimated the roundness proportion of each cairn visually. The estimation scale consists of seven steps: the score 1 equals a stone setting with edged boulders only, the middle score 4 denotes a stone setting with roughly equal amounts of edged and rounded boulders and the score 7 refers to a stone setting constructed of rounded boulders only. The aim in estimating the roundness proportion is to investigate the origin of the construction material when the boulders are being compared with the natural ground in the adjacent surroundings.

Table 12. Observations on the soil under the burial cairn and its vicinity.

Outcrop	227
Outcrop with adjacent moraine, boulder field, fine sediments, gravel and/or marsh	93
Moraine	3
Moraine with adjacent outcrop, boulder field, fine sediments, gravel and/or marsh	20
Boulder field, raised shore formation	4
Gravel- and sand layer or -formation	15
Gravel- and sand layer or -formation with adjacent outcrop and/or boulder field	5
Mineral soil not defined accurately	5
Total	372

Table 13. The distribution of the roundness proportion of boulders in cairns built on a rock and on soil.

Roundness proportion	1–3	4–5	6–7	Total
Rock	21	229	52	302
Soil	0	22	21	43
Total	21	251	73	345

The soil under the cairn and in its vicinity was classified on the basis of the field observations (table 12). More than 200 cairns are situated on an outcrop with the near terrain lacking a soil cover, and more than 90 cairns in a rocky terrain with mineral soil or marsh nearby. The rest of the cairns have been constructed on a mineral ground, usually in a moraine terrain between rocky highlands. Four cairns only – i.e. only one per cent of the 372 cairns – have been constructed on raised shore formations, with boulders readily at hand. Thus, it may be concluded that the burial places were not selected according to availability of stones and boulders. Furthermore, there are 20 cairns on gravel and sand formations, mostly ridges or ice-marginal formations belonging to Salpausselkä III.

To allow tabulation and to test the significance of the association between the roundness proportion and the soil, table 13 presents the roundness proportion scores in three categories, and the soil around the cairn in two categories. The total number is smaller than in table 12, because the roundness proportion of all the cairns could not be estimated due to the vegetation. Of the cairns constructed on a rock, three fourths are of mixed material brought to the cairn from different places on the rock, and from a lower terrain. In the other burial cairns rounded stones dominate. In the chi-square test of independence, $\chi 2 = 23.922$ with two degrees of freedom, whereat the significance level $\alpha = 0.000$. The difference in the roundness proportions is thus statistically significant.

The difference between the roundness proportion on rocks and elsewhere is concretized by the fact that, among the cairns built on soil there are none consisting totally or predominantly of edged boulders. This supports the idea that when a cairn was constructed, the stones in the adjacent surroundings were collected at first, whereat plenty of edged stones scaled from the surface of the rock were carried into cairns located on rock outcrops while cairns placed on soil were filled with relatively more rounded stones, originating from glacial and shore processes.

The field observations of the roundness proportion also allow another type of scrutiny. Let us assume that a burial cairn was constructed on the top of a rock. At first, scattered boulders were searched from the adjacent surroundings, and when they got depleted, further stones and boulders were collected in the lower terrain, and perhaps on the shore. The boulders fetched from the lower terrain are probably more rounded on an average than those collected from areas higher up. The larger the stone setting to be constructed the bigger the amount of rounded stones. If the top of the rock was not exceptionally extensive, we can assume further that a large burial cairn contains relatively more rounded boulders than a small one.

We can examine this hypothesis by examining the possible connection between the size of the cairn and the roundness proportion in the cairns built on a rock. May the measuring unit of the size of the cairn be the volume of the smallest hexahedron that the cairn would fit in – that is to say the product of the length, breadth and height in cubic meters. The volumes of the cairns vary from 0.9 m^3 to 640 m^3. Table 14 presents the distribution of the roundness proportion in cairns of different sizes classified in the categories those under 12 m^3, 12–75 m^3, and those over 75 m^3. A comparison of the empirical frequencies with expected frequencies indicates that there are plenty of small-sized cairns constructed of edged material and large ones constructed of mixed material. Instead, in the group of the largest cairns, there are fewer cairns than expected constructed of exclusively or almost exclusively rounded material. In the contingency table χ^2 = 11.238 with the degrees of freedom $df = 4$, whereat the significance level $\alpha = 0.024$, and the association is statistically significant. Accordingly, the material supports the idea of the construction material having been collected from the adjacent terrain.

Table 14. The volume of the burial cairns in cubic meters, and the roundness proportion of the boulders.

Volume	1–3	4–5	6–7	Total
<12 m^3	9	39	11	59
12–75 m^3	7	100	30	137
>75 m^3	3	62	9	74
Total	19	201	50	270

The connection indicated by the contingency table is affected by the relatively small-sized cairns constructed of rounded boulders in Keistiö in Iniö, Kummelbergen, Kalnäs and Hästkilsbergen in Houtskär, Stora Ängeskär (a burial cairn dating back to the Iron Age to be discussed later in another connection), and Hertsböle in Dragsfjärd.

The median of the volumes of the cairns is 31 m^3 ($n = 338$). When placing the median into the regression equation of fig. 26, a rough estimate of 13 tons is obtained as the average mass of a cairn. Assuming that the stones for a cairn of an average volume were fetched from the adjacent terrain, and that each person participating in the work carried 200 stones of an average weight of 10 kg every day, the cairn would have been completed within a week by one person and within one day by seven persons. Thus, a typical amount of labour did probably not involve a major exertion for a local community.

At places, observations can be made of the probable origin of the boulders. For instance, on top of Öijen in the village of Haraldsholm in Pargas, there is a cairn (266) situated beside a granite projection with a nearly vertical tip. The granite is cracking strongly, and stones can be detached from it with bare hands. The burial cairn contains stones of the same red granite, placed in the southern and south-eastern parts of the cairn in a semi-arch, with the even surfaces pointing outwards. In Norrby, Iniö, there is a well-developed horizontal cracking in the granite with a whole lot of loose stone flags on the rock. These flags can be found in burial cairns in Norrby. Near the Lilla Kuusis burial cairn in Nagu, to the west of it, the *bankung*-cracking has loosened boulders from the bedding, and the edged boulders of the cairn seem to originate from this slope.

The Ängeskär island in Dragsfjärd is surrounded by a stretch of open sea, called Gullkrona fjärden. The 14 meter high top of the island is covered with a boulder field with a visibility in all directions. On the boulders, there is a round cairn (346), with a precipitous cavity in the middle. In the boulder field, a ditch-like depression can be seen surrounding the edge of the stone setting; the boulders have thus been lifted from the boulder field adjoining the stone setting. The boulders are, indeed, almost exclusively rounded, weighing 1–60 kg, and they do not differ in any way from those in the surrounding boulder field. Although the stone setting is only 6 meters in diameter, its height is 0.9 meters. The height may be due to the excavation of the crater, whereas boulders have been lifted on the stone setting to serve as a rampart.

4.7 Weathering studies

4.7.1 The principles

Inside the rock, the stone material is in a stable state. When the surface of the stone is uncovered in connection with geological processes, it reacts with the organic compounds of atmosphere and hydrosphere, it becomes an object of various physical processes and changes into soluble compounds, and gravel, sand, or clay. Weathering has started. In weathering, there are simultaneous physical factors disintegrating the stone material; chemical reactions change the mineral composition and the surrounding community of living organisms, and this, in its turn, affects the physical and chemical weathering environment. We talk about mechanical, chemical and biological weathering (e.g., Small & Clark 1982: 14–26). The factors regulating weathering can be divided into climatic factors – above all acquisition of water, and thermal conditions –, hydrological conditions, topography, different weathering qualities of stones, and the effect of the organic environment (Uusinoka 1983).

The stone surface on the bottom of the sea is protected from conditions favouring weathering, and it weathers only chemically and very slowly (Uusinoka 1983: 20). When the stone surface comes into contact with the atmosphere because of land uplift, a process begins in which the stone surface experiences various conditions favouring weathering. The conditions change when the land uplift progresses. If the factors regulating this process are recognizable and the changes taking place on the stone surface and their ultimate results in different phases can be observed, the temporal course of the process can be defined in each weathering environment. We can, for instance, measure the surface weathering in the shore zone and above it and compare the observed weathering differences with time differences calculated from the shore displacement.

The shore displacement is only one of the possible factors exposing the surface of the stone to weathering processes and starting the weathering from a definable original state. The stone can experience a similar change also at the cracking of the rock, melting of a glacier, or when a sudden thermal distension breaks the stone when fire is made on the stone surface or when a lightning strikes the stone. The human being can also split and work stone or fetch boulders from the water boundary or below it in order to clear the shore, or, for instance, to build a stone foundation, a pier, or a burial cairn.

If the elapsed time between the moment of measuring the weathering and the time representing the original state of the surface can be determined, and if the local weathering-regulating factors and the course of the weathering process are sufficiently known, the local progression of weathering can be, at least roughly, delineated. When a human being removes boulders, wears weathering surfaces or in other ways interferes with the natural order of stones, he is responsible for anomalies in the weathering environment. If the anomalies can be related to the undisturbed weathering process of nature, their age can be roughly determined. For instance, the weathering rate of a boulder which has been carried to the height of 10 meters from the shore zone, differs from the rest of the local weathering environment.

The application of this simple principle has only recently been introduced in the process of dating archaeological remains on a larger scale. An early predecessor was, however, the study based on stereo photograph pairs by Nils Edelman of the age of the rock carvings in Jan Karlsgården, Sund, Åland (Edelman 1968). In 1985, at the University of Umeå in Sweden, Wibjörn Karlén and Rabbe Sjöberg came across the idea of using the Schmidt hammer, originally designed for industrial hardness measuring, in determining the age of boulder surfaces in a shore displacement environment on the coast of Västerbotten, Sweden (Sjöberg). This soon led to other dating results, often in connection with lichen studies (among others Broadbent 1990; Sjöberg 1990; Sjöberg 1991 a). The aim of the studies was to present the age of the weathering surface as a function of the weathering rate measured by the Schmidt hammer in the specific lithologic environment with a standard error of the least possible magnitude. Objects of dating have been hut foundations, burial and clearance cairns, net-drying racks, *tomtning*-remains, labyrinths, and recent disturbances in the boulder fields on the east coast of Sweden, and the rune carvings at Båtholmen, Vörå, Finland (Sjöberg 1991 b).

4.7.2 The weathering of the shore rock and the shore displacement

The sea shore is a zone washed by the sea water, where the surface of the stones rising from the sea stays for hundreds of years. Due to the shore displacement, the stone surface is gradually more and more affected by the air. The weathering process starts, but for a long time the surface will still be in contact with the sea water. Ultimately, washing by the sea water ends only after the surface of the stone has risen above the highest limit of the splash. Before that, the lasting and the frequency of the washing has, however, diminished considerably. It is probable that the sea water does not greatly affect the chemical weathering above the mean of the annual maximum peaks (mean high water) any more, particularly because the rain water every now and then washes off the salts brought by the sea water. Instead, the washing effect is important in the mechanic weathering as it transports away the weathering products, and constitutes the prerequisite for frost weathering.

According to the time series of Stenij and Hela (1947) the maximum high water rate measured by the mareograph in Ruissalo, Turku, has been 95 cm, the mean high water rate being 72 cm, and the rate corresponding to the durability of 1 % is 53 cm. These rates illustrate the effective zone of the sea water above the mean sea level. The effect of the sea water may reach higher up in the case of mechanical weathering as compared to chemical weathering. As for mechanical weathering, a significant fact is that the high level peaks occur most frequently during the strong winds of the autumn and winter seasons (Vermeer *et al*. 1989). The high water effect is then combined with the freezing of the wet rock surface, which causes scaling. The splash reaches considerably higher. During a storm it can – depending on the exposition and the quality of the shore – swell to the height of 2 meters from the theoretical mean sea level (Niemi 1969) in the inner archipelago, in the outer archipelago even higher.

Below the mean sea level there is a zone where weathering starts. Extremely low sea levels may not have any noticeable effect on weathering because they are of short duration. Ritva Karhunen (1985: 22) estimated that the weathering starts in a zone 50–60 cm below the mean sea level. When the shore displacement is 3–5 mm/year in the Archipelago Sea (Kakkuri 1997), the weathering forces begin their effect on the stone surface approximately 100–200 years before it rises on to the theoretical mean sea level. In the region of Turku, the ground surface rising from the sea remains a shore zone exposed to the effect of the shore processes for a period of about 400 years (Granö & Roto 1989).

Because of the level fluctuation of the water surface, it is reasonable to presume that the weathering conditions in the shore zone are different from those above it. In the shore zone, the surface conditions frequently vary between wet and dry, causing variation even in the temperature of the surface. The waves wash weathering products off the surface and bring salts on it. When the temperature drops, the water first freezes in the shore zone beginning from the upper limit of the splash and causing frost weathering. The conditions of the shore zone should, thus, generate relatively fast weathering. Above the shore zone, the effect of the vegetation joins the weathering factors: the penetration of roots into the cracks, and the effect of micro-organisms, lichen and humus substances (chelation). At least roots have been observed to accelerate mechanical weathering; instead, the significance of lichen cover in the weathering process is disputable and of minor importance (Berner 1992; Walderhaug & Walderhaug 1998).

The total effect of the different factors on the temporal course of the weathering process can hardly be defined in any exact way other than empirically for each weathering environment. Due to the relation of the shore zone and the dry shore rock above it, we cannot assume the rate of weathering to be a linear function of time in all conditions.

The weathering crust forming on the surface of the stone retards the access of water and carbon dioxide dissolved in it into the inner parts of the stone, and prevents the chemical transportation of the weathering products (Colman 1981). Thus the developing of a weathering crust retards the weathering, and makes the weathering process non-linear. The weathering does not, however, stop altogether because the weathering products usually get transported away from a bare surface. The weathering products are washed off the more effectively the more precipitously the surface inclines (Uusinoka 1983:20). Gradually a state of equilibrium is achieved, in which the weathering products are being washed off the surface at the same rate as further weathering proceeds in the weathering crust and under it. Such observations can be made on high shore cliffs (Karhunen 1985). The thickness or mechanic tenacity of the weathering crust can no more be used to define the age of a weathering surface when the surface is in a state of equilibrium, and the accuracy of age defining weakens considerably before the state of equilibrium.

To measure weathering, physical and chemical techniques have been developed (Aires-Barros & Mouraz-Miranda 1989; McCarroll 1985). The non-linear progress of the weathering process has most often been modelled using a logarithmic time function, in which the quantity measured is the thickness of the weathering crust, the mass loss of the sample, or a chemical indicator, among others (Colman 1981). Rabbe Sjöberg (1987; 1991) has, however, used a linear regression to model weathering measured by the Schmidt hammer.

4.7.3 The rocks

The most important factors regulating weathering in stone are the composition of the rock, the microstructure (cleavage, porosity, fabric, crystal structure), and the mass qualities (absorption of water, capacity of conducting heat, heat distension, pulling tenacity) (Uusinoka 1983). Even if it has so far proved to be difficult to define the absolute weathering of each rock type, attempts have been made to determine the mutual order of weathering (Aires-Barros & Mouraz-Miranda 1989). Raimo Uusinoka (1983: 25) gives the following series of rocks from the most to the least tenacious: quartzite > amphibolite, gabbro, peridotite, and diabase > granite, granodiorite, and quartz diorite > granite and mica gneisses > arcose sandstone, silt stone, and their metamorphic products > dolomite > limestone. Ritva Karhunen (1985) presents by comparison the series granite > mica gneiss > postorogenic rapakivi granite, in which mica gneiss weathers about 1.5 times, and rapakivi two times faster than granite.

Rocks measured in this study appear roughly in the middle of the series, and their differences in weathering are not very significant. The differences are, however, large enough to prevent a direct comparison between the measure values of different rocks.

4.7.4 The Schmidt hammer measurements

The weathering measurements for this study were made using the N-type Schmidt hammer (see e.g. Day & Goudie 1977). By using the Schmidt hammer, the hardness of a rock, boulder or concrete surface can be measured on a per cent scale. In the instrument, there is a weight strained by a spring. The mass of the weight is released through a bar and an impact plunger with kinetic energy of more than 2 Nm against the surface to be tested. Part of the impulse caused by the stroke is absorbed in the breaking of the crystal structure of the surface, part of it is reflected back to the instrument. The scale measures the amount of kinetic energy reflected back on a per cent scale (the rebound value). The reading accuracy is 0.5 per cent. The higher the rebound value, the greater the mechanic tenacity of the surface against the impulse. The rebound values are distributed mainly between 30 and 75 per cent.

By using the Schmidt hammer, it is possible to collect quickly numerous observations of the hardness of the stone surface, to be measured for weathering, and, thus, for the age of the exposed surface. The changes of rebound values in stone have been proved empirically to be in close connection with weathering in limestone (Day 1980), gabbro (McCarroll 1991), graywacke, sediment gneiss, and gneiss granite (Sjöberg 1987). The rebound values are, however, not only a function of weathering, but they are also affected by the calibration of the measuring instrument, the measuring arrangements, and the local weathering environment, which all have to be carefully considered in the planning of the measurement in order to gain interpretable results (McCarroll 1994).

M.J. Day and A.S. Goudie (1977) measured the instrument accuracy of the Schmidt hammer and the repeatability of the results. They observed that the operator variance and the effect of temperature were of little significance, but poor calibration was a statistically significant source of error. It was even obvious that the same surfaces gave significantly lower rebound values when the surface was wet compared with the values given by a dry surface. On account of this, I have measured the rebound values on dry surfaces or surfaces dried after the washing of the rock. Spots where the running water could be observed to channel were not measured at all, nor were any smooth facet surfaces.

The rebound values were measured in areas of the size of a palm with no lichen on it, and if necessary cleared with a brush. In each area, 5–30 rebound values R were measured, after corrections as to their inclination (R_c) according to the tables supplied by the manufacturer and, if needed, also calibrated to compensate for the mechanical crawling of the hammer (R_{cal}). Of the rebound values thus obtained, mean values and standard errors of the mean value were calculated and used as standard figures.

4.7.5 The estimation of weathering curves

4.7.5.1 The regression models

The possibilities of using weathering measurements as an absolute dating technique are not quite indisputable because other factors, too, besides the course of time affect the measuring results. Numerical models may give, at least in geomorphologic studies, a rather optimistic idea of the accuracy of the weathering techniques, as pointed out by Danny McCarroll (1994). Studies by Rabbe Sjöberg and Noel Broadbent in the shore displacement environment of the Baltic Sea, have, however, established a close connection between the rebound values and the weathering surfaces on different levels, and illustrated this finding with curves (Sjöberg & Broadbent 1991). Since Sjöberg's first report (1987) on the shore displacement environment on the east coast of Sweden, it has seemed that, on the coast of Finland, too, it is possible to determine the connection between the rebound values and the ages of the surfaces using weathering curves. If such curves can be established, they can produce age gradients, which can be made use of in the interpretation of the measuring results of the weathering surfaces in the burial cairns.

Weathering environments vary and one of the sources of variation is the different weathering qualities of different rocks. To control variation not related to the progress of weathering, the simplest practice may be measuring by types of rock. It must also be assumed that the coefficients of the estimated weathering curves can only be applied in areas with essentially similar climatic and microclimatic factors.

Above it was suggested that the regression model presenting weathering should theoretically be exponential rather than linear. In an exponential regression model, the retardation of the weathering process from the initial situation as a function of time can be expressed in the same way as, e.g. in land uplift (c.f. Okko 1967; Ten Brink 1974). May the mean values of the rebound values used as measure figures be marked $\bar{R}_{cal_i}$ and the height from the sea level h_i. The exponential model is of the form

$$\bar{R}_{cal_i} = \hat{\beta}_0 + e^{\hat{\beta}_1 - \hat{\beta}_2 h_i}$$

in which the intercept $\hat{\beta}_0$ gives the value which the function approaches asymptotically as the height h_i increases. The parameters $\hat{\beta}_1$ and $\hat{\beta}_2$ of the inner function determine the shape of the curve.

The rebound values of the shore displacement sequence may, however, decrease linearly as the height from the sea level grows. In this case, the exponential regression model does not offer any special advantage compared with the linear one, but only assumes more number crunching. Accordingly, the function to be used has to be chosen in conformity to the type of dependence between the values observed.

Weathering curves estimated from the shore displacement environment are bound up with the place because the rate of shore displacement in the SW archipelago accelerates from SE to NW. If there is a desire to generalize weathering curves to some extent or to make comparisons between various localities, the rebound values must be replaced with the shore displacement ages of the rock surface. This procedure involves an obvious disadvantage: the altitudes of the observation points can be measured with the accuracy of one centimeter, but when converted into shore displacement ages they become estimated ages involving certain sources of error instead of measured values.

Because the measured weathering surfaces reach the height of 15 meters and more above sea level corresponding to the shore displacement of more than 2000 years, the present land uplift in relation to the mean sea level cannot reliably be applied to the whole time scale. The shore displacement ages can, instead, be estimated by comparing the altitudes with the (uncalibrated) radiocarbon dates of the shore level zones as given by Gunnar Glückert (1976). Some uncertainty is caused by the fact that Glückert's shore level data was mainly collected on the coast. However, in Glückert's data, there is a close linear relationship between the age of the shore level zone and the altitude. In linear least-squares fit for regression of the rebound values upon the ages, the squared multiple correlation and the standard errors of the estimates are practically identical as in a fit for regression of the rebound values upon the altitudes. Thus, the conversion of altitudes into ages hardly causes any practical decline in the accuracy of the model.

The aim of the estimation of the weathering curves is to express the age of exposure of the stone surfaces as functions of the measured weathering values. Sjöberg applied the regression model to his data by placing the altitude of the measuring point in the position of a response variable (y) and the rebound value in the position of the factor (x) (Sjöberg 1987; 1991 a). In field measurements, however, the rebound values are measured at altitudes measured in advance, the ages of which can, thus, also be determined in advance. Therefore, I think it is a better solution to place the rebound values as a response in the regression model and the altitude or age as a factor. The weathering rate of the surface should be regarded as dependent on shore displacement, and not the other way round.

After the calculation of the regression estimates, the regression equations can, however, be solved in relation to the age (or to the altitude). The standard errors of regression estimates can be altered to concern ages (or altitudes) so that the regression equations are solved in relation to age (or altitude), and the terminal points of the standard error are placed in a clause whose value is calculated separately for the upper and the lower terminal point. To put it in geometry: in a scatter plot, the terminal points of the standard error of the estimate of the rebound value are determined on the y-axis, projected on the regression line and further projected on the x-axis.

4.7.5.2 Case studies

I have measured rebound values to generate weathering curves at six places in the outer and middle archipelago zones (fig. 30). The readings were measured in areas of the size of a palm on a pre-levelled point on a bare shore rock, 20 or 30 measurements on each spot. The results are presented in table 15 and figures 32 and 33.

Table 15. The altitudes and numbers of the measuring points, the numbers of rebound values n, the means and the standard deviations of rebound values, the lowest and highest rebound values and the standard errors of the mean values (SEM) in the measuring point on an average.

Site	Altitudes (N60)	Measuring spots	n	Mean	Sd	Min	Max	Mean of SEM
1. Sundbergen, Nagu	-0.09...28.77	23	460	41.0	8.1	22.4	63.3	1.29
2. Hagaudd, Korpo	0.17...16.44	8	240	51.3	11.3	25.3	70.5	1.20
3. Säbbholmen, Dragsfjärd	1.65...16.91	7	210	44.2	14.9	15.5	77.4	1.22
4. Ramsö, Houtskär	-0.18...20.47	24	720	51.2	12.8	16.3	76.7	1.43
5. Kyrkudden, Nagu	-0.25...21.48	16	480	53.1	12.4	23.4	78.4	1.17
6. Immaskär, Houtskär	0.20...18.85	18	540	57.7	13.1	23.4	79.4	1.42

1. *Sundbergen, Nagu.* The location is a shore rock at Sundbergen, Nötö, to the north of the excavated burial cairns[73]. The granodioritic shore is open to the north to the stretch of open sea of Berghamns fjärden. On higher shore levels, the shores have also been open in other directions because the outer archipelago surrounding Nötö has risen from the sea later than the top of Sundbergen which is 30 meters high.

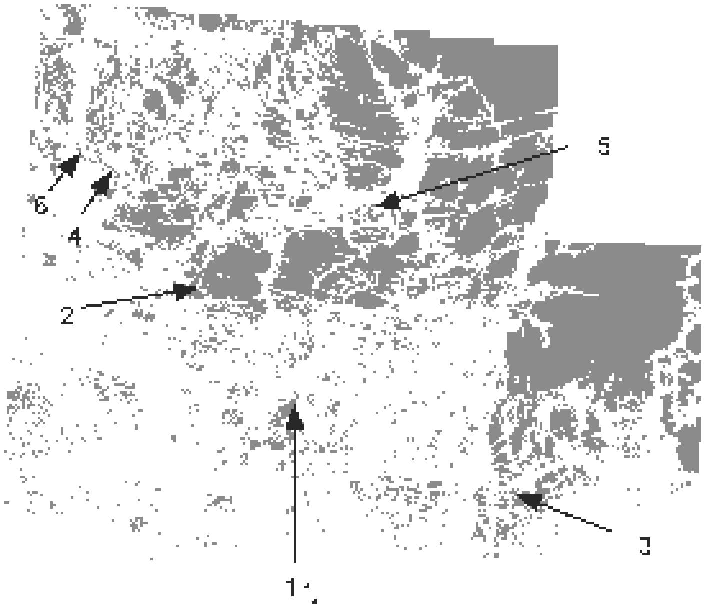

Fig. 30. The sites for the determination of weathering curves. 1. Sundbergen, Nagu. 2. Hagaudd, Korpo. 3. Säbbholmen, Dragsfjärd. 4. Ramsö, Houtskär. 5. Kyrkudden, Nagu. 6. Immaskär, Houtskär.

At Sundbergen the regression equation is (with the standard errors of the estimates in parentheses)

$$\overline{R}_{cal_i} = 37.80 + e^{2.952 - 0.294 h_i}$$

(0.63)(0.087)(0.053)

with the squared multiple correlation (the amount of the total variance accounted for by the fit) $R^2 = 0.876$ and the standard error $s_e = 2.14$. The standard errors of the rebound values (figure 31) indicate that the prediction of low rebound values is the most inaccurate. On high levels, along the progress of weathering, the variation of rebound values increases.

The form of the dependence is clearly exponential (figure 31). The rebound values descend consistently to the level of about five meters, but above that the standard errors of the rebound values increase, and they vary randomly without any noticeable dependence on the altitude. In this case, it is probably a question of a state of equilibrium of the rock surface in which the weathering products of granodiorite are transported away

73. Basic map 1034 01, x = 6651 30, y = 1543 35 (± 50).

as soon as the stone material under the weathering crust gets weathered. The weathering crust only develops consistently for a certain period of time and the development gradually begins to slow down when approaching the state of equilibrium. In the end, the variation in mechanical tenacity can no more be used as a measuring quantity which relies on dating through time function. The development of the weathering crust can be considered to be divided into two time sequences, the consistent linear weathering and the state of equilibrium.

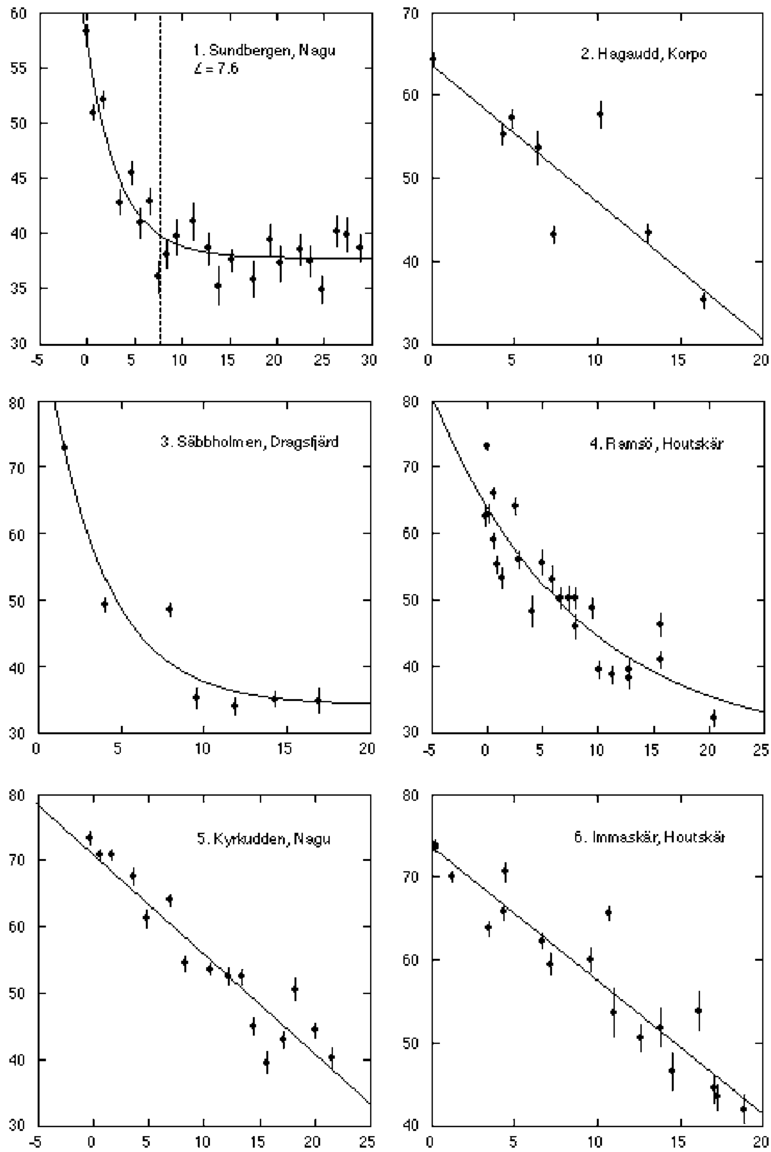

Fig. 31. Weathering curves (previous page): the mean values of the rebound values (vertical axis) and the altitudes of the measuring spots (horizontal axis). The error bars are the standard errors of the mean value. The estimated changeover point *L* has been marked for the curve for Sundbergen, Nagu.

As to the weathering curve of Sundbergen, the point at which the state of equilibrium develops can be approximately determined, that is to say, until which phase of development the mechanical tenacity of the weathering crust can be used as a dating quantity. A two-phase linear regression is used (Hinkley 1971). We write

$$\overline{R}_{cal_i} = \hat{\beta}_0 + \hat{\beta}_1 h_i + \hat{\beta}_2 (h_i - L) d_i \quad ,$$

where $d_i = 1$ if $h_i > L$ and $d_i = 0$ if $h_i = L$.

The regression line consists of two rectilinear parts and the changeover point *L*. In lower *h* values than the changeover point $d_i = 0$, and accordingly $\hat{\beta}_2(h_1 - L)d_1 = 0$. In the changeover point of the function, the regression line changes its direction because, due to the indicator variable d_i, $\left|\hat{\beta}_2(h_1 - L)d_1\right| > 0$ if the values of *h* are higher than the changeover point. The changeover point can be estimated with the SYSTAT statistical package (Wilkinson 1987). Using the NONLIN module, we obtain $L = 7.6$ m. The result suggests that at the height of 7.6 m at the latest the rebound values cannot be used any more to help in the determination of age. The initial weathering until this height can be described with the equation

$$\overline{R}_{cal_i} = 54.68 - 2.206 h_i$$

(1.69)(0.328).

The squared multiple correlation $R^2 = 0.866$, and the standard error $s_e = 2.82$.

For the age corresponding to the altitude we obtained until the year 500 AD

$$\overline{R}_{cal_i} = 31.25 + 0.0117 T_G$$

(2.28)(0.0017),

in which T_G is the date estimated in the Litorina shoreline zone or between two such zones using the ratio diagram given by Glückert (1976, appendix I). The squared multiple correlation $R^2 = 0.867$, and the standard error $s_e = 2.81$.

2. *Hagaudd, Korpo*. The place is situated on a shore rock inclining to the north-west in a sheltered bay[74]. It was measured in connection with the levelling of an adjacent burial cairn (203). The rock consists of mica gneiss, with some quartz veins. The surface is heavily covered with lichen, and on the lower slope with moss.

The number of observations is fairly limited but the rebound values tend to decrease linearly with increasing altitude. We get

$$\overline{R}_{cal_i} = 63.57 - 1.561 h_i$$

(3.78)(0.408)

$$\overline{R}_{cal_i} = 46.30 + 0.00914 T_G$$

(2.37)(0.00239)

74. Basic map 1032 08, x = 6668 20, y = 1528 80 (± 50).

with $R^2 = 0.709$, and $s_e = 5.62$.

3. *Säbbholmen, Dragsfjärd.* The place is a shore cliff sloping to the west, with a fairly heavy lichen and moss cover[75]. On the highest shore levels the place has been more open than today to the west and the north-west. The coarse surface consists mainly of gabbro. On the shore, some granite, pegmatite, gneiss, and migmatitic mixed rock can be found. We obtain

$$\overline{R}_{cal_i} = 34.14 + e^{4.096 - 0.285 h_i}$$
$$(4.18)(0.242)(0.138) \; .$$

The squared multiple correlation $R^2 = 0.921$, and the standard error $s_e = 4.90$. It seems that in Säbbholmen, too, the slowing down of the weathering, and the approaching of the state of equilibrium are apparent.

The age corresponding to the altitude equals

$$\overline{R}_{cal_i} = 34.14 + e^{-1.957 + 1.529 T_G^*}$$
$$(4.18)(2.747)(0.742).$$

In this case, has been defined that $T_G^* \;\; \frac{T_G}{1000} \;\; 2$ to obtain a realistic value range for the exponent function. The squared multiple correlation $R^2 = 0.921$, and the standard error $s_e = 4.90$.

4. *Ramsö, Houtskär.* At the western end of the island of Ramsö, there is a cape with a uniform shore rock, in which both the southern and the northern slopes incline to the sea[76]. On the smooth-worn granite surface, there are stripes in the west-east direction. The stripes contain more *K*-feldspar, granate, and biotite-plagioclase than the main stone. On the SW slope, the rock is particularly smooth, and the facet surfaces are well preserved. The northern side is somewhat coarser, here and there pegmatitic. The surfaces are exposed on both sides of the cape to stretches of open sea, Skiftet (SW) and Äpplö fjärden (N). On higher levels, the shore has been considerably more exposed than in the present.

On Ramsö, the weathering curve is nonlinear. We obtain

$$\overline{R}_{cal_i} = 27.59 + e^{3.589 - 0.076 h_i}$$
$$(12.37)(0.323)(0.045)$$

$$\overline{R}_{cal_i} = 27.59 + e^{1.686 + 0.491 T_G^*}$$
$$(12.50)(1.442)(0.291)$$

with $R^2 = 0.812$, and $s_e = 4.64$.

5. *Kyrkudden, Nagu.* The northern side of Kyrkudden consists of bare rocks[77]. The surface consists of mica gneiss, with frequent stripes of migmate. On the western shore there is some amphibolite. The shores are open in the north and north-east in the direction of the Erstan, on higher levels also in other directions.

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75. Basic map 1033 11, x = 6639 65, y = 1579 25 (± 50).
76. Basic map 1041 04, x = 6684 48, y = 1513 05 (± 50).
77. Basic map 1043 04, x = 6681 68, y = 1553 72 (± 50).

On Kyrkudden, the dependence of the rebound values on height is linear:

$$\overline{R}_{cal_i} = 71.28 - 1.523 h_i$$
(1.74)(0.138)

$$\overline{R}_{cal_i} = 53.78 + 0.00939 T_G$$
(0.961)(0.00085)

with $R^2 = 0.897$, and $s_e = 3.81$.

6. *Immaskär, Houtskär*. On the cape of the western part of the island there are bare rocks, over which rebound values can be measured from shore to shore[78]. The rock is made up of light-coloured granite with gneiss, and pegmatite veins in places. The horizontal top area is plane and very smooth-worn in places. In the south and the north the shores are exposed to shore processes from the stretch of open sea of Skiftet. On Immaskär

$$\overline{R}_{cal_i} = 73.53 - 1.608 h_i$$
(1.60)(0.143)

$$\overline{R}_{cal_i} = 54.01 + 0.0104 T_G$$
(0.94)(0.0009)

with $R^2 = 0.888$, and $s_e = 3.64$. The standard errors of the rebound values increase with increasing altitude.

The declivity is a significant factor in the weathering process (Uusinoka 1983: 20–21). The radiation of the sun is distributed in a different way on the southern and northern slopes, which has been shown to affect weathering (Ohlson 1964: 83–84). This effect was studied on Ramsö, Kyrkudden and Immaskär. The different distribution of radiation on the northern and southern slopes was expressed as the cosine of the opposite of the direction of the slope. In regression analysis, however, neither the coefficients of the steepness nor the direction of the slope proved to be statistically significant.

4.7.5.3 Discussion

The weathering curves show local variation. Actually, retarded weathering is seen in the curve of Sundbergen only. In it, the initial rebound value $\overline{Rcal}$ = 58.2 % is lower, and the measurements reach higher than in the other curves. When it comes to the other curves, little can be said of the retarding or reaching the state of equilibrium. The curve of Säbbholmen is, due to the small number of samples, primarily indicative, but in it, too, retardation can be seen around the percentage of a little less than 40. The main reason for the differences is probably the variation of qualities in different stones. While retardation can be observed in the granodiorite of Sundbergen and the gabbro of Säbbholmen, the rebound values develop linearly in the mica gneiss of Hagaudd and Kyrkudden, and in

78. Basic map 1041 01, x = 6687 55, y = 1507 18 (± 50).

the granite of Immaskär. The curve of the Ramsö granite shows slight retardation. The initial levels of the weathering values of the Hagaudd and Kyrkudden biotite-plagioclase gneiss differ from each other whereas those of the Houtskär granites do not, to any noteworthy degree.

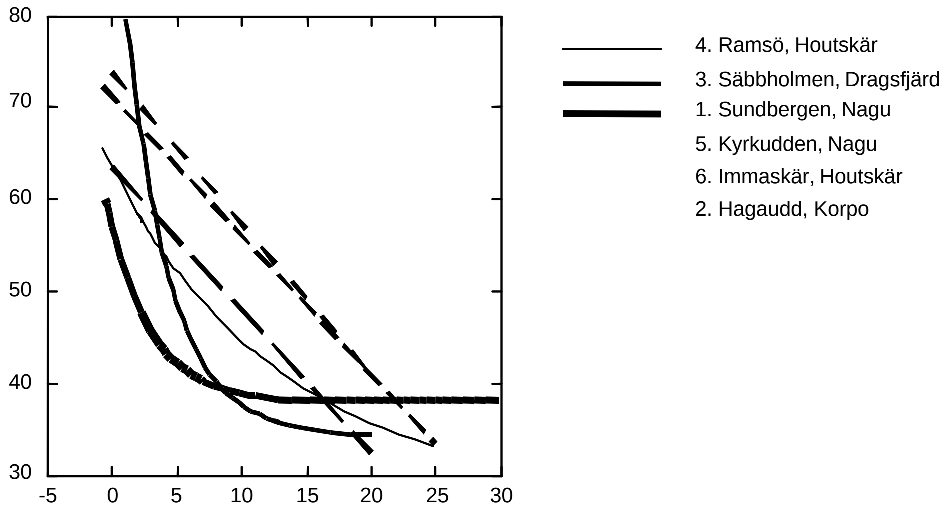

Fig. 32. Summary of the weathering curves.

The coefficients of the weathering curves (figure 31) are close to each other. Thus, the same altitude difference corresponds to approximately the same difference in rebound values. The same difference in the rebound values does not, however, signify the very same difference in the ages of the weathering surfaces because the shore displacement rates of the measured sites differ from each other. Linear weathering curves are better applicable to dating than exponential ones because the rebound value difference corresponding to the altitude difference is constant irrespective of altitude. This may be a practical quality in relative datings: the age difference of two surfaces can be defined even if the absolute ages cannot. The differences in the shore displacement can also partly account for the differences between the linear and the exponential curves (5, 6, 2 and 4, 3, 1 in figure 31): the Sundbergen and Säbbholmen curves sloping precipitously at low altitudes derive from measuring sites where apparent land uplift is 0.5–1.0 mm/y slower than at the other measuring sites.

The difference between the linear and the exponential curves illustrates the difference between acid and hard rocks (granite and mica gneiss), and basic ones containing more dark minerals (granodiorite and gabbro). The quicker the initial stage of the weathering process, the sooner it seems to retard. The granites and the mica gneisses are common rocks in the Archipelago Sea; accordingly, suitable surfaces for dating should be found almost anywhere in the area.

The determination of the weathering curves of shore rocks seems to involve two problems: the random variation of rebound values and the development of a state of equilibrium on the surface of the stone. As for the varying rebound values, it is essential to optimize the measurement procedure and screen one type of rock only in each measurement series. When aiming at accuracy, it is theoretically well-argumented to obtain a sufficiently great number of measuring points even if it, for practical reasons, resulted in decreased rebound values per measuring point: increasing the amount of measuring points yields smaller standard errors of estimates, and produces less biased estimates (Barry 1993: 385). In the data at hand, 20 or 30 rebound values have been determined at each measuring point. The amount is probably sufficient when in comes to weathering environments and local rocks. Danny McCarroll, for instance, did four measurements per boulder in his geomorphologic investigations in Norway (McCarroll 1994: 36). In the field work practice, a fairly low number of rebound values per measuring point may be acceptable, and thus a greater proportion of the time available can be spent on levelling the measuring points. On the other hand, especially when working alone, the very levelling takes most of the time.

The random variation of the rebound values at each measuring point is inclined to increase with increasing altitude and decreasing rebound values. The variation is in connection with the roughness of the surface (McCarroll 1991; McCarroll 1994), and, at least in the case of the Sundbergen granodiorite, the development of a state of equilibrium in the stone material. On the surfaces of Sundbergen, the changeover point estimated was 7.6 meters which corresponds to the age of about 1600 years. At other measuring sites, the reaching of the state of equilibrium seems to take longer. In the light of these case studies, the Schmidt hammer technique seems to offer a possibility to date numerical weathering gradients for a period of at least 1600 years. Anomalies in the weathering environment caused by the human being can then be compared with these gradients.

4.7.6 The weathering of the basal surfaces of burial cairns

When the surface of a rock is covered by constructing a burial cairn on it, the strength and duration of the weathering forces affecting the surface change. The boulders protect the surface from solar radiation. The soil layer gradually forming on the surface of the rock smooths the variation of the temperature, decreases the oxygen supply to the surface, and retards the transportation of weathering products. It can be assumed that these factors protect the surface from the weathering forces. On the other hand, the rock surface under the soil layer is moister than the bare surface, and thus the conditions for weathering may be better under the soil layer (Walderhaug & Walderhaug 1998). If it can be empirically verified that there is a difference between the weathering process under a burial cairn built on a rock and that of the surrounding rock surfaces, the difference may be of use in dating, at least in relative dating. It may help, for instance, to determine whether a stone heap is a prehistoric cairn or a recent stone pile.

In the following, we will compare series of rebound values which have been measured of the rock surface covered by a cairn (the *basal surface*) and of the bare rock surface outside the cairn (the *lateral surface*). The measurements have been carried out at Sundbergen, Lilla Kuusis, and Ängesnäs bergen (table 17), at the altitude of about 30 meters. At this altitude, weathering has advanced far, and the rebound values fluctuate considerably.

The distribution of the samples is fairly normal, and, consequently, the *t*-test can be used in comparing the surfaces. The differences in the mean rebound values of the basal and lateral surfaces are, indeed, statistically significant (table 17). The comparison indicates, however, that in the Sundbergen granodiorite, weathering has progressed further on the basal than on the lateral surface, whereas in the gneiss granite of Lilla Kuusis, and in the mica gneiss of Ängesnäs bergen the case is quite the opposite: weathering has advanced further on the lateral than on the basal surface.

The most detailed rebound series is derived from Ängesnäs bergen. There, 651 rebound values (mean values of five readings) were read in a rectangular measuring set of squares, the length of the square side being 25 cm. The contour plot (figure 33) shows the distribution of rebound values on the surface of the rock. The rebound values of the basal surface are, on the average, 7 % higher than on the lateral surface, and the highest values of the basal surface are close to 70 %. At the western edge, a distinct margin of anomaly following the outer edge of the stone setting is apparent. In the southern and eastern parts the margin of the anomaly and the edge of the stone setting are less distinct. In the southern and eastern parts of the stone setting it seems, both on the basis of field observations and rebound values, that the stones and boulders have been secondarily spread out from the stone setting. The bare rock outcrop in the eastern part of the burial cairn (cf. fig. 20) is not reflected in the rebound values even if some exfoliation, probably caused by thermal expansion due to a forest fire was observed.

At Sundbergen, too, the weathering difference between the basal and lateral surfaces is clearly discernible but in the opposite direction. At the burial cairn 1 at Sundbergen, the rebound values of the lateral surface are, on average, a little less than 2 % higher than those of the basal surface. The corresponding difference at the burial cairn 2 is more than 6 %. At the cairn 2, the difference in weathering can be seen by the naked eye: the basal surface is rougher than the lateral one.

The probable explanation is that granodiorite has weathered at the height of 30 meters to the extent that the rebound values do not change any more contrary to the process on the lower slope where the change is continued as a function of shore displacement with higher weathering age. The phenomenon seems to be linked with the rapid weathering of dark minerals on the basal surface, and the forming of a rough surface. Dark magmatic rocks, enriched in mafic silicate minerals (e.g., pyroxene, amphibole, biotite mica), tend to have a faster chemical weathering rate than felsic magmas with higher concentrations of lighter minerals (e.g., quartz and orthoclase feldspar) (Mälkki 1998: 11). The rough surface easily yields under the impact plunger of the Schmidt hammer and produces low readings (McCarroll 1994: 37–38). For this reason, the weathering differences at Sundbergen cannot, be used in dating. This is unfortunate because the age could have been controlled on the basis of the Late Iron Age artefacts of the burials. – The average weathering difference observed at Lilla Kuusis was a little less than 6 %, but here no comparison curve is available.

In Ängesnäs bergen the mean of the rebound values of the basal surface are 7.1 % higher than those of the lateral surface. Large variations in the rebound values of both surfaces make, however, the conversion of the weathering difference into a difference in age somewhat arbitrary. In addition, the comparison curve measured at Kyrkudden, the northern part of the church cape of the same island of Själö, only reaches to the height of 21.5 meters because the top of the church cape is lower than the burial site. Ängesnäs bergen being at the altitude of 30 meters, there remains a height difference of almost 10 meters where weathering is probably beginning to slow down. It is not known to what extent the changing of the rebound values on the rock surface has retarded or altogether stopped after the erection of the burial cairn. To solve this problem, further measurements should be taken on covered rock surfaces, where the covering can be dated. Consequently, the conversion of an anomalous difference in weathering into a date remains problematic. The development of a great difference in weathering must, however, have taken quite a long time. Thus, the cairn of Ängesnäs bergen must be old, probably prehistoric. To be on the safe side, I place it among the Iron Age burial cairns.

Table 16. Schmidt-hammer measurements of rock surfaces (sites, types of rock, altitudes h, numbers of measuring points, numbers of rebound values, means, standard deviations Sd, and means of standard errors of mean).

Site	Type of rock	h	No. of points	No. of *R*'s	$\bar{x}$	Sd	Mean of SEM
Sundbergen 1	Granodiorite	28	78	771	36.0	7.9	2.32
Sundbergen 2	Granodiorite	30	47	470	36.7	7.8	2.17
Lilla Kuusis	Gneiss granite	31	46	570	45.1	10.2	2.36
Ängesnäs bergen	Mica gneiss	31	651	3255	49.1	10.7	2.91

Table 17. Comparison of the mean rebound values of the basal and the lateral surfaces (t-testing).

Site	Basal surface			Lateral surface			Total		t	df	α
	$\bar{x}$	s	n	$\bar{x}$	s	n	$\bar{x}$	s			
Sundbergen 1	35.4	3.2	50	37.2	3.5	28	36.0	3.4	-2.336	76	0.022
Sundbergen 2	34.5	2.4	31	41.0	2.0	16	36.7	3.8	-9.175	45	0.000
Lilla Kuusis	47.0	4.8	31	41.2	6.5	15	45.1	6.0	-3.410	44	0.001
Ängesnäs bergen	52.7	7.5	321	45.6	8.0	330	49.1	8.5	-11.572	649	0.000

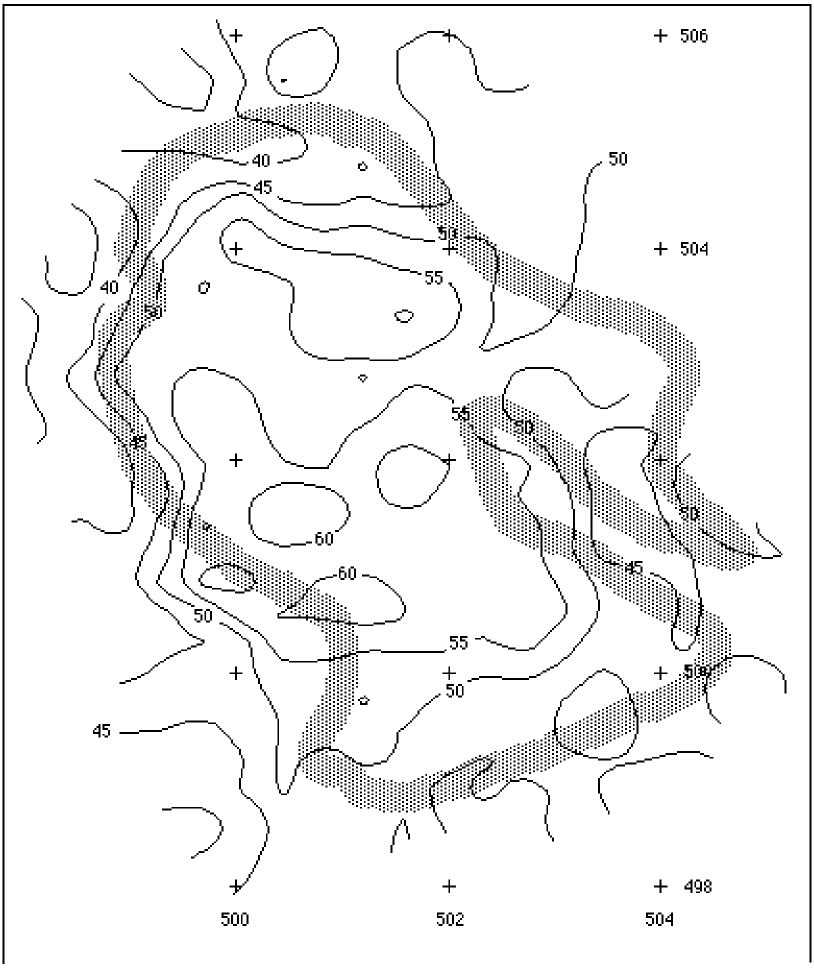

Fig. 33. Ängesnäs bergen, Nagu. Contour plot of the rebound values of the basal and the lateral surface and the approximate outer edge of the stone setting (thick screened border, cf. fig. 20).

4.7.7 The weathering of boulders

The upper surface of a rock lying on a base is more exposed to the weathering forces than the lower surface. The longer the surfaces of a boulder have weathered the greater the difference in weathering between the upper and the lower surfaces. Finally, the faster weathering surface reaches a state where approximately the same amount of weathering products is transported off the surface as is being produced by the process of weathering in the weathering crust and under it. Comparing the weathering on the lower and upper surfaces gives a possibility to investigate the anomalies in a boulder field which have possibly been caused by human activity. The most appropriate objects are the anomalies in the shore boulder fields washed by the waves (Sjöberg 1987: 22–32), but the surface of a burial cairn, too, can be regarded as a suitable weathering environment. In the case of burial cairns, it is, however, difficult to determine precisely the initial situation. Even if the initial phase is not known it is still possible to examine whether the boulders on the surface of the cairn have maintained their original positions, or whether they have been removed or turned around secondarily fairly recently. The Schmidt-hammer technique has earlier been applied to the investigation of anomalies caused by the turning over of boulders in *tomtning*s and labyrinths in Norrbotten, Sweden (Sjöberg 1987).

The rebound values of the upper and lower surfaces of the covering boulders were observed at Sundbergen, Lilla Kuusis and Ängesnäs bergen. Steadily lying heavy boulders (≥ 15 kg) were chosen for hammering. Mean values were calculated of the rebound values separately for the lower and upper surfaces. The significance of the differences of means was determined by using the Welch *t*-test because the distributions can be assumed to be approximately similar but with different variances (the Behrens-Fisher problem, see Widjeskog 1987 or Mardia *et al*. 1979: 142–144). Here, the purpose of calculating the Student's *t* statistic is to describe the magnitude of the differences based on the sample size and the variation of the values, not to test the significance of the differences because some differences are expected to develop.

At the burial cairn 1 at Sundbergen, Nagu, the boulders to be measured were chosen on the border of the stone setting and around the crater in the middle (figure 34; cf. Appendix 1). In the granite boulders, the difference varied from a few per cent up to 30 per cent. In addition, four boulders were found with significantly higher upper surface values than lower surface values, and several boulders with a parallel yet statistically insignificant difference. These boulders must have been turned over.

The boulders which had been turned over were situated around the crater. The most probable explanation for the observations is that the crater has been excavated secondarily, whereat some of the boulders removed from the crater have ended up in a reverse position in relation to the weathering surfaces. Not a very long time has elapsed since the disturbance, compared to the age of the burial cairn – yet long enough to allow the occurrence of rather large *Rhizocarpon* lichens occur on the boulders (cf. Innes 1983).

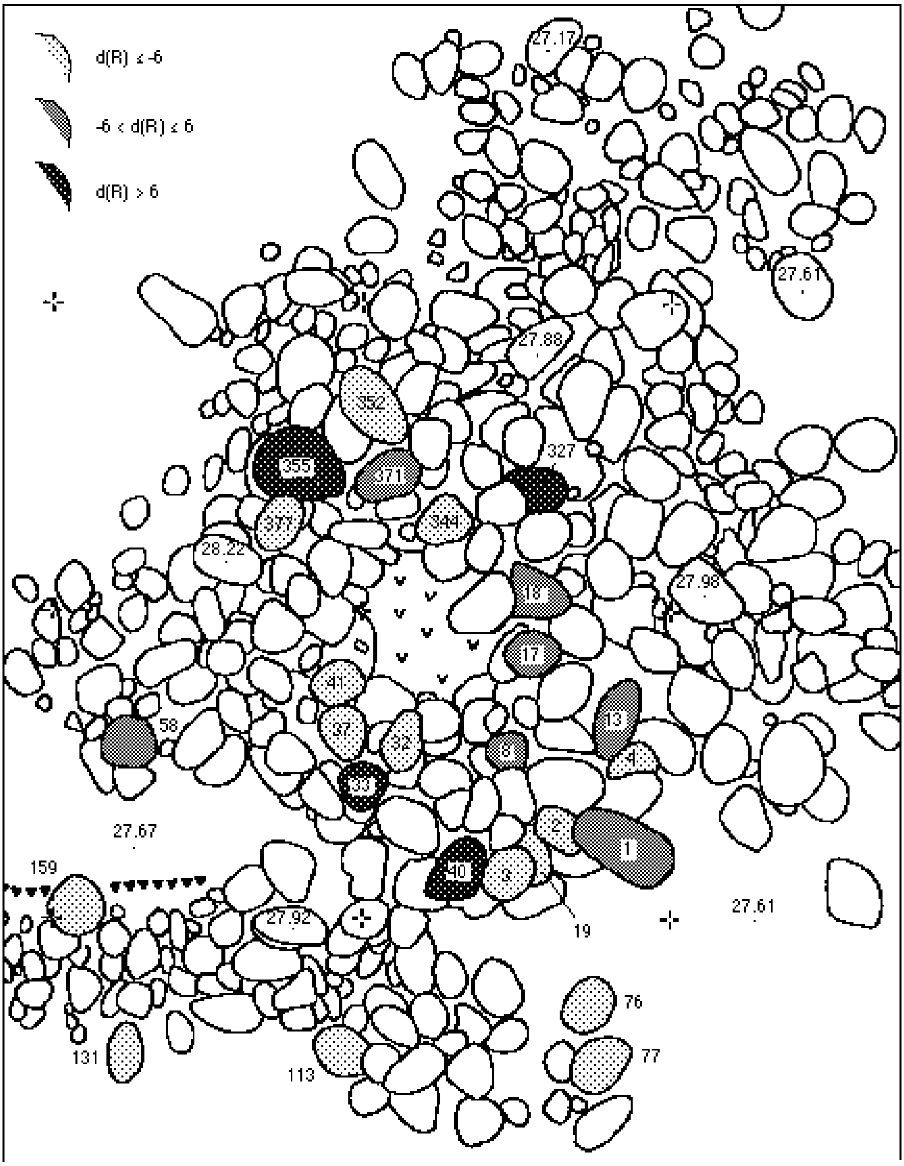

Fig. 34. Sundbergen 1, Nagu. The plan of the cairn. The differences of the mean values of the upper and lower surface rebound values d_R (cf. Appendix 1). Drawn by Timo Kuokkanen and the author, 1988 (TYA).

The cairn 2 at Sundbergen contained considerably fewer steadily lying heavy boulders than the cairn 1. Only three boulders were measured, and the only significant difference was that in one boulder the lower surface was more weathered than the upper one. At Lilla Kuusis, in five of the six boulders measured, the mean values of the lower surface rebound values were higher than those of the upper surface. At Ängesnäs bergen, 13 boulders were measured, and in twelve of them, major differences in rebound values were established, the lower surface values being on an average, higher than the upper surface values. The exceptional boulder (n:o 253, cf. figure 34) was situated in the southern part of the burial cairn. This is in accordance with the field observations and the rock surface weathering values, which have led to the assumption that the southern part has extended secondarily. Thus, the results from the investigations of the burial cairns seem to suggest that, normally, there are differences between the mean rebound values obtained from the upper and lower surfaces of the covering boulders, and that the differences in most boulders are fairly similar. Deviations from the normal situation can, then, be caused by secondary disturbances, as the crater in the burial cairn 1 at Sundbergen or the heterogeneous origin of the boulders: the boulders have been carried to the site from different weathering environments, for instance from the shore or from high rocks.

In the comparison of mean values, the Student's *t*-statistic indicates the relation of the difference of the means to the standard deviation of the difference. The *t* statistics with their signs indicate how great the deviations are in either direction, considering the deviation and the number of the rebound values. The mean, the standard deviation and the skewness indices of the sample distribution of the *t*-statistics are, thus, applicable as empirical figures in assessing to what extent the positions of the boulders correspond to the normal situation, and to what extent they differ from it. In the cairn 1 at Sundbergen, the mean value is -2.06, the standard deviation 5.00, the variation coefficient 2.43 and the skewness 0.53. At Ängesnäs bergen, the corresponding figures are -8.05, 7.70, 0.96 and -0.62. It may thus be concluded that, at Sundbergen, there was a relatively greater number of turned-over boulders than at Ängesnäs bergen, that the relative variation of the differences was greater at Sundbergen, and that, at Sundbergen, the great positive differences of the turned-over boulders appeared as a positive skewness of the distribution. In other words: the burial cairn at Ängesnäs bergen has remained more untouched than the cairn at Sundbergen, where later disturbances have affected the structure.

4.7.8 Are the craters secondary?

Different ideas have been presented of the origin of the craters, which are often conic cavities in the middle of the cairn. According to C.F. Meinander, the craters were formed when the cairn collapsed after the wooden coffin inside it had mouldered, or secondarily while the cairn was excavated for some reason (Meinander 1954 a: 101–103). Unto Salo regards the cavities mainly as actions of grave robbers, but some of the cavities of the large cairns in Satakunta may, according to him, be regarded as remains of collapsed sepulchral chambers, and as evidence of Scandinavian mortuary tradition (Salo 1981 b: 156–164). The vertical dry-stone wall of the eastern side of the burial cairn at Öijen, Pargas (266), suggests such a chamber.

Stone constructions with a middle cavity may also be remains of ground cellars dating from the Historical Age (Jarva & Okkonen 1993: 102–103). In the archipelago of Åboland, there are unmistakable remains of ground cellars, especially in the inner archipelago but also further out, for instance at Höglandet, Dragsfjärd, where they are part of the ruined remains of a tenant farm inhabited in the 19th century.

The material collected in the surveys allows us to scrutinize the nature of the craters. Let us assume that the craters were excavated rather than a result of collapsing due to the decomposition of a wooden coffin. During the digging work, the removed boulders had to be placed somewhere, and, without a good reason, they have hardly been carried further away than to the edge of the pit. Thus, the height of the cairn grew gradually. If the mean height of crater-like burial cairns turns out to be significantly greater than that of burial cairns of other types, the observation supports the hypothesis of the secondary nature of the origin of the craters. When this may have occured is, of course, another matter.

We exclude the lowest cairns, those under 0.4 meters in height because there are only a few low cairns with unambiguous crater-like cavities. There remain 89 cairns classified as crater-like and 135 graves classified as convex or indeterminable by profile. Because the sample distributions of the heights are skew, we had better examine the medians of the heights. The total median for all the cairns (n = 224) is 0.8 meters, the minimum height being 0.4 m and the maximum height 2.2 m. The median for the crater-like cairns is 1.1 m with a quartile range of 0.25 m while the median for convex or indeterminable cairns is 0.7 m with a quartile range of 0.20 m. The Mann-Whitney U = 3043 and α = 0.000; the difference of medians is statistically significant. The comparison of the medians supports the idea that the craters have been excavated secondarily. The dry wall in the stone setting of the above mentioned cairn at Öijen, Pargas (266) indicates, however, that *all* craters are not secondary.

In occasional cairns, it is possible to discover recently excavated craters because the boulders have not yet had time to become covered by *Rhizocarpon* lichen. In the lichen cover of the cairn on the island of Norra Mågsholmen, Västanfjärd (334), there are visible traces of boulders having been lifted on the stone setting during the excavation, whereat its height has grown. There are traces in the *Rhizocarpon* lichen cover also in the cairns at Surnon (Houtskär, 083) and Kaldoholmen 2 (Dragsfjärd, 033). – Another possible characteristic of secondary damage is the presence of small stones on the covering layer of the cairn, especially if they occur where there are cavities, craters and other signs of excavation – for instance in the cairn at Kalvholms fladan, Dragsfjärd (338). Small stones tend to run in between larger boulders in the course of time, so, if there are many of them on the surface of the stone setting, they can be regarded as a sign of a secondary interference in the stone setting.

4.7.9 Discussion

Observations support the idea that anomalies caused by human activity on the weathering environment can be quantified by means of the Schmidt hammer because the variation of rebound values is connected to the shore displacement age of the weathering surface. On the other hand, the interpretation of anomalies and the dating are more difficult if we cannot establish the initial situation with which the weathering gradients should be compared. Therefore, more observations are needed to construct comparative curves for the weathering environments in order to obtain a quantitative basis to allow the comparison of the weathering gradients. One possibility is to combine lichen measurements with weathering measurements (Sjöberg 1990).

Granite is a suitable base for many reasons: it weathers slowly, it is homogeneous, common, and easily recognized, even with a lichen cover. The schistose and, in the archipelago of Åboland, striped and streaked character of gneiss weakens the possibility of measuring the rate of weathering using the Schmidt-hammer. In the data from Hagaudd, Korpo, the influence of heterogeneity appears as a large variation of rebound values. On the other hand, at Kyrkudden, a consistent gradient with smaller standard deviations was acquired of gneiss.

The measuring of weathering differences on rock surfaces seems to be well suited when investigating whether a stone cairn can be dated back to prehistoric times with certainty. In a suitable weathering environment, even absolute datings may be possible. This method would be of particular significance because artefacts are rare in burial cairns. Weathering measurements can even throw light on what characteristics distinguish a prehistoric stone pile from a more recent one. In an expedient weathering environment it is possible to attempt to determine the original size and possible later changes in the stone setting. Further information is, however, needed of the magnitude of weathering differences on surfaces covered by a burial cairn, soil layer, or boulder field in reference to bare surfaces of different altitudes. The burial cairns selected for investigation should preferably be located in slightly inclining, extensive granite areas, in which the uninterrupted development of rebound values can be observed from the shore to the top.

By combining weathering, boulder, and soil studies, information independent of artefact finds can be acquired concerning the age, construction, and material of cairns, the interment of the deceased, recent disturbances, and, possibly, the age of the cairn. This requires careful excavation techniques. The contamination of the stone layers should also be prevented by taking care of the removal of the refuse and the soil as the stone setting is being disassembled during the excavation.

The possibility of combined techniques allows the retrieval of a significant amount of potential archaeological information from the cairns, not only from burials with their endowments. All physical contact with the boulders impairs the possibilities of investigation. To prevent the boulders from moving from their original positions, one should observe special caution when moving on the stones. Restoration or ”improvement” even with good intentions should not be undertaken without investigating the grave carefully at the same time. The same applies to the use of burial cairns as tourist attractions.

5 The Morphology of the Burial Cairns

5.1 The Outlines and Surface Topographies

The shape of the cairn was classified on-site. *Indeterminable* are stone settings with scattered edges, those which possibly extend down along the rock slope as different projections and scattered stone settings, and those which cannot be said to have any particular regular form. The total number of such cairns was 133 (30.5 %). 244 cairns (56.0 %) are *round or oval*, 15 (3.4 %) are *rectangular,* 7 (1.8 %) are of a *polygon or triangle* form and 37 (8.5%) remain *undefined* (*n* = 436).

When surveying the cairns, it is often apparent that the outlines and the surface don't seem to have preserved the form of the original construction. This is suggested by the relationship of the edges to the form of the rock surface under it. At the edges of the cairn, compact and outward-directed boulder projections can often be detected, the outlines of which follow the cavities of the rock surface. They have probably been formed by the movement of the mass which is brought forth when the melting and freezing of water on a sloping rock surface makes the boulders crawl, in the course of thousands of years, little by little downwards until the movement of the boulder is stopped by an obstacle (King & Hirst 1964). On horizontal, even rocks, distinct signs of crawling are more rarely detected. On the slope below the cairn, it is also quite common to find scattered boulders, which seem to have rolled down the descent due to the movement of the mass or intervention by human being or cattle. Clues are, though, rarely available of the age of such slides or their effect on the structure of the cairn. Sometimes, it can be observed that there is compressed moss under the scattered boulders lying on the slope, or that they have not yet had time to become covered by lichen. In such cases, the slide must have occured quite recently, at most 10–20 years ago. Sometimes, on the upper slope of the rock, immediately below the top, tons of boulders lying on the ground can be observed, while the top is quite bare. In a case like this, it can be a question of a totally destroyed burial cairn.

Most of the stone settings are lying on a horizontal ground, on which the movement of the mass is minor. Of the thirteen cairns on a clearly inclining slope, nine are situated on the island of Kimitoön. In Påvalsby, Kimito, there are two adjacent cairns (166, 167) on the slope; the larger one, 17.8 m in length and 2.4 m in heigth, is situated on a rocky moraine slope under a precipice. Under the cairn of Österängsberget, Kimito (118), the ground descends steeply towards the east and only the western edge is on a horizontal ground.

The field studies brought only little light on whether the edges of the stone settings were originally designed as a clearly limited, regular outline. The question primarily concerns a rounding outline because a regular angular form is indisputably visible only in a couple of cairns; the cairn 088 at Furunabb in Houtskär can be mentioned as an example. The vertical dry-stone wall constructions which are usually, at least partly, covered under the boulders, suggest distinct edge constructions, but, in the absence of boulder studies, it is impossible to establish whether the dry-stone wall has originally formed the border of the stone setting, or whether it has been covered under the boulders at the time of the construction.

We can, however, approach this question by means of the graves classified as indefinite by form instead of investigating regular stone settings. If we assume that a regular form has been the aim, and that the friction of the basal surface under the cairn has later affected the magnitude of forces (physical or caused by a human being or an animal) needed to remove the boulders from their positions, the cairns should be more frequently indeterminable in shape where the friction of the ground is the lowest – on the rocks. If we compare the frequencies of the indeterminable stone settings with the frequencies of all the other stone settings on rocks and mineral soils, we cannot, however, present a statistically significant association between the frequency distributions (table 18).

Table 18. The comparison between the frequencies of stone settings with indeterminable outline, and those with a regular shape, on rocks and mineral grounds ($\chi^2 = 0.306$, $df = 1$, $\alpha = 0.580$).

	Indefinite shape	Regular shape	Total
Rock ground	104	211	315
Mineral soil ground	13	32	45
Total	117	243	360

Burial cairns built on boulder fields suggest, however, that a regular form has been the aim when building the stone setting. On such a ground, the edges of the cairn can be assumed to have been preserved well because the boulders have been firmly placed in their positions in the cavities on the ground (a boulder field provides, it is true, a dry vegetation ground, and it is not covered with stone-preserving moss to the same extent as moraine).

There are four known burial cairns built in a boulder field. The cairn on Nämanön, Dragsfjärd (006) is over 20 meters long, it has a rounded edge, and a regular convex surface. Out from Nämanön, towards the stretch of open sea called Gullkrona fjärden, there is the isle of Ängeskär, where a cairn (346) has been built in the boulder field covering the top of the island. The stone setting is 6.3 m in length, 5.9 m in width, with a crater-like cavity in the middle, and a regularly round outline. There is a ditch around the stone setting, which indicates where the boulders have been lifted from for the cairn, and that the edge of the stone setting has not spread essentially outwards, otherwise the ditch would have been covered under the boulders[79]. The cairn on the island of Haverö, Nagu (257) on the eastern cape of the island is large, 12.7 m in length and 10.0 m in width, and its outline is regularly round. Opposite the cape, on the eastern shore of the strait, there is the cairn of Klofsudden, Pargas (268), measuring 9.6 m and 7.2 m, built in a boulder field. Its outline is indeterminable. Thus, three of the four boulder field cairns are of a regular shape. As there are only four cairns and as they may be of very different ages, the shapes of the stone settings must be regarded merely as suggestive evidence of a burial custom that might have included the shaping of a regularly rounded edge in the stone setting.

The surface topography of a burial cairn has been characterized by means of a profile variable with a nominal scale. Uneven profiles, profiles full of pits and profiles following the underlying uneven surface, are classified as *indeterminable* (98 observations, 22.5 %), curving, relatively even surfaces are classified as *convex* (90 observations, 20.6 %). A low stone setting of even thickness is classified as *flat* (81 observations, 18.6 %) while a high-profile stone setting with a flat upper surface is classified as *flat-topped* (3 observations, 0.7 %). In 95 (21.8 %) stone settings the profile is *crater-like* with at least one large deep cavity. In two cairns a *border circle* dominated the profile (0.5 %), and the profile was classified as *otherwise* in four cairns (0.9 %). The profiles of 63 (14.5 %) cairns remained *undefined*.

The shape and the profile are clearly connected to each other. In the test of statistical independence of the shape and the profile, $\chi^2 = 81.880$ with the degrees of freedom $df = 6$, and $\alpha = 0.000$ (the lowest expected frequency $f = 4.0$) (table 19).

Table 19. The shape (the columns) and the profile (the rows) of the burial cairns. Some categories were combined to avoid low frequencies so that cairns of rectangular and polygonal or triangular forms were amalgamated into one class of angular cairns. The rarest profile classes were omitted.

	Indefinite	Round/oval	Angular	Total
Indefinite	66	29	2	97
Convex	25	59	4	88
Flat, flat-topped	24	45	11	80
Crater-like	15	79	1	95
Total	130	212	18	360

Table 20. The shape (the columns) and the profile (the rows). The standardized deviates between observed and expected frequencies for each cell.

	Indeterminable	Round/oval	Angular	Total
Indeterminable	5.2	-3.7	-1.3	0.2
Convex	-1.2	1.0	-0.2	-0.4
Flat, flat-topped	-0.9	-0.3	3.5	2.3
Crater-like	-3.3	3.1	-1.7	-1.9
Total	-0.2	0.1	0.3	0.2

79. The structure is rare but not unique. The cairn 99 in Rieskaronmäki, Nakkila, investigated by Unto Salo, was surrounded by a somewhat similar ditch dug in till (Salo 1981: 151).

The comparison between the observed and the expected frequencies with the help of the standardized deviates (table 20) indicates that the categories of shape and profile classified as indeterminable are most closely connected with each other. This is well in accordance with the often presented interpretation that the scattered condition of the stone setting is due to its having been secondarily rummaged. The displacing of boulders is bound to cause irregularities and spread out the edges of the stone setting which certainly does not give more regularity to the setting than before. Consequently, the more substantial the secondary manipulation of the cairn, the more uneven and scattered the stone setting should be. Yet, secondary interference is only an interpretation because, so far, there is no means – at least without excavations – to establish what the ”original” stone setting was like, whether its surface was flat, and what changes the stone setting has been exposed to after its construction. The cairn might have been rebuilt or modified – and thus reactivated in rituals during a very long time as Hans Bolin suggests (Bolin 1999) – so one may ask whether there was any ”original”, permanent, and completed shape.

On the other hand, it seems that crater-like profiles, which have been regarded as evidence of secondary manipulation, are not, as one could expect, typically connected with the indeterminable, scattered stone settings, but rather with rounded cairns. If we stick to the idea that the craters have mainly been caused by people looking for buried things in the historical times or, in any case, a long time after the burial, we can assume that mainly round and oval cairns have become objects of ransacking because they are most easily recognized as constructed by man, and they are more common than, for example, the rectangular ones.

The contingency table (table 19) indicates that there is an association between the angular shape, and the flat profile. Angular, flat burial cairns, often characterized as stone settings, thus form a morphological group of their own. Low stone settings can often be distinguished as a group of their own characterized by the feature that the boulders have been set on a flat, often level, rock surface (at least 7 cases). However, it should be noticed that a flat and horizontal basal surface may have been a precondition for the preservation of a flat stone cairn. In such a cairn, the weight of the stones may not be sufficient to keep them in their positions to the same degree as in large cairns. Thus the stones of a small stone setting are easily displaced from their positions by the feet of people or cattle. They may also get caught in the movement of mass caused by the freezing and melting of the water. It may be assumed that there have been low cairns even on other kinds of surfaces than flat ones, but they have been destroyed in the course of time.

5.2 The Dimensions and Relative Lengths

Most of the cairns in the southwestern archipelago are small. Measured by the product of length and width, the area of half of the cairns is less than 50 m^2. If the length and the width were the same, the measures would thus be less than $\sqrt{50} = 7.1$ m (table 21). Cairns with dimensions of more than ten meters represent less than one fourth of the material. The few large graves are, however, so big compared with the small ones that the distribution of the area of the cairns becomes lognormal (figure 35). Among the largest burial cairns are Hammarsboda 106 (043, 291 m²) and Hammarsboda 107 (044, 204 m²) in Dragsfjärd, Smisskullen (122, 277 m²), Verkholm (126, 227m²), Tjuda (132, 242 m², Påvalsby (167, 233 m² and 168, 355 m²), Kåddböle (176, 337 m²), and Kummelberget (178, 205 m²) in Kimito, Kummelberget (285, 303 m²) in Pargas, Öijen (232, 283 m²), Sandö (233, 203 m²), and Öbergen (358, 400 m²) in Nagu, Hanka in Rymättylä (310, 245 m²), and Trollberg (087, 207 m²) in Houtskär.

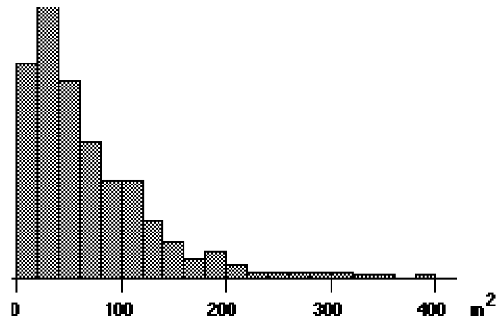

Fig. 35. The distribution of the area of the stone settings of the burial cairns. n = 358.

Table 21. The length, width, height, area (product of length and width) and volume (product of length, breadth and height) of the stone settings of the burial cairns.

Variable	$\bar{x}$	Median	Min	Max	s	Quartile range	Skewness	n
Length	9.2	8.0	1.6	48.8	5.3	2.8	2.6	363
Width	6.6	6.0	1.3	20.0	3.2	2.1	1.0	358
Height	0.8	0.7	0.2	2.4	0.4	0.3	1.2	338
Area	69.9	49.8	2.1	400.0	62.5	35.5	1.9	358
Volume	75.3	31.5	0.8	639.3	107.4	39.7	2.7	331

Large burial cairns mainly occur on large islands such as the island of Kimitoön and the main islands of Pargas and Nagu (figure 37). Typically there are other, often large cairns in the immediate vicinity. The Trollberg grave in Houtskär, located in the west, far from the other large cairns is, however, an exception in this respect.

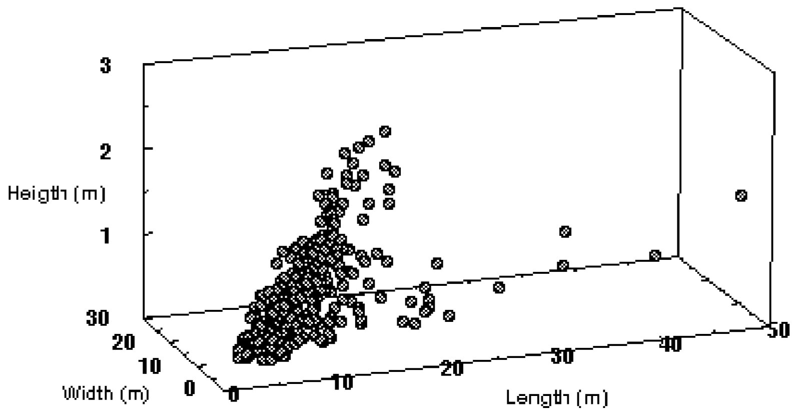

Fig. 36. **The length-width-height-hexahedron of the burial cairns.** ***n*** **= 338.**

The large cairns can be classified into two, partly overlapping, morphological groups. In the main part measuring more than 15 meters, the length of the stone setting is only a little greater than the width. Part of the large cairns are, however, separated as the group of *long cairns* (*Sw. långröse*). The longest of them is the cairn of Öijen, Nagu (232), a 49 m long cairn in SW–NE direction on the ridge of a rock outcrop. The width is 5.8 m and height ca 1.4 m. According to statistics given by Juha-Matti Vuorinen, Öijen is the longest cairn in SW Finland – if not in the whole country (Vuorinen 2000 c: 181). It is longer than, e.g. the grave at Viikkala, Nakkila (Kuokkanen & Korkeakoski-Väisänen 1985; Salo 1981b: 175–177).

Many small cairns, too, are long, even wall-like, but they are not as distinctly a separate group in the size distribution of the burial cairns as the large cairns. The distinction between the large cairn groups is visualized in figure 36 as two ”whiskers” scattering into different directions.

The *relative length* or the ratio of the length to the width of the stone setting is distributed between 1.00 and 8.41. The relatively longest cairn – the great cairn of Öijen – is thus more than 8 times longer than its width. In large cairns, long burial cairns can be separated from the rest of the cairns by the relative length of approximately 2.5. Of the large cairns, 17 are long cairns with a relative length more than 2.5. The large long cairns are mainly situated on large islands, yet close to the sea. They only occur near Dalsbruk, Dragsfjärd and in an area covering Lillandet, Nagu, the south-western part of Pargas, and Hanka, Rymättylä (figure 37).

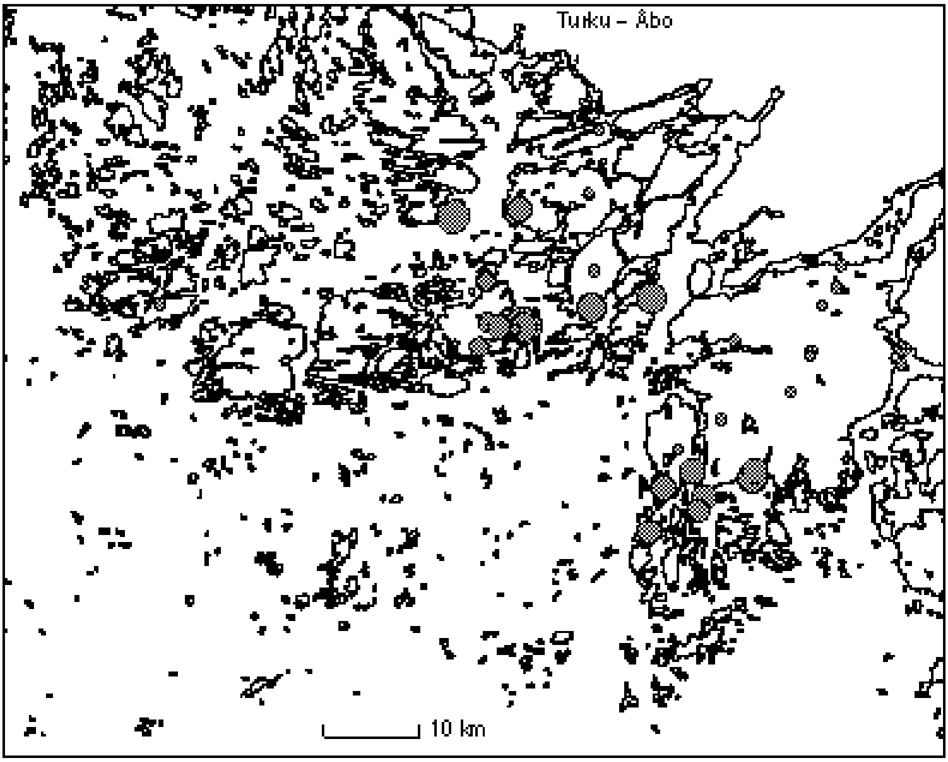

Fig. 37. The 38 largest burial cairns in Åboland (length more than 15 meters or area larger than 175 m²). The size of the symbol on the map is directly proportional to the relative length of the stone setting.

In the largest cairns, there seem to be no intermediate forms between long and other burial cairns. There are no long stone settings in the form of T or L either, but the long cairns are rectilinear[80]. This supports the earlier notions of long cairns forming a separate group, possibly dating back to the Pre-Roman Iron Age (Salo 1981 b: 95–96; Tuovinen 1980). Long, structureless burial cairns occur also in Satakunta and in Southern Ostrobothnia. They are believed to originate from an enlargement of the stone setting in the longitudinal direction in connection of secondary interments (Salo 1981 b: 170–172; Salo 1984b: 188) or from building several burial cairns together to form a chain (Miettinen 1980: 91). The idea of long burial cairns having their origin in longitudinal enlarging is supported by the fact that only one way of enlarging needs to be considered: the stone settings of the cairns have been enlarged either at the edges in the direction of the radius, whereat the setting has been enlarged both longitudinally and latitudinally, or in the longitudinal direction, whereat the form of the stone setting has gradually approached that of long cairns. Building a chain of cairns involves, on the other hand,

80. In a note published in the newspaper *Åbo Underrättelser* in 1935, under the pseudonym G. (Allan Gustafsson), it was told that in Släts, Dragsfjärd, there was a large stone setting of the form of a cross. So far, I have not been able to locate it. See Gustafsson 1935.

joining together stone settings, which is difficult to imagine as the manner of enlarging cairns of other types than long cairns.

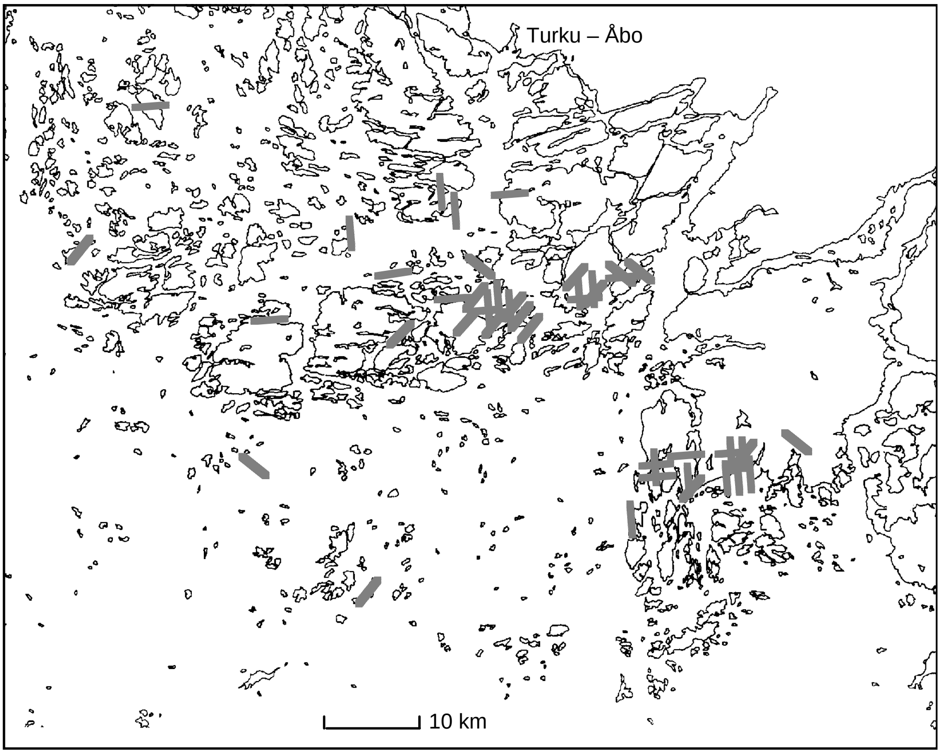

Fig. 38. Burial cairns with a relative length of at least 2 (*n* = 49). The direction of the map symbol indicates the direction of the longitudinal axis of the stone setting.

Clearly elongated cairns are usually not equipped with architectural constructions. At one or both ends of the stone setting, there may, however, be large boulders or slabs raised transversely in regard to the longitudinal direction. These boulders have probably formed constructions giving prominence to the ends of a long stone setting. Large boulders placed mainly at the gable occur in altogether 13 oblong burial cairns. At Kosackkullan, Dragsfjärd (002), the 26.8 meters long and 7.1 meters wide burial cairn in the W–E direction ends in the western part in a rock precipice and a large boulder, and in the eastern part in a rock bank. The close group of cairns in Hertsböle, Dragsfjärd, consists of three long cairns, the constructions of which contain large boulders (022, 025, 027). At both ends of a wall-like, 18-meter-long cairn at Mågby, Pargas (271), there are large boulders. The cairn at Strandby, Pargas (299) is rectangular, in the east-west direction and at the eastern end there are distinct, large rounded gable boulders. There are boulders even in the cairns of Kosackkullan (002) and Söljeholmen (048), Dragsfjärd, in the cairns of Taslot (204), Ådholm (206), Brännskär (212), and Piparby (231), Nagu, and in the cairns of Boda (263) and Mielisholm (277), Pargas. The cairn can also end in an erratic rock which is so heavy that it is highly improbable that it has been dislocated while constructing the cairn (Mielisholm, Pargas, 269).

Other structures are rare in oblong burial cairns. At Prostvik, Nagu (220), there is a 14.4 m long, 6.4 m wide and 1.1 m high cairn on a high rock. Its stone setting has revealed parts of a straight wall of dry-stone construction in rapakivi granite, the visible part being 2.0 m in length and 1.1 m in height. The wall does not run in the S-N direction like the stone setting but in the direction SW-NE. The oblong burial cairn (328) investigated by Volter Högman in the year 1886 at Lillskogen, Västanfjärd, was lined by large boulders set in a rectangular form.

5.3 The Direction of the Longitudinal Axis

The stone settings in over one hundred burial cairns are so round that it is impossible to establish any particular direction on them. The approximate direction of the longitudinal axis of the cairn can, however, be determined in most cases. The S–N direction is predominant but other directions, too, are evenly represented (table 22). In long cairns, the direction of the longitudinal axis seems to be dependent on the local strike of the bedding and banding of the bedrock. The longer the burial cairn is and the nearer the top of the rock outcrop it is located, the more eminent this feature is.

Many long cairns have been situated on the top so that there is a 1–3 meter high precipitously descending or vertical distal rock stair beside them, and the cairn has been constructed in the direction of its brink. Such burial places have been discovered especially in Nagu, for instance on the island of Brännskär (212, figure 38), individual ones also in Houtskär, Rymättylä and Pargas. At Simonby, Nagu (223), the cairn is lined on both sides by an approximately three-meter-high rock precipice. Below the stair, on the rock surface there are usually boulders, probably originating in the cairns.

Table 22. The directions of the longitudinal axes of the cairns.

Direction	n	%
N-S	83	32.0
SW-NE	60	23.2
W-E	66	25.5
NW-SE	50	19.3
Total	259	100.0

Fig. 39. A large cairn at Norrskogsbergen, Nagu (240). Photographed by Timo Kuokkanen (TYA).

Fig. 40. A small cairn on the island of Mjoö, Nagu (254). Photographed by the author.

5.4 The Architectural Constructions

5.4.1 The chains

The structural details of the cairns consist of different stone chains or parts of them, walls set of boulders, caskets arranged of slabs and prominent upright boulders on the stone settings. The stone chains are usually hidden inside the cairns and they can only be observed if the surface has been damaged to the extent that part of the chain has become visible. Chains have been reported in 30 burial cairns; 11 of them have been discovered during the excavations and 19 registrations have been made during the survey work. The figures indicate distinctly that parts of the stone setting must be taken up in order to detect chains. It ensues from this, moreover, that unexcavated and excavated burial cairns must be kept apart when investigating the occurrence of chains. The same applies also to other inner structures of a stone setting. If we assume that the excavated burial cairns represent sufficiently all preserved cairns, 39 % of all cairns would have at least one chain.

Stone chains appear most usually as a sequence of boulders surrounding the periphery of the cairn either along the edge or embedded between and under the stones. The chain may consist of one layer of boulders or several boulder layers as a dry-stone wall (figures 42 and 43). The heights of the constructions range between 0.3 and 1.0 meters. In case of several chains, they are concentric. One chain has been registered in 23 cairns (5.3 % of all), two chains in six (1.4 %), and three chains in one (0.2 %) cairn. I have also seen groups of boulders in a row as well as edge-like stone settings which might be parts of a chain or just incidental structures from the time of the building process.

A peripheral chain was reported by Ella Kivikoski in 1935 when she was investigating the burial cairn at Söderby, Dragsfjärd, and also by Volter Högman during his investigations at Långnäsudden, Dragsfjärd, at Hammarsboda (108), and at Tjuda, and at Jättekastberget, Kimito. Of the burial cairns investigated at Furunabb, Houtskär, three had a peripheral chain. There are peripheral chains recorded in surveys at Stornäset in Dragsfjärd, at Storhomman, Kummelberget, Tjuda, Mörkdalsberget, and Östermark in Kimito; further, at Kummelbergen, Houtskär, at Norrby, Iniö, at Prostvik, and Simonby, Nagu, and on the island of Öijen, Pargas.

The cairn at Storhomman (125) is on the top of a rock outcrop at the altitude of 45 meters (figure 41). It has been constructed of rounded and edged, mainly granite boulders (about 1–150 kg). The NW, W, SW, and E edges reveal a dry-stone construction, a 0.4–0.5 m high wall set of two or more slabs laid flatwise. At the SW edge, the top slab has been propped in a horizontal position by means of stone wedges (figure 42). There are also loose slabs in the stone setting, probably deriving from a damaged chain.

Fig. 41. A burial cairn at Storhomman, Kimito (125). Photographed by the author.

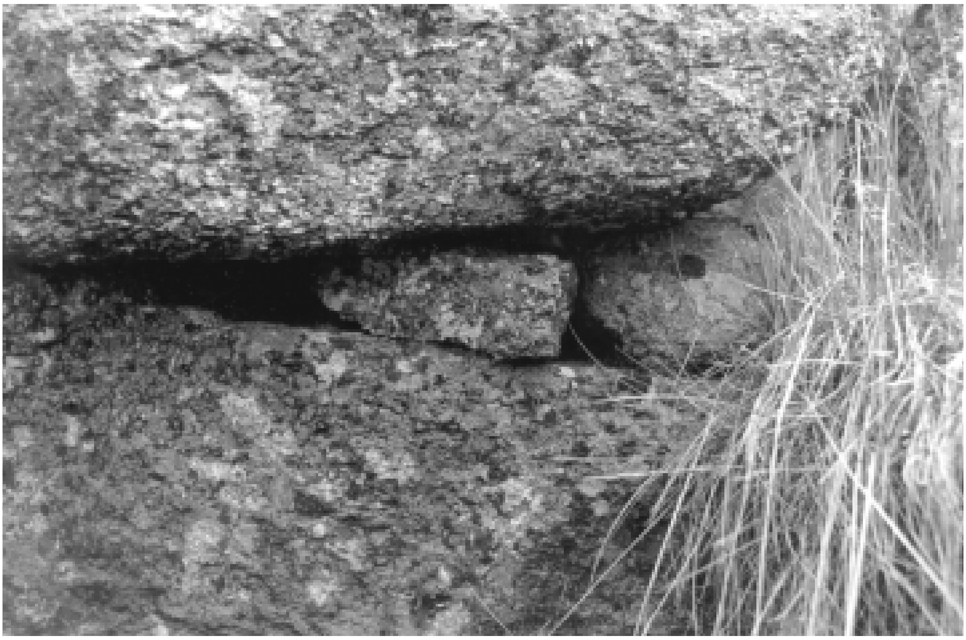

Fig. 42. A detail of the chain of the SW periphery of the cairn at Storhomman: stones wedging the boulders in a horizontal position have been pushed between the flatwise laid rounded boulders of the dry-stone. Photographed by the author.

Fig. 43. A burial cairn with an upright dry-stone wall at Genböle, Dragsfjärd (001). The boulders have been apparently collected in the adjacent terrain, in which schistose gneiss is cracking up into edged pieces. Photographed by the author.

Fig. 44. A burial cairn on the island of Långfuruholm, Dragsfjärd (060). Photographed by Timo Kuokkanen (TYA).

Fig. 45. A burial cairn at Furunabb, Houtskär (088). Photographed by Timo Kuokkanen (TYA).

At Österängsberget, Kimito, there are two burial cairns (117 and 118) at a distance of 30 meters from each other. The northern one is structureless, large – 12.4 meters in length – and it has been built on a precipitous convex rock surface. The southern cairn, 4.5 meters in diameter, consists of edged and rounded boulders of various sizes up to 200 kilograms. In the NE part of the cairn a part of a 0.3–0.4 meter high chain can be seen: an about 3-meter-long sequence of edged boulders set on top of each other with their smooth surfaces outward. The preserved part is evenly curved which suggests that the stone setting has originally been round or oval. – At Tjuda, Kimito, too, there is a cairn (128) lined by an evenly curving chain. 11 boulders of equal size, approximately 100 kilos, are visible.

At Kummelberget, Elmdal, Kimito, there are two cairns (140 and 141). In the northern cairn there is a section of a dry-stone construction consisting of 3–4 layers of slabs on top of each other in the western and northern part of the cairn. The chain of the western part is the most distinct, linear and 2.8 meters in length. In the northern part, the chain is curved and more collapsed; 2.3 meters of the curving chain can be seen. If the dry-stone wall at Kummelberget has been a peripheral chain bordering the cairn, the cairn has not been, at least not entirely, roundly curving in outline. The southern cairn at Kummelberget – at a distance of 20 meters from the former – is lined for the length of approximately 6 meters, by a dry-stone wall, 1–3 layers in height, of edged slabs with the smooth side carefully laid outwards. In the cairn at Mörkdalsberget, Kimito (184), there is also a linear dry-stone wall with 4–5 stone layers.

At Trotby, Kimito, there is a ten-meter long burial cairn has been built of rounded and edged boulders (123) (figure 46) at the height of 56 meters, 50 meters to the west of the highest point of the rock. At the southern and western edges of the cairn, a dry-stone wall layed flatwise of slabs can be seen. The edged slabs have been placed on each other with the smooth surfaces outwards in 1–3 layers. The evenly curving 0.3–0.5-meter-high wall is visible for the length of 10.7 meters. The middle and northern part of the burial cairn descends down as a crater. At its northern edge, there are inwards inclining slabs, propped up to each other and the rounded boulders underneath – part of some sort of an inner structure.

Fig. 46. A cairn at Trotby, Kimito. Photographed by the author.

The cairn at Spångmalm, Kimito (137), is at the altitude of 53 meters on the top of a rock outcrop, twenty meters SW of the highest point. In the ten-meter-long cairn there is an exceptionally distinct dry-stone structure which can be seen at the edge of the cairn underneath and between the boulders. It has been laid of mostly edged boulders in one to four layers, 0.2–0.6 meters high and evenly curving. The plane surfaces of the boulders are visible from the outside. The same pattern of the edged boulders with their plane surfaces outwards can be seen in some other chain constructions as well.

Two concentric chains have been observed in excavations, at Tjuda, Kimito, Lillskogen in Västanfjärd, in two cairns at Jordbro, Dragsfjärd, and at Trollberg, Houtskär. – The cairn at Genböle (001, figure 43) in Dragsfjärd, has not been excavated. It is a cairn 14.2 meters in length, 13.1 meters in width and 2.2 meters in height, which has been set of rounded and edged stones and boulders (approximately 1–150 kilos) on the highest top of a rock at the height of 45 meters. Along the edges of the cairn some damaged remains of two concentric dry-stone walls can be seen, built of edged boulders, mainly longish slabs, by setting them on top of each other in the direction of the radius. The structure is most distinctly visible at the N, SE, W, and NW edges of the cairn. In this cairn, too, the boulders have often been set with their even plane surfaces outwards. In the wall, boulders detached from the slope of the gneiss outcrop seem to have been used.

There were three concentric circles in the cairn at Labbnäsåsen, Dragsfjärd, investigated by Volter Högman in 1886. The outer circle was built of flat, plane boulders and inside there were two further concentric chains. The inner chain was not entirely on the rock but partly on a soil ground.

5.4.2 The stone cists

Stone cists have been discovered in only three cairns in Åboland. In his investigations at Tjuda, Kimito (130), Högman observed, besides chains, within the outer circle an indistinct stone cist, 1.8 m in length and 1.0–1.3 m in width. Inside the stone cist, there was some charcoal and unburnt and burnt (human?) bone in an area of 1.3 x 0.8 meters. – At Sunsveden, Houtskär, there is an exceptional cairn constructed on a horizontal shelf-like surface (081), with an area of about 5 square meters of bare rock surface in the middle. In the SW part of the cairn, there is in the SE–NW direction a stone cist set of vertical slabs, filled with stones. The length of the construction is 3.6 m, breadth 2.0 m and height 0.6 m. It is unusually large for a stone cist; indeed of the same size as the cist in the massive cairn of Viikkala, Nakkila (Satakunta) (Kuokkanen & Korkeakoski-Väisänen 1985). The Sunsveden coffin consists of maybe two slab cists.

The cairn on the little island of Långfuruholm, Dragsfjärd (060), is known since Högman's expedition. The cairn is situated on the top of a rocky islet of the size of 8.8 hectares, on a convex rock surface, at the altitude of 11.2 meters. Although the cairn is not at the highest point of the skerry, it is visible to the sea for some distance, which is not usual. The cairn has been collected of rounded boulders of the size of about 1–30 kilos. On both sides of the middle crater, there are two flat vertical stone slabs (figure 44). When Svante Dahlström visited Långfuruholm in 1929, he noted two or three boulders turned into an upright position in the cairn. On the boulders, some horizontal slabs had been lifted, forming the cover of something like a stone cist. When peeking under the cover, he could see human bones, among others unburnt parts of a human skull (Dahlström 1940). Hildur Planting visited the island four years later. She described the construction as a pit covered by two large slabs and bordered by two cubic and one rounded boulder. Between the boulders there opened a cavity the bottom of which was covered by a thin layer of humus. On the bottom of the cavity, she saw human cranial bones, a *femur* and some *vertebrae*. According to oral tradition the stone setting had been rummaged on several occasions. The cairn had been stirred up in order to ”att åt skelettdelarna bereda en värdigare plats” (prepare a worthier place for the skeleton parts). Planting collected a bone sample of 8.2 grams, which has later been determined as unburnt parts of the *calvarium* of a human adult (*Adult*, MIND = 1)[81].

When revisiting Långfuruholm in 1940, Dahlström observed that the coffin had been destroyed meanwhile. The slabs had been removed far from each other and erected (Dahlström 1940). The stone setting is still in approximately this state. On both sides of the middle crater, there are two flat vertical boulders in the direction W–E.

81. See survey report by Planting 1933: 1–2 (NBA). Artefacts: NM 9749:2. The osteological analysis was carried out by Tarja Formisto, Stockholms universitet 1987.

5.4.3 Other constructions

There are six cairns with centrally placed boulders, vertical slabs or various kinds of boulders rising from the stone setting: in the Hammarsboda cairn 10 in Dragsfjärd, in two cairns in Furunabb, Houtskär, in one of the cairns in Lofsdal in Pargas, and in the cairns at Södergårdskvarn and Nivelax in Västanfjärd. In Hammarsboda 10, there is a large rounded central boulder. The Södergårdskvarn, Nivelax, and Lofsdal burial cairns seem to have been built around an erratic boulder of the height of more than a meter. – In Engelsby, Kimito, there is a cairn, which seems to have been built between large erratic boulders weighing many hundred kilos in a way that the boulders have formed a rectangle surrounding the cairn. The cairn is, however, scattered to the extent that the construction is no longer distinct.

The vertical stone slab in the rectangular cairn 088 in Furunabb is an edged slab of the height of 1.7 meters (figure 45), the long side of which is fairly exactly in the direction N–S and the side profile of the form of an irregular polygon. Further, the burial cairn 093 had, according to the excavation report, two gravestones.

On the highest point of Ängeskär, Dragsfjärd, there is a burial cairn (346) built of rounded stones, surrounded by a ditch and a boulder field. The boulders of the cairn have obviously been lifted from the ditch. Although boulder fields and shore formations washed out of moraine occur frequently in different parts of Åboland, not many cairns seem to have been built in them; besides Ängeskär, among these cairns belong Nämanön in Dragsfjärd (006), Jälankort in Innamo, Nagu (208), and Långholm in Iniö (102). Ängeskär is probably the only cairn where it can be morphologically discerned where the stones and boulders have been taken from. Building a burial cairn in a boulder field is not as such rare and the grave type has also been reported in Sweden and Norway (e.g. Lundborg 1966; Tysdal 1985).

From Malmudden, the shore of Pargas situated on the side of Erstan (*Fi.* Airisto), there reaches an esker about four kilometers to the SSE. In Koupo, at the southern end of the esker, there are side by side two burial cairns set mainly of rounded boulders (297 and 298). The greatest dimensions of the cairns are 5.7 and 12.9 meters. They are joined together by a stone setting about 48 meters long and about 2 meters broad, with a convex profile, running in the direction SE–NW, and consisting of rounded boulders. To the west of it there are some small stone settings at the level of the ground (fig. 47). Although the long cairn is on the top of the esker, the surface of which has become washed and possibly deformed by the waves[82], the impression, however, remains that the construction is not a natural formation but a stone road built between two burial cairns. It can also be a question of a variant of a long cairn, with an extended stone setting at both ends. There would not seem to be many equivalents for the construction. Unto Salo has described a stone road starting from a burial cairn in Soukainen, Rauma, limited by two parallel lines of stones, the context of which dates back to the Bronze Age (Salo 1981 b: 171–172). From Tyrväntö, a 50 meter long road, starting out from a burial cairn, is known (Kivikoski 1966: 96). A kind of parallel construction is included in the Rösaring complex in Central Sweden. There, a cairn cemetery, some mounds and a labyrinth appear in connection

82. For a description of the deformation mechanism, see Granö 1977.

with a 540 meter long stone road, which has been dated back to the Viking Age (Damell & Östmark 1986).

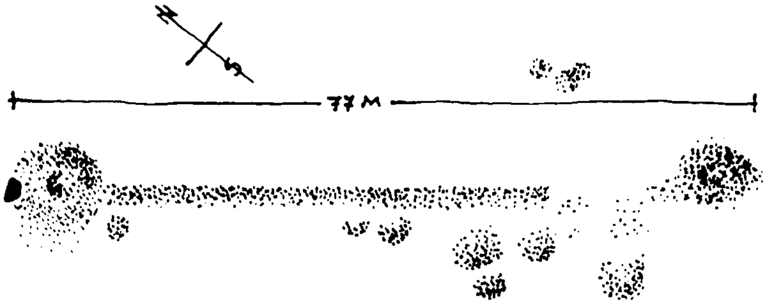

Fig. 47. A stone road on the esker between two burial cairns in Koupo, Pargas. Drawing by Ragnar Nyberg (Nyberg 1985: 35).

Here and there, projections diverging from the edge of the cairn occur. The most distinct of them is in a crater-like cairn in Sandvik, Pargas (301). From the southern edge of the cairn, an about 3.5–4.0 meter long projection, set of fairly large boulders, diverges to the SE.

5.4.4 Burial cairns with and without architectural constructions

There are chains, dry-stone walls, stone cists or other constructions in 40 of the burial cairns. The small number may partly be explained by the fact that they are often only observed if the cairn is excavated or damaged. Especially in large cairns, the stone setting can conceal constructions, which only become visible when the stone setting is being taken up.

Table 23. Comparison between burial cairns with and without architectural constructions: the ln-volume, roundness proportion, altitude and ln-sum of distances to nearest neighbours. The degrees of freedom for the altitude were determined using the Welch method (Widjeskog 1987).

No constructions	$\bar{x}$	s	n	Constructions $\bar{x}$	s	n	*t*-test t	df	α
Ln-volume	3.416	1.396	293	4.017	1.132	38	-2.55	329	0.011
Roundness proportion	4.8	1.1	310	4.4	1.2	35	1.87	343	0.062
Altitude	25.20	10.98	332	29.26	13.68	40	-1.81	45.3	0.077
Ln-sum of distances	-1.496	0.791	332	-1.264	0.880	40	-1.73	370	0.084

The comparison of structureless burial cairns with cairns with additional constructions indicates the most distinct difference in the size of the stone cover. If the length, width, and height are multiplied by each other, the volume of the smallest hexahedron is acquired into which the burial cairn would fit. This volume is, in the structureless cairns, 72 cubic metres on the average and 97 cubic meters in the cairns with a structure. The distributions of the volumes are, however, highly skew, in consequence of which the comparison between the mean values has been presented, instead of the volume, with the natural logarithm of the volume (the *ln*-volume). The difference of *ln*-volume between cairns with structure and structureless ones is statistically significant (α = 0.011, table 23). If there are structures in a small and flat cairn, they become more easily observed than if hidden under a large mass of stone in a large cairn. The structures of small burial cairns are, accordingly, well represented in the material. This confirms the fact that the larger average volume of burial cairns with a structure is actual.

The differences in the roundness proportion of the boulders, in the altitudes and the sum of distances to nearest neighbours (*ln*-as a transformed figure) are considerably smaller when comparing the structureless cairns with those containing a specific structure. The stone settings of the structureless cairns, on the average, consist of more rounded boulders than the settings of cairns with a structure. Cairns without a structure are situated, on an average, at the altitude of 25.2 meters from the sea level, whereas the ones with a structure are situated a little higher, on an average, on the level of 29.3 meters. The average sum of distances to five nearest neighbours is 0.318 for the structureless cairns and 0.433 for those with a structure. The structureless cairns are, accordingly, situated, on an average, further away from other nearest burial cairns than the ones with a structure.

5.5 The constructing material

The burial cairns in Åboland are composed of stones and boulders without a soil filling discernible from the outside. Although attention was paid during field work on detecting possible mixing of soil in the stone-settings, actual stone settings consisting of a mixture of stone and soil were not found. An exception is cairn 2 in Sundbergen, Nagu, the construction of which revealed, during excavation, a sand layer on the bottom of it; superficially observed, this cairn did not seem mixed with soil.

The distribution of the roundness proportion (figure 48) indicates a feature characteristic of burial cairns. Contrary to natural stone heaps, burial cairns consist of mixed material. In the surface layer, boulders rounded by wearing get mixed with edged boulders originating from moraine or rock surfaces broken by exfoliation. This feature can be used as one of the criteria of identifying a burial cairn.

Burial cairns consisting of edged boulders or almost exclusively edged ones are rare (8 observations). They are small cairns in Houtskär, Nagu, Kimito, Dragsfjärd, and Västanfjärd at different altitudes up to 35 meters. The cairn on Svinö Svälteskär, Houtskär (071), is uneven by surface and assembled of almost exclusively granite stones. The cairn on Svinö Norrnäs, Houtskär (082) is situated on the altitude of 9.5 m, consequently it was built after the Bronze Age. The cairns in Västerskogen, Houtskär (079 and 080) are small stone settings, similar to the cairn on Högsar, Nagu (359). A cairn in Vestlax, Kimito (192), consists of exceptionally small stones and boulders. The Söderviken cairn, Västanfjärd (327), is at the altitude of 15 meters, which dates it at the most about the age of the Litorina VI shore level zone (Glückert 1976). Beside it, there is a rectangular stone setting, similarly consisting of mostly edged boulders, which, on the ground of equivalents (e.g. Edgren 1983) would date rather from the Iron than the Bronze Age. The cairn at Krogarudden, Dragsfjärd (059), on the other hand, is situated in the vicinity of a medieval harbour (Kallberg 1990; Edgren 1999 b) that possibly dates back to the late Iron Age. In consequence, burial cairns consisting of edged boulders would seem to have, to a certain extent, an Iron Age context.

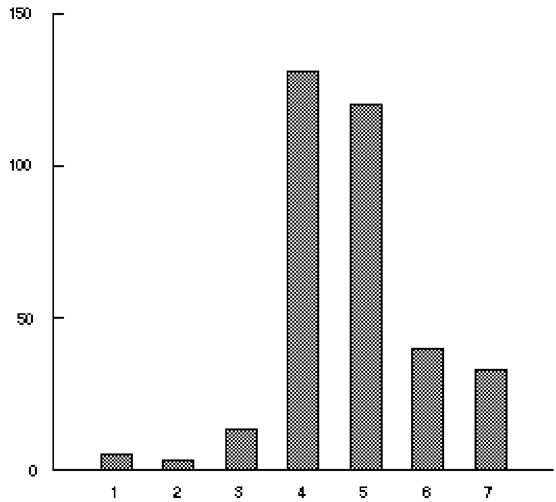

Fig. 48. The distribution of the roundness proportion of the boulders (*n* = 345). Codes: 1 – edged; 2 - almost exclusively edged; 3 - mostly edged; 4 - edged and rounded; 5 - mostly rounded; 6 - almost exclusively rounded; 7 – rounded.

Burial cairns built of exclusively rounded boulders constitute a more heterogeneous group, in which part of the cairns are situated quite close to a boulder field. There are altogether 33 of them. Their distribution, to a great deal, concentrates in the archipelagoes of Dragsfjärd and Lillandet, Nagu. As to their context, there are among them cairns referring to both the Iron and the Bronze Age.

5.6 The interments

On the basis of field records, 31 cases of interment can be distinguished (table 24 and Appendix 2). Half of them have been provided with a stone chain surrounding the grave or with a frame or a cist-like structure laid of boulders. Constructions are oftenmost observed not until the cairn is excavated, and they seem to be in connection with the size of the stone setting, especially with its height. For instance, of the low stone settings investigated in Furunabb, Houtskär, only one (093) was reported to be equipped with constructions.

The gravegoods are sparse. In the only burial cairn containing ceramics, in Jordbro, Dragsfjärd (036), the fragments of a clay vessel possibly originate from an underlying Neolithic cultural layer dating to the Kiukais culture (Meinander 1954 b: 60). There remain six interments which have contained artefacts; according to this, every fifth of the interments would be equipped with gravegoods.

There are no more than one individual in each burial, so far it can be determined. Of the samples enumerated in the table 24, the samples from Jordbro, Rosendal and Långfuruholm in Dragsfjärd and Vallis in Pargas, do not originate from an excavation, so the comparison of their numbers of individuals with the excavation samples is not sensible. Cairns containing no bones at all may be inhumations in which bones have been destroyed (e.g. Salo 1981 b: 178; Kaliff 1992: 15).

Table 24. The osteological finds of the burial cairns in Åboland: the sample size (g), the part defined as human bone (g), the calvarium parts (g), the estimated age, the number of individuals MNI, animal bones and the occurrence of burnt/unburnt bones. The samples were analysed by Tarja Formisto in 1987 and 1998[83]*.*

Burial	Sample size (g)	Determined (g)	Calvarium (g)	Age	MNI	Animal bones (g)	Burnt	Unburnt
Jordbro, Dragsfjärd (036)	14.6					Seal 14.6	X	X
Jordbro, Dragsfjärd	15.4	14.6	1.9	Adult	1		X	
Rosendal, Dragsfjärd	23.3	10.0	2.4	Adult	1		X	
Långfuruholm, Dragsfjärd (060)	8.2	8.2	8.2	Adult	1			X
Söderby, Dragsfjärd (037)	16.9	7.7	3.6	Adult	1		X	
Tjuda, Kimito (129)	34.6	22.5	7.4	Infans II/ Juvenilis	1	Unburnt, horse 3.7	X	X
Vallis, Pargas (282)	0.5							X
Trollberg, Houtskär (087)	330.1	231.8	32.1	Juvenilis/ Adultus	1		X	
Sundbergen 1, Nagu (258)	179.0	179.0	.	Juvenilis/ Adultus	1	25.8 bird, rodent, roe deer/deer, fish	X	X
Sundbergen 2, Nagu (259)	249.9	249.6	.	Adult	.	202.9 cattle, pig, goat/sheep, bird, cat, rodent, fish	X	X

The known human bones are burned with two exceptions, the cairn on Långfuruholm, Dragsfjärd, and the cairn 2 on Sundbergen, Nagu. In these cairns, the conditions of preserving of an unburnt deceased in a burial cairn were certainly not good, especially during the centuries following the burial, when oxygen, humidity and the washing effect of water are influencing the remains of the deceased before there had formed a protecting layer of humus under the stones. Neither of the cairns, indeed, has a high age. The altitude of the Långfuruholm cairn is 11.2 meters, which approximately corresponds to

83. It was not possible to determine the sex from the samples. The samples are, in the order of the table, NM 2503A:22, NM 9575:1, NM 9575:2, NM 9749:2, NM 10108:1–4, NM 2503A:19–20, TYA 170, NM 20434:1–3, TYA 486:23–29 and TYA 486:14–20.

the Litorina VII shore level (200 AD) (Glückert 1976). The cairn is, however, probably younger than the Roman Iron Age. The Sundbergen cairn 2 dates back to the Late Iron Age, according to the excavation results examined earlier[84].

Let us assume that both of the cairns were built in the Late Iron Age, approximately in the ninth century. The land surface, at that time, was 5.3 ± 0.9 meters lower than today. Of the present area of Långfuruholm, which is 8.8 hectares, about 4.6 hectares was above the sea level at that time. The island must have consisted, at that time, of almost exclusively bare granite bedrock. Sundbergen, which is the northern point of Nötö, was 5.6 ± 0.9 meters lower than today. The point formed a 20 meter high rocky cape diverging from the main island of Nötö, connected with the larger island by a neck of land only a few meters high. The area of the cape separated by the isthmus was 22 hectares. On the S and E shores and in the slopes, there were boulder fields, and in the SW slope mineral soil, but for the rest, the island was nothing but bedrock.

The local topographies of Långfuruholm and Sundbergen suggest thus that the wood supply was short. This can, as Milton Núñez has suggested in a seminar contribution, explain the fact that the deceased were buried unburnt: the amount of wood required for a pyre was simply not available. Mogens Bo Henriksen has demonstrated experimentally that the burning of a carcass of a swine in a pile would take one cubic meter of hardwood, when the burning takes place in a well arranged wood construction (Henriksen 1993). Besides the structure of the burning pile, the amount of energy needed certainly depends on wind, the moisture of the wood and other conditions where the burning takes place. In circumstances typical of the archipelago, more than one cubic meter of wood would probably have been required to burn a human body.

84. In addition, there are two unverified notes concerning possible Iron Age or later inhumations in stone cairns: a note by John Gardberg in 1929 from Norrkumlet, Korpo (348) (Tuovinen 2000 b: 50), and a note from Arkesholmen, Pargas (Finska Hushållningssällskapet 1979: 265; Nyberg 1985: 51). The latter site is at the altitude of less than 10 meters, on the top of an island 1.8 hectares large.

6 The Cemeteries and the Single Graves

The burial cairns have been built on islands and rocky islets, separated from each other by straits, in places even by wide stretches of open sea. Due to the mosaic pattern of land and sea as such, cairns on same islands are located relatively close to each other, while graves on different islands are situated far from each other. So far, burial cairns are not known in swamps or cultivated land – they would, indeed, have become cleared away from cultivations – so, the pattern of the soil also affects the relation of the cairns to the terrain and to each other.

The cairn constructors, however, often placed the graves in a distinctly more compact group than the pattern of the surrounding areas of water, cultivations and swamps as such would have required**.** In Houtskär, Korpo and Nagu, the spatial clustering of the burial places is, as we have seen above, statistically significantly greater than that of randomly selected places. The relative locations of burial places are, thus, not explained only by the pattern of the soil or the pattern between land and sea.

In the groups of cairns placed on top of a rock outcrop, one can often observe that one or two cairns have been located in the middle of the group, often on the highest point of the top, in the saddle point, as, for instance, on Sundbergen. The fact that even single graves are frequently placed in the saddle point or nearby suggests that the centrally located grave or graves within a group of cairns are the oldest ones. When the first and oldest cairn had been built, the chosen place had become marked with a monument. In semiotic terms, the cairn had become *the index of a natural place*. It made the place significant for the people who shared a common tradition and knowledge about the place. The groups of cairns that we see, have been constructed in sequences, in which the building of each cairn took a position dependent on older cairns. The relative location of the cairns is connected to their order of age, the duration of time represented by the cairn group and the cultural significances of the burial place.

In principle, it makes sense to determine the location of a cairn in relation to the surrounding cairns only provided that the location of a particular cairn is only compared with the locations of cairns older than the said cairn. The cairns situated nearby must be assumed to have existed when that particular cairn was built in order to justify the thought that the nearby cairns had the significance of an index of a natural place and**,** likewise, that the choice of the burial place was dependent on the existence of older graves. An analysis of the relative locations of the graves would require knowledge of the relative ages of the cairns in the study area (or at least of the cairns situated fairly close to each other within an area) as well as of the possible secondary interments in these cairns. In practice, this makes the task impossible, unless its conditions are extenuated.

To adopt an alleviation**,** we can assume that cairns situated close to each other, from the earliest to the latest one, can be regarded as expressions of the significance of the same *burial site*. Then, it can be meaningful to determine their relative locations symmetrically, disregarding the order of age. Illogical spatial relations, for instance the distance from an early grave to a later one, naturally cause noise in the data. Minimizing the noise presupposes that the relative locations are taken into consideration only or mainly in the close vicinity of each cairn. The greater the distance between each pair of burial sites is, the less likely is even an approximate simultaneusness of the graves and the less likely is the association of the locations with each other.

To describe the relative locations of burial cairns, a suitable quantity has to be defined. We will examine, to what extent the location of each cairn is influenced by other cairns and how many other neighbouring cairns the location of each cairn is associated with.

A cairn included in a group is surrounded by one or more cairns. The subject to be determined is a zone surrounding the cairn, which characterizes the typical maximum area of groups formed by cairns. The cairns which fit inside this zone, can be regarded to represent a group of interrelated burials, a cairn cemetery. The singe graves not fitting inside the zone are situated in various degrees detached and separate from each other.

To start with, the mutual distances between burial places have to be computed. The starting values of the coordinates in Finnish national grid are in most cases correct with an accuracy of 30 meters (cf. Rainio 1988: B10–12). Since the inaccuracy of the map coordinates is of graphical origin, the inaccuracy of the distances between burial places is independent of the positioning of the places. The inaccuracy has no practical significance when cemeteries are discussed in contrast to single graves, since the characteristic feature of single graves is their solitary location some distance from other graves.

The desired zone can be determined using local density analysis (LDA) (Johnson 1984; Kintigh 1990). In general, local density analysis involves the calculation of a triangle matrix of *local density coefficients* $C_{ii(r)}$, which expresses the degree of spatial clustering between the artefact types *i* and *j*. The diagonal of the triangle matrix expresses the coefficient of a type with itself $C_{ii(r)}$, which is a measure of the degree of clustering of that type. From the diagonal of the matrix we may compute the local density for each cairn, which gives the number of cairns located within the fixed distance *r* from the cairn being examined. According to the definition, there is always at least one cairn, the particular one being examined.

The local density coefficient $C_{ii(r)}$ which is the ratio of the mean local density to the mean density of the whole of the area investigated, has been calculated for each radius r = 10, 20, 30, 40, 50,..., 300 meters. The mean density of the area investigated (6384 km²) is somewhat theoretical because the area includes plenty of water and lowlands, where we cannot expect to meet with cairns.

The radius *r* expresses the resolution involved in the local density coefficient. The coefficient can be expressed as a function of the radius *r*. Figure 49 indicates that the coefficient diminishes rapidly as the radius increases up to the distance of a little less than 100 meters. When increasing the radius further, the value of the local density coefficient only gradually reduces. The sharpest turn of the plotted curve indicates that the requested zone is outlined by a distance of around 60 meters from each cairn.

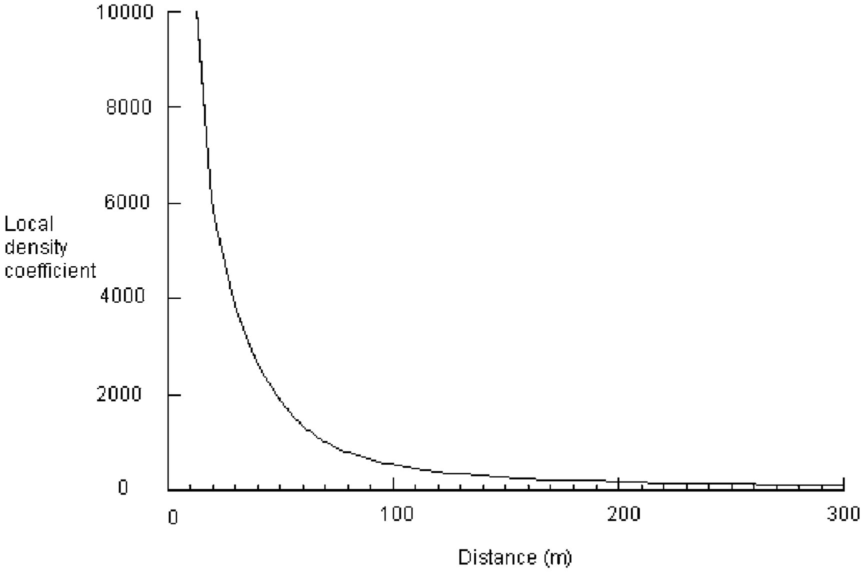

Fig. 49. The local density coefficient $C_{ii(r)}$ as a function of the radius *r* (m). The values of the coefficients were computed using the LDEN module (Kintigh 1987; Kintigh 1992).

Table 25. The frequencies of the local densities within the radii of 60 and 200 meters.

Local density	1	2	3	4	5	6	7	12	Total
r = 60	238	86	32	0	5	0	7	12	380
r = 200	184	92	41	31	12	1	7	12	380

We shall examine more closely the zones of each cairn within the radii of 60 and 200 meters (table 25). The areas of the zones are 1.1 and 12.6 hectares. Around most cairns, the zone only contains the cairn itself, accordingly, they don't have a neighbour within this distance, and the local density is one. Within the radius of 60 meters, 2/3 of the cairns are considered single graves; within the radius of 200 meters, half of the graves are single. If we consider the radius of 60 meters as a criterion of a cemetery in contrast to the single graves, 142 cairns or a good third of them belong to a cemetery of at least two cairns. When stating this, it has to be remembered, however, that the frequencies depend on the radius of the zone chosen; there is no changeover point but a continuum between the single graves and the cemeteries.

By running through the material it is not hard to find the cairns with the highest local densities (table 25). For values higher than six, the frequencies of cairns produced by the radii of 60 and 200 meters are the same. The cairns with the local density 12, thus having 11 neighbours, belong to the Furunabb Iron Age cemetery. The local density value of 7 is connected with the Iron Age cemetery Östergård 2. The local density value 5 with a radius of 60 meters refers to a group of five cairns in Östergård in Hangslax, Nagu. With the radius of 200 meters, Kummelberget in Elmdal, Kimito and the cairns in Sundbergen, Nagu, are included. The distribution of the local density indicates that a cairn seldom has more than three or four neighbours.

7 The Bronze Age – the Iron Age

7.1 Earlier studies on the chronology of cairns in SW Finland

Before we examine what kind of characteristics there are that might differentiate cairns of different ages in Åboland, we take earlier studies on the mainland of SW Finland and Åland as a starting point. The *monumentality* of cairns is probably the most important of the attributes that have been regarded to characterize burial cairns of different ages. In literature, monumentality has not quite been defined in an explicit manner. Depending on the context, monumentality has been primarily used to denote the total volume of the cairn, its scale, and the visibility of the cairn itself. It sometimes refers to the characteristics of the burial place, especially its altitude. A large and high burial cairn, built on a picturesque hill with a wide view is monumental, if any. Architectural constructions, such as chains and frames, stone cists, dry-stone walls and centrally placed boulders have also been included in monumentality.

Of Finnish scholars, especially Unto Salo has discussed burial cairns as monuments and suggested symbolic interpretations of monumentality. In his reviews into the Early Metal Age, he sketches a theory of the cairn tradition, the constituents of which are the sign language of the graves, kinship, agricultural landownership, property, and sedentary dwelling. According to him, the Bronze Age cairns had a symbolic function in protecting and preserving the family. The volume of the cairn was of great importance especially during the Early Bronze Age, when the graves used to be built large. The more interments were made in a cairn, the greater it grew. And the mightier the grave was enlarged the more powerful was the endeavour of the family and the peasant farm (*Fi*. talo) to express its right to land property, its dominance, its freedom of will, territorial control, and competence of rivalry. Settlers competed for lands suited for cultivating and cattle breeding, and cairns indicated outsiders the family's proprietory rights to the land acquired with hard work, a transformation from something originally owned by no one to private property. Due to the origin of the property, the continuous ownership could only be guaranteed by continuous utilization of land and natural resources and protection against competitors. Changes in expressions of ownership led to changes in the monumentality of the graves. At the latest during the V period the cairns were gradually built smaller than before. Instead of making secondary interments and enlarging the stone cover, individual small cairns, that constituted cemeteries, were built. At the latest during the Roman Iron Age, the landownership had become established, and the right to control land and resources was no more associated with social tensions and opposing interests. Thus there was no need to build monumental graves (Salo 1981 b: 125–, 201–204; 1984 a: 133–139; 1984 b: 89–90; Salo 1997: 87–93; see also Pihlman 1999: 65, 73).

During the Bronze Age, the nature of burial places also changed so that, towards the end of the Bronze Age, the burial places were no longer chosen on the tops of high hills but lower in the terrain on moraine and near dwelling sites. Excavations by Salo on the shores of the ancient bay of Nakkila and Panelia in Satakunta yielded evidence of this. In Rieskaronmäki, Nakkila, the Late Bronze Age graves were located lower than before, on moraines, near buildings and they were grouped into a cemetery instead of solitary located single graves.

The progress outlined by Salo is based on excavations and discoveries made mainly in the province of Satakunta. Towards the South, on the mainland coast of Finland Proper, there is less evidence on the alteration of the cairns along with the time. The cairn in Kotokallio, Lieto, from the period II (Edgren 1969; Kaskinen 1980) is a single grave on the top of a rock outcrop. In Lehmihaka, Perniö, there is a cairn cemetery located by a dwelling place, dating from the end of the Bronze Age and the Pre-Roman Iron Age. The cairns are situated one beside the other on a moraine-covered slope (Lähdesmäki 1983; Lähdesmäki 1987). The differences between these cairns dating from different ages are well in conformity with the progress described by Unto Salo.

From the Early Iron Age, there are examples of burial cairns built into a cemetery. In the valley of the river Aura, the Iron Age cairns and cemeteries are situated in low-lying terrain on mineral soil (Salo 1995: 15–18; Laukkanen & Vuorinen 1987). The statistics presented by Vuorinen indicate, that in the former administrative district of Turku and Pori, SW Finland, small cairns are common on lowlands, suggesting that they are, in average, later than large cairns. Those cairns that have been dated to the Iron Age, are in average smaller than the Bronze Age ones (Vuorinen 2000: 181–182). Observations from Uusimaa match into this pattern (Laurén 1991), and in the size, grouping and location in the terrain, a similar tendency can be observed in Southern Ostrobothnia, too (Miettinen 1989).

On an outer island of the Gulf of Finland, in Suursuonmäki, Lavansaari, there is a cairn cemetery, radiocarbon dated to the Pre-Roman and the Early Roman Iron Age. There are at least 29 cairns in a chain of the length of 110 meters. However, they are not situated in a low terrain but on the top of a ridge (Miettinen 1996). The cairn cemetery in Piiloinen, Vehmaa, to the NW from Turku (Salo 1968: 67–69), is also on the top of a rock outcrop. It greatly resembles the burial cairn grounds in the archipelago of Åboland.

Helena Edgren has dealt with cairns and cairn cemeteries dating from the Early Iron Age on Åland. There are 1200 cairns and they are grouped into 123 cemeteries. According to her, the Bronze Age cairns were built on tops, whereas during the Early Iron Age the graves were placed lower on mineral soils, near present cultivated lands. Many of the cairns are three- or four-sided. The location and altitude distinguish them from the Bronze Age ones: while cairns from the Bronze Age are situated by the sea, the ones from the Iron Age are grouped near lakes and protected gulfs of sea, on islands and in the inland of Åland. This form of burial was, however, quite unknown for the Swedish population of the Late Iron Age (Edgren 1983: 88–89, 96). To the Iron Age cemeteries belong, among others, Västra Nabbergen in Eckerö, with three- and four-sided stone settings (Dreijer 1979: 45) and the Pre-Roman cemeteries Jomala 37.4 Överby and Lemland 4.1 Flaka with tens of burial cairns (excavation reports Storå 1991 and 1990, ÅM).

There is not much evidence on the change in the constructing material of the cairns. Earlier, we have observed that the boulder material suggests that the stones were mainly carried from the near surroundings. The composition of the stone material is thus rather local and dependent on the choice of the place. The choice of the place, on the other hand, seems to change along with the time. As stated above, cairns consisting of edged boulders seem to have an Iron Age context. The composition of the boulder material would seem to be an interesting chronological characteristic.

To summarize, the small size is clearly characteristic of Iron Age burials. The cairns are sometimes three- or four-sided and often located on relatively low altitudes, on mineral soils. They are surrounded by a mainland or inland topography and often grouped into cairn cemeteries. The grouping tendency – a great relative proportion of solitary Metal Age cairns outside cemeteries indicates a high age of the cairns – is also known in Sweden (Selinge 1986: 24–25).

7.2 The dated cairns in Åboland

7.2.1 The dating criteria

In Åboland, there are about thirty cairns, the age of which can, at least approximately, be considered to be known. The most reliable dating of a cairn is achieved when the dating artefact or other chronological evidence is enclosed in the structure of the cairn in a way that it *stratigraphically* dates the time of building. If the cemetery includes other cairns besides the stratigraphically dated one, they can, depending on local topography, be regarded approximately contemporary on the basis of a *cemetery chorological dating* – to use Bo Gräslund's terms (1974: 38–39). This is based on the presumption that there exists a spatial autocorrelation between the cairns in regard to age; many observations indeed support this notion. Here, it is enough to state that the cairn dates either from the Bronze or the Iron Age. The frequency distribution of the local density gives the ground to define which of the cairns belong to the same cemetery, probably of roughly the same age.

The structure of a burial cairn can closely resemble a morphological cairn group datable somewhere else. In a case like this, we can talk about *group analogical* dating (Gräslund 1974: 35). The group analogical dating of burial cairns has been criticised because many morphological features are of long duration (Furingsten 1986).

On the other hand, as Baudou showed, some consistent morphological changes did take place during the Bronze Age and the Iron Age in Ångermanland, Sweden (Baudou 1968: 97–103). Therefore, in the case of Åboland, they can be taken as an evidence of the age of the cairns although there is no reason to believe that the morphological changes themselves were the same in the Finnish archipelago as in the Swedish Ångermanland.

The stratigraphical, cemetery chorological and group analogical datings have been gathered together in the table 26. In addition, the shore displacement makes the shore zone dating of many cairns possible. At first, we will, however, examine what can be made of dating criteria independent of the displacement of the shore zone.

7.2.2 The stratigraphical and the cemetery chorological datings

The artefacts of the Långnäsudden and Hammarsboda burial cairns in Dragsfjärd have been published several times (Björck 1882; Heikel 1890; Hackman 1987; Cleve 1942 b; Meinander 1954 b; Edgren 1999b: 1–3). One of the two Långnäsudden cairns is stratigraphically dated by a bronze dagger[85] of period II found by Volter Högman in his excavations in 1886. The unexcavated cairn quite next to it can be assumed to date from same age. In addition, a narrow-bladed palstave[86] of approximately the same age originates from the cairn 106 in Hammarsboda. Högman did not find any artefacts of a dating nature while investigating the cairn 108, but the four Hammarsboda cairns preserved, situated close to each other, can be dated to the Bronze Age, using cemetery chorological criteria.

A cremation area, with an underlying carbon layer and covered by a burial cairn was excavated in Trollberg, Houtskär in 1978. The carbon layer was radiocarbon dated 2990 ± 140 BP (Hel-1143; Jungner & Sonninen 1983: 72), which, calibrated according to Stuiver and Reimer (1993), takes the cairn back to a good thousand years BC[87], that is to the second or possibly third period of the Bronze Age. The burial of Trollberg is one of the oldest known cremations in Finland; it is of almost the same age as the burial of Kotokallio, Lieto (Edgren 1969; Kaskinen 1980). The cairn on Ängesnäs bergen, Nagu, can, with the reservations mentioned above, be dated to the Iron Age on the basis of weathering measurements of the rock surface.

In 1886, Volter Högman found a cairn on Långfuruholm, Dragsfjärd (see chapter 5.42). It is situated on the top of a rocky skerry close to Gullkrona fjärden, at the altitude of 11.2 meters. Svante Dahlström and Hildur Planting observed parts of a well preserved unburnt human skeleton under the cairn. The fact that an unburnt skeleton hardly preserves under the stones, exposed to moisture and oxygen, for thousands of years, suggests that the cairn is from the Iron Age or even medieval. The altitude makes dating to the Bronze Age impossible.

On a cold day in the spring of the year 1924, some fowlers from Holma in Dragsfjärd were ransacking a cairn on the island of Stora Ängeskär just to keep themselves warm. Then, they suddenly noticed a pendant grinder under the stones, dated later to the Viking Age by Nils Cleve in the Historical Museum of Turku (Dahlström 1945: 52–57). The stick like grinder is four-sided, with a hole and it is of black slate and there are marks of grinding crosswise on it (figure 51)[88]. On Åland, this type of a grinder occurs at least in

85. NM 2503A:1.
86. NM 1910.
87. The radiocarbon age of the sample is, calibrated according to the A-method by Stuiver and Reimer (1993) , 1 σ: cal BC 1425 (1212, 1199, 1192, 1138, 1132) 974.

Rangsby and Kvarnbacken, Saltvik and in Långängsbacken, Sund. On the Finnish mainland the type is known from Vanhalinna (Lieto), Köyliönsaari (Köyliö) and Luistari (Eura) and in Sweden, among others, in Birka (Kivikoski 1973: 982; Kivikoski 1963: 117, 125–126; Kivikoski 1980: 41, k. 9:5; Luoto 1984: 102; Cleve 1943: 22–24, k. 8:39; Lehtosalo-Hilander 1982: 62; Sundbergh & Arwidsson 1989); hence mainly in Viking Age contexts. A later dating, however, is possible, too (cf. Petersen 1952: 251–257). Grinders occur already in the Roman Iron Age (Erkola 1960; Kivikoski 1973: k. 184; Salo 1970: 73-83), but the altitude of the burial site of Stora Ängeskär, 8.2 meters, makes such an early dating impossible.

Table 26. The dated burial cairns in Åboland. n = 31.

No	Site	Dating criteria	Age
041	Långnäsudden, Dragsfjärd	Stratigraphic	Bronze Age period II
040	Långnäsudden, Dragsfjärd	Cemetery chorological	Bronze Age
043	Hammarsboda 106, Dragsfjärd	Stratigraphic	Bronze Age period II/III
044	Hammarsboda 107, Dragsfjärd	Cemetery chorological	Bronze Age
045	Hammarsboda 108, Dragsfjärd	Cemetery chorological	Bronze Age
046	Hammarsboda 109, Dragsfjärd	Cemetery chorological	Bronze Age
087	Trollberg, Houtskär	Stratigraphic	Bronze Age period II/III
217	Ängesnäs bergen, Nagu	Stratigraphic	Iron Age
060	Långfuruholm, Dragsfjärd	Stratigraphic	Later Iron Age or historical time
063	Stora Ängeskär, Dragsfjärd	Stratigraphic	Viking Age or later
154	Makila, Kimito	Stratigraphic	Early Iron Age
092	Furunabb, Houtskär	Stratigraphic	Early Iron Age
088	Furunabb, Houtskär	Cemetery chorological	Early Iron Age
089	Furunabb, Houtskär	Cemetery chorological	Early Iron Age
090	Furunabb, Houtskär	Cemetery chorological	Early Iron Age
091	Furunabb, Houtskär	Cemetery chorological	Early Iron Age
093	Furunabb, Houtskär	Cemetery chorological	Early Iron Age
094	Furunabb, Houtskär	Cemetery chorological	Early Iron Age
095	Furunabb, Houtskär	Cemetery chorological	Early Iron Age
096	Furunabb, Houtskär	Cemetery chorological	Early Iron Age
097	Furunabb, Houtskär	Cemetery chorological	Early Iron Age
098	Furunabb, Houtskär	Cemetery chorological	Early Iron Age
099	Furunabb, Houtskär	Cemetery chorological	Early Iron Age
258	Sundbergen 1, Nagu	Stratigraphic	Late Iron Age
259	Sundbergen 2, Nagu	Stratigraphic	Late Iron Age
250	Sundbergen 3, Nagu	Cemetery chorological	Late Iron Age
366	Ådön, Nagu	Group analogical	Early Iron Age
326	Söderviken, Västanfjärd	Group analogical	Iron Age
327	Söderviken, Västanfjärd	Group analogical	Iron Age
005	Stora Ängeskär, Dragsfjärd	Group analogical	Iron Age
209	Jälankort, Nagu	Group analogical	Iron Age

88. PMT 12960.

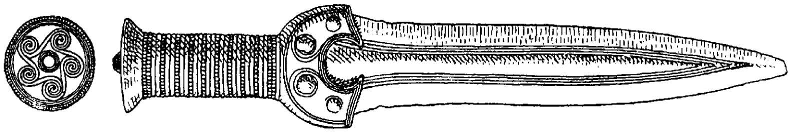

Fig. 50. The dagger from Långnäsudden, Dragsfjärd, according to Alfred Hackman (1897).

Fig. 51. The grind stone from Stora Ängeskär, Dragsfjärd. Photographed by the author.

In Östergård (Makila), Kimito, a cairn is located on a dwelling site where some Morby ceramics was found in excavations in 1989 and 1990. The cairn is of the same age or later than the dwelling site. According to Henrik Asplund[89], the site is from the Pre-Roman Iron Age. On the basis of the Morby ceramics, an earlier dating for the habitation and the cairn is, however, as possible (cf. Carpelan 1979; Salo 1981 b: 11–12; Uino 1986: 71; Edgren 1999 b: 325–326).

In the excavations of the cemetery at Furunabb, Houtskär, in the years 1979, 1981 and 1986, one dating artefact was found, an iron ferrule of a belt from the Early Iron Age[90]. The other cairns in the same cemetery can be regarded, contemporary on the basis of

89. The finds consist of pottery, burnt clay and bone (TYA 522: 1–6). See excavation report by Henrik Asplund 1990 (TYA). Asplund 1997a: 258–259.
90. NM 20576:1–5. See excavation report by Pirkko Höysniemi 1979 (NBA).

cemetery chorological criteria. The altitude excludes the Bronze Age. The cairns 1 and 2 in Sundbergen, Nagu, are from the Later Iron Age, which implies an Iron Age dating of also the unexcavated cairns of Sundbergen.

7.2.3 The group analogical datings

On Ådön, in the southern archipelago of Nagu (366), there is a cairn consisting of mainly rounded stones and boulders (see chapter 4.62). The stone cover is dominated by the red colour of Jotun sandstone. The boulder fields of Ådön contain some red sandstone, but the percentage is much lower there than in the cairn, so it seems obvious that sandstone has been chosen for the cairn. Unto Salo has, based on the excavation reports by Mirja Miettinen (1986), come to the conclusion that sandstone covered cairns in SW Finland date to the Pre-Roman and the Early Roman Iron Age (Salo 1987: 69–70). On account of this, the Ådön cairn can be regarded as an Iron Age one. Another cairn containing sandstone on the border of Bendby and Böle, Korpo (202), is more variable as to its composition; let us regard it as so far undated.

Group analogical datings can also be applied to four-sided stone settings. They are known, in addition to those in Åboland, in 17 parishes in the former administrative district of Turku and Pori; there are 77 such graves altogether[91]. One of the most reliably dated burials is the four-sided cairn in Savemäki, Laitila, dating from the Early Roman Age, associated in literature rather with *tarand* graves than cairns. The cairn in Koskenhaka, Piikkiö, is from the Early Roman Age and the four-sided stone setting of Ristenkömppä, Laitila, dates to the Merovingian period (Salo 1968: 22–23; Kivikoski 1969: 22–23; 47–48; Pihlman 1985 a; Kivikoski 1937). In Oiva Keskitalo's review of the Late Roman Age, there are four-sided graves in Tiikkinummi and Karpinmäki in Perniö, Ketohaka in Salo and Etterkilen I, Högvalla and Brobacka I in Karis (Keskitalo 1979: 119–123). On Åland, a special Iron Age characteristic is the three- and four sided structure of the cairn: Helena Edgren (1983) calls such remains the Eckerö type. In Central Sweden, too, there are equivalents of four-sided burial cairns from the Early Iron Age (e.g. Ambrosiani 1964: 64–68; Anttila 1985).

A seemingly structureless cairn can conceal a four-sided stone setting. Constructions like this are known at least from the Bronze Age (Salo 1981: 92–94, 143–146), the Pre-Roman Iron Age and the Roman Iron Age (Meinander 1969; Salo 1970: 90–93). In many cases, as far as the excavation reports disclose, it is a question of interpretation to what extent the four-sided structure has been invisible inside the stone setting.

The four-sided cairns in Åboland are, hence, probably from the Iron Age. To be dated, we can, however, qualify only outwardly distinct and sufficiently indisputable constructions. Two of the three cairns which I have validated are situated in Söderviken, Västanfjärd (one of them excavated by Volter Högman) and one on Stora Ängeskär, Dragsfjärd, on the rocks above the burial cairn in which the pendant grinder from the Late Iron Age was found (table 26).

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91. Based on the TYARKTIKA database (Salo *et al*. 1992; Vuorinen 2000), according to the situation in 1996.

7.3 The empirical determination of chronological characteristics

7.3.1 The stone cover of the burial cairn

The size of the burial cairn belongs to the basic observations documented in surveys. The size can be informed as the volume of the smallest hexahedron the cairn would fit in – the product of the length, width and height. The volume, however may be an inaccurate measure, because its numeric value greatly depends on the height of the stone setting, the measuring of which is approximate – as far as it is even possible. The area of the stone setting – the product of the length and the width (or the area of an ellipse corresponding the length and the width) – is, thus, a more sensible standard. The product of the length and the width seems regularly to have a positively skew distribution, so, instead of it, in the analyses, the logarithm of the numeric value can be used, having an approximately normal distribution. The field data of this study also included the information of the shape and profile of the stone cover, the roundness of the boulders and the possible architectural constructions**.**

Architectural constructions, such as the stone chains in Bronze Age cairns (Långnäsudden, Hammarsboda 108 and Trollberg) are, yet, problematic as morphologic-chronological characteristics, because they often remain invisible under the stone cover, whereat the cairn would have to be excavated in order to observe the constructions. Negative information of the structures are, thus, in most cases missing observations. Yet, to define systematic typological characteristics, information perceivable without excavations or other destructive techniques would be required.

7.3.2 The relative location of the burial cairns

The relative locations of the cairns can be used to determine to what extent a grave has been connected to other graves, has become part of a cemetery, or if a grave is more likely to belong to a single grave tradition. The spatial interrelationships between the cairns are constituted by two factors, the number of cairns in the close vicinity of any individual cairn and the distances between cairns.

The local density is a possible measure of spatial clustering. It is, however, tied to a fixed radius and gets only few possible numeric values and most often small ones, which diminishes the usefulness of the variable in the analysis of the location. Another possibility is offered by the distance of each burial place to its nearest neighbour or neighbours (attraction) (e.g. Hodder & Orton 1976: 38–52). The distances characterise the relation of each burial with the neighbouring burial sites and the variation of the relations from one grave to another. Calculating clustering statistics from the distributions of distances would, however, be partly trivial, because the cairns are clustered near each other simply on account of the water areas separating the islands.

Table 27. The distances to the five nearest neighbours (m) and the sum of distances to the nearest neighbours.

Variable	Min	Max	Mean	Median	Standard deviation	Skewness
Distance to 1. neighbour	0	12600	843	170	1743	3.86
Distance to 2. neighbour	0	14311	1483	633	2219	2.80
Distance to 3. neighbour	10	16197	1959	1082	2468	2.37
Distance to 4. neighbour	10	17279	2345	1356	2673	2.21
Distance to 5. neighbour	10	21147	2663	1593	2824	2.15
Sum of distances to the nearest neighbour	0.040	2.778	0.333	0.225	0.381	3.80

Most cairns are located relatively near each other. Long distances, however, do occur, and the longest ones exceed ten kilometers (table 27, figure 52). The distances distinguish cairns situated distinctly detached in the terrain, far from other cairns. For instance, of the 14 cairns, the distance of which to the closest neighbour is more than 5000 meters, nine are situated on islands far from each other in the outer archipelago zone; the rest of them on large islands near the mainland coast (one on Martinmaa, Velkua, one on Lilla Kuusis, Nagu, two in Pargas and one on Kakskerta, Turku). Especially in the inner archipelago zone, great distances are exposed to edge effects of the study area and changes caused by new field archaeological projects.

To make sure that both the number of cairns in close vicinity and their relative distances are taken into account in determining the relative locations of the cairns, it is not sufficient to examine the distance of two closest cairns in pairs but more than two have to be considered. The cairn seldom has more than three or four neighbours, so if we examine the distances to the five nearest neighbours of each cairn, the positions of the most essential close cairns are taken into account.

The sum of distances to nearest neighbours n_d was defined in Chapter 4. With the five nearest neighbours $0 < n_d \leq 5$ so that the closer the cairns are to each other, the greater numeric value the sum of distances n_d acquires (figure 53). The further the *j*:th neighbour is from the cairn in relation to which the distance is measured, the less the neighbour influences the value of n_d. We saw earlier that in the sampling study area in Houtskär, Korpo and Nagu, the distribution of the sum of distances indicated a statistically significant clustering of the cairns.

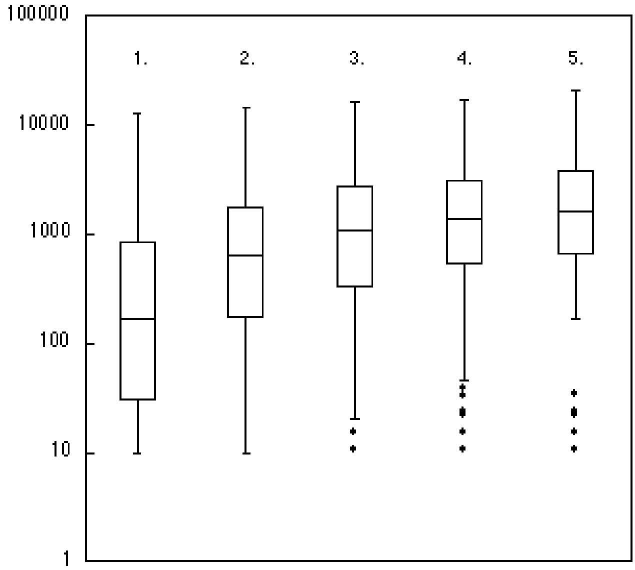

Fig. 52. Boxplot of the distances (m) to the five nearest neighbours. The scale is logarithmic.

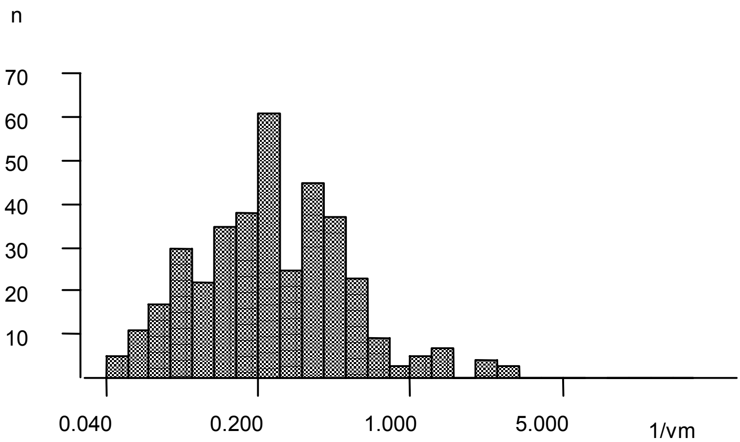

Fig. 53. The distribution of the sum of distances to nearest neighbours (*n* = 380) (logarithmic scale).

7.3.3 The topography of the burial place

The height variation of the scenery and the relations between its parts constitute the physical premises and the context for the choice of the burial place and its range of vision. Describing them is, at the same time, describing burial places and preferences used in selecting them. The topography of the surrounding scenery and the patterns of land and sea can be illustrated morphometrically by means of a digital elevation model. In the grid, a circular window is opened, the center point of which is the cell from which the topography is examined.

Finding an appropriate size of the window is a classical problem. Too small a window does not cover sufficiently the height variation of the terrain, but only represents a part of it. Then, the value of the variable primarily changes as a function of local slope. Too large a window generalizes the height variation so that a detailed enough illustration of the relief of the terrain cannot be obtained.

Fausto Guzzetti and Paola Reichenbach (1994) determined, while discussing a topographic division for Italy, the properties of topographic variation typical of the ridges and the valleys. The characteristic wavelength was obtained when variation was measured within nested windows of increasing size until the full range of local elevation was encountered (the grain). The method can also be applied in investigating Åboland. The crucial difference, however, is that the subject is not only the variation of altitudes but also the location of the burial places in relation to the topography. The location of a cairn is not random, but related to the surrounding terrain and other burial places. The starting point of a measurement of the topography is the burial place, so the area of the topography to be examined is determined according to the burial place. The size of the window should be sufficient to illustrate the essential characteristics of the topography surrounding the burial place but it should not generalize too much the small-scale features of the peneplane. The larger the window the more it covers the landscape that a burial place has in common with the other burial places.

The local density coefficient (figure 49) as a measure of the relative distances between cairns gives an idea about the minimum size of the window. With short radius lengths, the coefficient obtains high numeric values but they decline abruptly up to about 60–100 meters and, while the radius continues to increase, the values decline only slowly. The distribution of distances to the nearest neighbour (table 27) yields that half of the distances remain less than 170 meters. The clustering of cairns in the same burial places comprises, thus, for the most part distances less than 170 meters. The radius of the window should be distinctly greater than this.

Using nested windows of increasing size, we can estimate the characteristic wavelength of the terrain and the upper limit of the size of the window. For two reasons, the result is an approximation. To begin with: the cairns are often situated on the tops, in the saddle points. If one finds the saddle point and settles there to observe the landscape, one comes to choose a position which limits, on an average, a greater difference of altitudes into a window with a fixed radius than a randomly chosen observation point would do. The observer is, indeed, standing in a place which represents the upper end of the local height variation. Secondly, the burial places have risen, compared to the sea level, 5–20 meters since the time of the construction of the cairns. The long duration of the burial cairn as a type of burials signifies that there is not one single ancient time level whose topographic study would be relevant, but there are, instead, as many levels as there are cairns. If burial cairns are considered as memorials and monuments preserving in time, there are as many time sequences as there are cairns. In an examination of the present topography, it is not necessary to make presumptions of the topographies of the time of the building of the cairns; at the same time, it has to be remembered that the present topography does not represent the actual ancient topography of any burial site.

Running through nested windows of increasing size produces fairly convergent wavelength measures for the burial places. The figure 54 shows the greatest altitude differences inside the window as a function of the radius of the window in four burial places. The chosen places are situated in a mainland high-relief topography in Spånåmalm, Kimito (135), in a topography with more islands but a fairly high relief in Käldinge, Nagu (378), in the middle archipelago zone with a low relief on Keistiö, Iniö (103) and in the outer zone on Bussö, Korpo (349). The differences of the curves illustrate the relation of the greatest altitude difference with the inclination of the peneplane from the mainland towards the Baltic Sea. The height relief of the outer archipelago zone is lower and more small-scaled than that of the inner zone. Most of the full range of altitudes is encountered at the point of about 1000 meters, and, on account of this, a value a little higher than that has been chosen as the radius of the window, 1200 meters. The area marked off by the radius is 4.52 km².

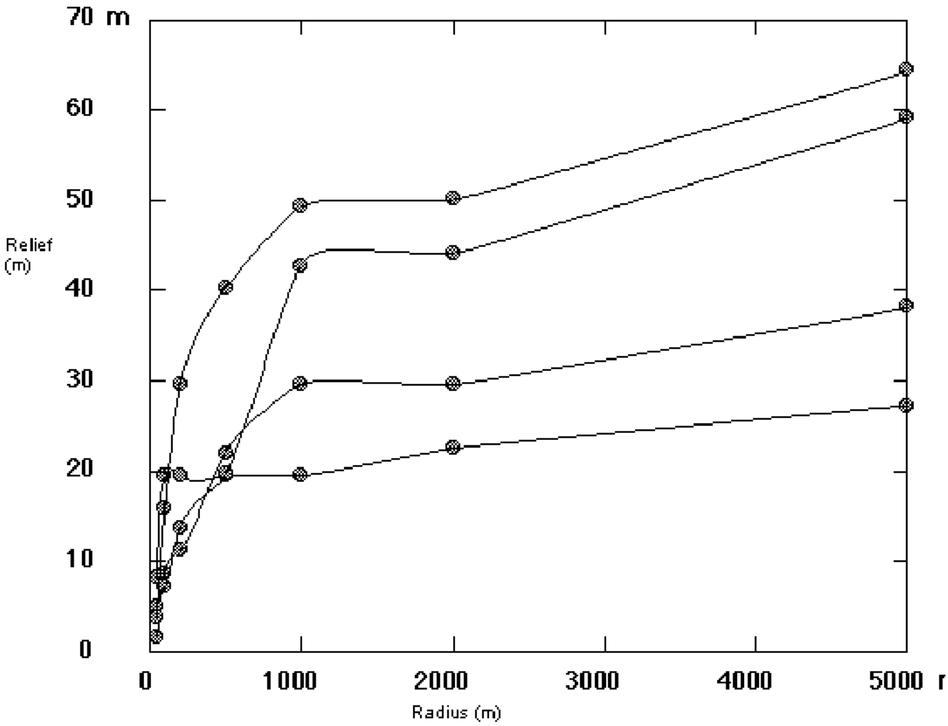

Fig. 54. The greatest difference of altitudes inside the window as a function of the radius of the window (*r* = 50, 100, 200, 500, 1000, 2000 and 5000 meters). Center points in the window are Spånåmalm, Kimito (135), Käldinge, Nagu (378), Keistiö, Iniö (103) and Bussö, Korpo (349).

7.4 Discriminant analysis

7.4.1 The groups P and R

The ages of the dated cairns in Åboland are known with a varying accuracy. The most approximate ages determine the accuracy of the whole chronology to a great degree. For example, if we try to identify the characteristics of Early Bronze Age cairns, we have to rely on not more than three cases that fairly reliably belong to that period. However, *all* the dated cairns fit into rough chronological categories, such as the Bronze Age or the Iron Age. Thus the known ages can be made use of in the most systematic manner so that the dated cairns are put in either of the two groups: the Bronze Age or the Iron Age group. In the following, I shall be calling the groups in the mentioned order groups *P* and *R*.. In this division into two groups, the ages of the cairns dated can be regarded as known.

Cairns dated and grouped can be compared with undated cairns regarding various attributes. Through comparison the division into two age groups can be expanded by examining the characteristics of the dated graves and connecting each undated cairn into the group that best corresponds to its features. The classification can finally be tested by checking if group *P* includes cairns which due to their altitude cannot have been built during the Bronze Age because, in that case, they would have been built in the waterline or under the water. In order to retain the possibility of testing, the altitude of the burial place is not included among the variables by means of which the characteristics of the groups are searched for. The classification also produces prognoses: the comparison with the classification can resolve which group a previously unknown cairn resembles most.

The grouping, thus, includes a reverse one-way multivariate analysis of variance: the contrast determined by values of a two-level factor variable is measured from a part of the sample, and the grouping induced by the contrast is extended to the rest of the sample. This was done using discriminant analysis, which is applicable in determining which variables or linear combinations of them distinguish two or more groups present in the sample from each other (e.g. Bahrenberg *et al*. 1992: 316–358; Mardia *et al*. 1979: 300–325)[92]. The variables are combined into a model and weighted with coefficients so that differences between the groups are maximized. The discriminant analysis aims at solving whether it is possible to improve the grouping criteria, what the structure of the difference between the groups is like and how to find the most appropriate group for a new observation or an ungrouped observation in the sample.

Discriminant analysis can be described geometrically so that each observation point is plotted into a space, where each variable represents one dimension. The points are

92. For two groups the alternative is logistic regression analysis. However, the maximum likelihood procedure involved in logistic regression analysis runs into indeterminance for some variables and does not give reliable results regarding them, nor does it exact logistic regression using the LogXact software. See Hosmer & Lemeshov 1989; Kleinbaum 1994; Mehta & Patel 1995; Cytel Software 1997. In practical empirical research, discriminant analysis tends to end up with fairly similar conclusions as logistic regression analysis (Press & Wilson 1978). For archaeological case studies using discriminant analysis, see Akazawa 1988, Tomber 1988, and Charles 1992. Variables with nominal scales could not be included here, however, the shape of the cairn did not prove a good group indicator in logistic regression analysis.

projected on a level, which is rotated into the position where maximum differences are produced between the groups. This position determines the coefficients of the discriminant functions. In the case of two groups, the level is a line and one discriminant function is obtained.

7.4.2 The potential variables

The attributes must be found which distinguish distinctly enough the cairns into the groups *P* and *R* and describe the characteristics of the groups. Earlier studies in the morphological and spatial attributes of the burial cairns and the change of them along with the time constitute a starting point for the selection of variables. Obviously, the most important morphological variable is *the area* of the cairn, but *the roundness proportion*, too, was tentatively included in the analysis.

A group of variables was used to measure the location of the burial place related to the topography and to neighbouring burial places. In order to compute them, a circular window was opened in the DEM with the radius of 1200 meters. Only the cells were taken into account the altitude of which is higher than zero, to eliminate the influence of the sea level to the value of measures describing land elevation. These variables were *the sum of distances to nearest neighbours, the distance to the nearest neighbour, the local density, the altitude relative to the cumulative frequency distribution, the altitude relative to the mean, the height difference of the altitude and the mean in the window, the altitude relative to the highest top, the height difference to the highest top, the slope, the convexity*[93] *and the center versus neighbours (CVN)* (table 28).

The topography around the burial place was measured using mean altitude, median altitude, standard deviation of altitude and the quartile range of the altitude. The extent of sea was given by the relative proportion of sea, while the elevation-relief ratio gave a measure of the degree of dissection of the landscape (Guzzetti & Reichenbach 1994). The location of the burial place in relation to the toposequence of the archipelago zones from the mainland coast to the skerry zone indicates in what degree the landscape can be characterized as maritime. Here we are examining the surface of the peneplane in relation to the sea surface (Granö 1955), so a rather large window has to be opened in the DEM. Thus, a quadratic area of 5.1 x 5.1 km^2 was chosen as the window. The burial place is situated in the middle cell of each window. The area closely corresponds to the measuring unit of the coastal geographical analysis of Olavi Granö and Markku Roto (1986), a quarter of a sheet of the Finnish basic map. In the window, the mean of the altitudes of all the cells was calculated, which I call the mean altitude of the archipelago zone.

93. The ridge-valley index by Kenneth Kvamme is another measure of the shape of the surface (Kvamme 1992).

Table 28. Potential variables measuring the location of the burial place in relation to neighbouring burial places and the topography.

Log-sum of distances	Natural logarithm of the sum of distances to five nearest neighbours
Nearest neighbour distance	Euclidean distance
Local density with r= 60 m	Johnson local density
The altitude relative to the cumulative frequency distribution h_r	The relative cumulative frequency of the altitude of the burial place, derived from the cumulative frequency distribution of non-zero altitudes, $0 \leq h_r \leq 1$
The altitude relative to the mean lnh_l	Natural logarithm of the ratio of the altitude to the mean of non-zero altitudes within window
The height difference of the altitude and the mean in the window d_m	The height difference of the altitude and the mean of non-zero altitudes within the window
The altitude relative to the highest top h_t	The ratio of the altitude of the cell to the maximum altitude within window
The height difference to the highest top d_t	The difference of the altitude of the cell and the maximum altitude within window
Slope S	The square root of the maximum slope computed in 3x3 cell neighbourhood
Convexity d_l	Difference of the altitude in the center cell and the mean of altitudes in 3x3 cell neighbourhood
Center versus neighbours *CVN*	The number of cells different from the center cell in 3x3 cell neighbourhood (possible values 0–8) (Murphy 1985)

Table 29. Comparison of differences between the groups P and R. To achieve an approximate normal distribution, natural logarithms were computed of the area of the stone cover, the sum of distances, the altitude relative to the mean, and the square root of the relative proportion of sea.

Variable	Group *P*	Group *R*	t	df	α
Log-area of stone cover	4.96	3.06	6.92	14.7	0.000
Roundness proportion	5.8	4.7	1.67	9.7	0.126
Log-sum of distances	-0.980	-0.545	-1.39	21.5	0.180
Nearest neighbour distance	163	546	-1.17	28.6	0.252
The altitude relative to the cumulative frequency distribution	57.2	73.1	-1.23	7.4	0.255
The altitude relative to the mean	0.235	0.328	-0.38	7.8	0.715
The height difference of the altitude and the mean in the window	2.8	4.5	-0.37	7.5	0.722
The altitude relative to the highest top	0.50	0.53	-0.38	10.1	0.712
The height difference to the highest top	-23.6	-15.4	-1.73	9.1	0.118
Slope	1.9	2.0	-0.14	6.4	0.894
Convexity	1.5	0.4	2.16	7.1	0.066
Center versus neighbours	7.4	7.7	-0.70	8.2	0.503
Mean altitude	18.7	11.5	2.14	7.1	0.069
Median altitude	16.6	10.7	1.54	6.9	0.168
Standard deviation of altitude	8.8	6.8	4.20	28.6	0.000
Quartile range of altitude	6.6	5.0	3.22	25.2	0.004
Relative proportion of sea	0.70	6.37	-7.05	10.0	0.000
Elevation-relief ratio	0.364	0.351	0.25	6.4	0.813
Mean altitude of archipelago zone	21.4	4.3	7.38	9.7	0.000

The most distinct difference between the groups *P* and *R* is in the difference of the mean values in the area of the stone cover of the cairn: the cairns in the group *P* are larger than those in the group *R*. The means of logarithmic values are 4.96 and 3.06; the means are 162 m^2 and 28 m^2 calculated of values given in square meters. The differences between the groups also appear in the height differences to the highest top, in the convexities of the burial place, in the mean altitudes, and in the variation of the altitude, in the relative proportions of sea, and in the mean altitudes of the archipelago zone. The differences are:

Group P	*Group R*
Large stone cover	*Small stone cover*
Burial site low in relation to the highest top	*Burial site high in relation to the highest top*
Burial site convex or inclining	*Burial site plane*
Burial site in high terrain	*Burial site in low terrain*
Burial site in a topographically varying terrain	*Burial site in a plane terrain*
Burial site in mainland landscape	*Burial site in maritime landscape*

The boulders in the cairns of the group *P* seem, on the basis of the mean values, more rounded than those in the group *R*, and so does the difference in medians indicate, which is more meaningful for an ordinal scale variable. The differences between the groups regarding the relative locations are not prominent, even if such differences have been described in literature, as we stated in the above. Regarding Åboland, it is obviously a question of maritime landscape: the cairns of the outer archipelago are situated, for the mere topography, far from each other, because the islands and groups of islands are separated from each other by wide stretches of open sea. The differences between the groups regarding the altitude relative to the topography are minor. The burial sites in both *P*- and *R*-groups are approximately 1.5 times higher than the mean value of the elevations of the window. The differences in the elevation-relief ratio are minor, too.

The proportion of sea and the mean altitude of archipelago zone are reasonably good predictors of group membership. However, since their values are connected to the topographic character of the archipelago zones and indirectly to the communication services in the archipelago communities, the variables partly reflect a fact irrelevant regarding their dating, the choice of the excavated cairns, where the mainland island of Kimito is clearly overrepresented. Therefore, the determination of the group membership should so far still be primarily based on the stone cover, the place of the burial and the topography surrounding the burial site.

7.4.3 The estimation

The variables that were apparently interesting on the basis of the comparison of group means were selected for a stepwise discriminant analysis using the BMDP7M software (Dixon 1992: 363–385). Using the *F*-to-enter value as a criterion for a statistically significant model with a minimum number of variables, the area of the cairn, the convexity of the burial place and the height difference to the highest top were entered into the discriminant function. The standardized discriminant function is

$f = -4.779 + 0.708A' + 0.670d_l - 0.720d_t$,

where A' is the natural logarithm of the product of the length and breadth of the cairn, d_l is the difference of the altitude in the center cell and the mean of altitudes in 3x3 cell neighbourhood, and d_t is the difference of the altitude of the cell and the maximum altitude within window (r = 1200 m). The classification functions are

$y_P = -27.869 + 7.701\ A' + 3.583\ d_l - 0.460\ d_t$

$y_R = -10.334 + 4.928\ A' + 1.188\ d_l - 0.244\ d_t$

with Wilks' lambda $\Lambda = 0.356$, $F = 16.301$, $df = 3{,}27$, and the significance level $\alpha = 0.000$. The results of the classification are presented in table 30.

Table 30. Classification matrix of the discriminant analysis of the area of the cairn, the convexity of the burial place and the height difference to the highest top.

Group	Percent correct	Number of cases classified into group *P*	Number of cases classified into group *R*
P	100.0	7	0
R	95.8	1	23
Total	96.8	8	23

To identify the group membership, it is thus sufficient to compare the size of the stone cover, the flatness of the terrain on the place of burial and the highest rock tops of the topography within 1200 m. *The cairns in the group P are larger than those in the group R. Within a distance of not more than circa 75 meters from the cairn, the land surface is more convex (or, in general, there are greater height differences) in the group P than in the group R. In the group P, the differences of altitudes between the burial places and the highest summits within 1200 meters are greater than in the group R. Hence, the burial sites in the group P have been chosen in a terrain with great height variation*, but not, however, on the summits more often than in the group *R*.

The classification matrix (table 30) indicates that the previously known classification fits to the group memberships computed from the classification functions – with the exception of one case. The cairn in Östergård, Kimito (154) previously classified to the group *R* has become reclassified into the group *P* because its high posterior probability of belonging to group *P*. On the basis of Morby ceramics, found on a dwelling site immediately beneath the grave, Henrik Asplund dated the cairn to the Pre-Roman Iron Age[94]. Morby ceramics is already known in Bronze Age contexts (Carpelan 1979; Salo 1981 b: 11–12; Uino 1986: 71; Edgren 1999 b: 325–326), so there is actually no discrepancy between the occurrence of this pottery and an earlier dating than that suggested by Asplund.

For each case, the Mahalanobis distance to each group mean and the posterior probabilities for belonging to group *R* were computed (appendix 3). The classification functions classify the graves into two groups: 147 cairns were attached into the group *P* with the posterior probability $p < 0.5$ and 218 cairns were classified into group *R* with p =

94. Excavation report by Henrik Asplund 1990 (TYA).

0.5 (figures 61 and 62). Thus, *more than half of the burial cairns in Åboland are of Iron Age character.*

7.4.4 The shore zone datings

Transferring dates from dated finds to finds with unknown age involves a generalization the plausibility of which may not be easy to assess. Yet, in Åboland, the shore displacement offers an opportunity to test the group membership of cairns by examining, whether the shore zone datings are logically consistent – assuming the cairns were not built in the waterline or under the water. Were cairns with group *P* characteristics erected in places which in the end of the Bronze Age still were under the sea level or in the shore zone?

Regarding the oldest shore level zones until the Litorina IV-level, the ages were estimated using the shore displacement curve in the district of Turku (figures 55 and 56) by Matti Eronen *et al*. (1993: 30). Regarding later Litorina shores, the shore zone ages were estimated as the function of the location of the burial place and the altitude by fitting a trend surface into 14 points in the ratio diagram given by Glückert for the altitudes of the shore level zones LVIII, LVII, LVI and LV[95](Glückert 1976, Appendix I). From the Late Iron Age circa 800 AD up to the present, the shore zone ages can be reckoned using formulas given by Ekman and isobases given by Kakkuri (Ekman 1993; Kakkuri 1997). The accuracy of the procedure improves towards the present although the dates, as a whole, are approximate because of the graphical source data, the scarcity of Glückert's data in the outer and skerry zones and the errors of the DEM.

The scatter points of the altitudes in both groups mostly fall between 15 and 30 meters. However, in the group *P*, there are two cairns located on a rock surface uncovered not earlier than the Iron Age. In figure 55, they settle on the time axis to the right side of the vertical segment denoting the year 500 BC. The cairns are situated in Pargas and Västanfjärd.

> *Lofsdal, Pargas (288).* The altitude is circa 15 meters. The cairn can have been built at the earliest about 500 BC. A cairn with a radius of 8 m, indeterminable shape, collected of rounded and edged boulders (about 0–100 kg) in a rocky terrain, on a NW slope, on an uneven rock surface. The cairn is rather large, about 70 m², its difference of height to the highest top is -25.5 m and the convexity of the burial place is 0.6m[96]
>
> *Norra Mågsholmen,* Västanfjärd (334). The altimetrically measured altitude is 11 m. The cairn can have been built at the earliest about 100 BC. A cairn with an indeterminable shape. The E edge of the cairn might have been rectangular. In the middle of it, there is – concluding from the Rhizocarpon lichens on the stones – a very recent crater. The place is on an island, separated from the mainland of the island of Kimito by a narrow strait, on a slightly inclining rock with an even top. The length of the cairn is 7.6 m, width 4.9 m (37 m²) and height 0.9 m. The stone cover consists of mostly

95. The points 25, 38, 57, 66, 81, 129, 137, 177, 191, 248, 250, 255, 269 and 295 in Glückert's data. For trend surface analysis, see e.g. Haggett *et al*. 1977: 379–383.
96. See survey report by Mickelson 1954, no 10 (NBA) and Tuovinen 1985, no 195 (TYA). Nyberg 1985, no 10.

rounded stones of various sizes (about 1–300 kg). The edge boulders are, on an average, larger than ones in the middle. The difference of height to the tops in the northern side of the island is -31 m. The convexity is 0.9 m[97].

Both of the cairns have been built in an inner archipelago milieu near the shore, not far from high rock tops and at least the cairn of Lofsdal is fairly large for an Iron Age one. Regarding these two cairns, a Bronze Age dating cannot, accordingly, be correct, even if they resemble more the group *P* than the group *R*.

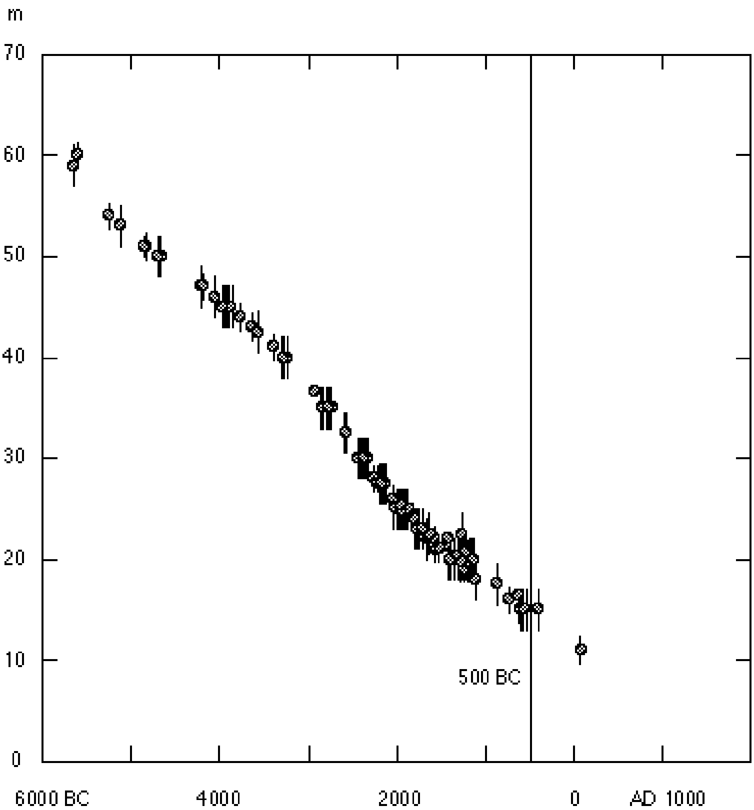

Fig. 55. The altitudes (m) and the shore zone ages (*n* = 147) of the *P*-group cairns. The error bar indicates whether the altitude was determined using the basic map, an altimeter or a levelling instrument.

In the group *R*, there are 58 cairns which were constructed on land uncovered as late as the Iron Age above a shore zone of one meter. Of these cairns, 32 were built at the earliest in the Pre-Roman Iron Age or the beginning of the Roman Iron Age before the year 50 AD, 21 not earlier than in the Roman Iron Age or Migration Period before the year 600 and 5 at the earliest in the Merovingian or Viking Age before 1000 AD (figure 56). The latest of the cairns are Kaldoholmen 2 in Holma, Dragsfjärd, Gånganberget in Trunsö,

97. See survey report by Tuovinen 1985, no 30 (TYA).

Nagu, Kistskär in Österskär, Korpo, Kalvholms fladan 2 and Kalvholms fladan 1 in Hitis, Dragsfjärd, and Djupklevsudden in Kälö, Korpo[98].

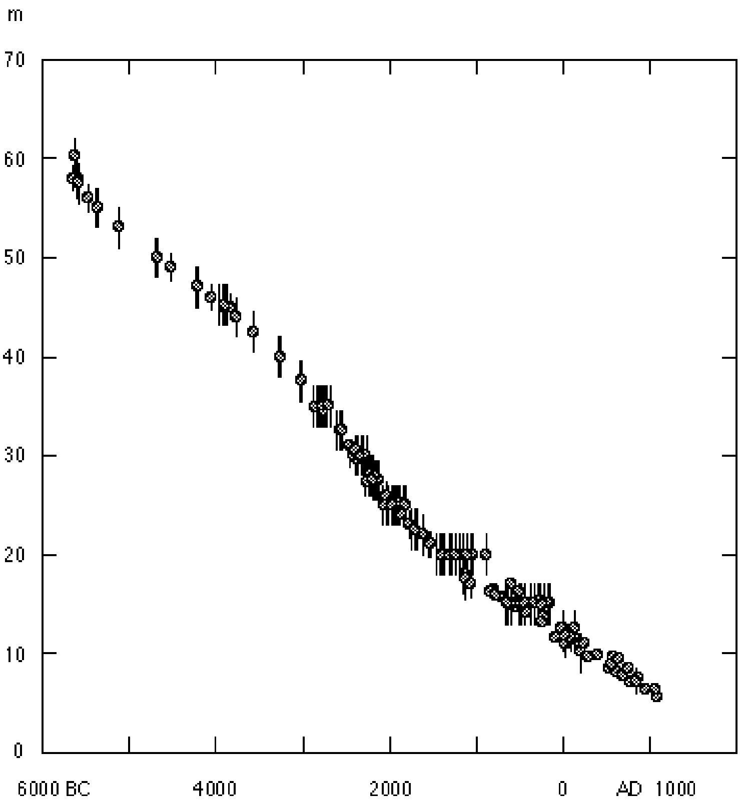

Fig. 56. The altitudes (m) and the shore zone ages (*n* = 218) of the *R*-group cairns. The error bar indicates whether the altitude was determined using the basic map, an altimeter or a levelling instrument.

98. After the writing of this thesis, Henrik Asplund wrote a report on the excavation of a burial cairn at Majberget, Kimito (134). The radiocarbon date of charcoal found under the stones indicated that the grave was built during the Viking Age (Asplund 2001: 198–201). This is well in accordance with the group membership suggested by the discriminant analysis, since the easternmost cairns of Majberget belong to group *R*. For this particular cairn the posterior probability for belonging to group *R* is $p = 0.97$.

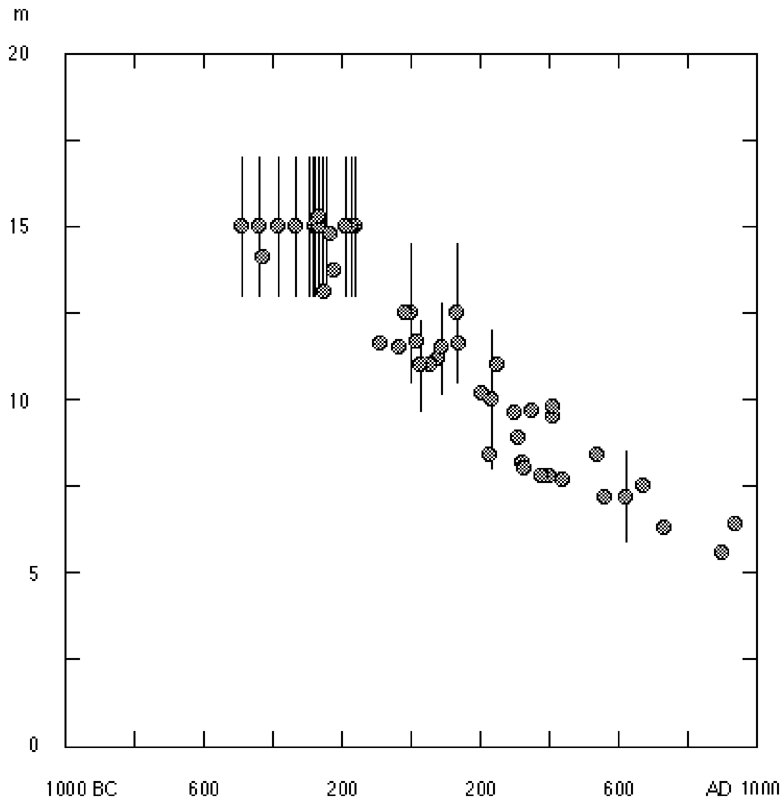

Fig. 57. The altitudes (m) and the shore zone datings of the *R*-group cairns with a shore zone dating of 500 BC or younger (*n* = 58). The error bar indicates whether the altitude was determined using the basic map, an altimeter or a levelling instrument.

Kaldoholmen 2, Dragsfjärd (033). A round cairn with an uneven surface (6.6 m, 5.3 m, 0.5 m) of almost exclusively rounded stones and boulders of varying size; in the middle there is a cavity which enters the rock. h = 7.2 (levelled), shore zone dating 560 ± 270.

Gånganberget, Nagu (370). A cairn of indeterminable shape, convex by profile (4.1 m, 3.1 m, 0.6 m) of almost exclusively rounded boulders, damages by thermal distension in the southern edge. Not quite a typical burial cairn. h = 7.2 (barom.), shore zone dating 620 ± 240.

Kistskär, Korpo (350). A round cairn with an indeterminable profile (9.1 m, 8.8 m, 0.7 m) of almost exclusively rounded and fairly large boulders which seem to have become set on top of large earth-fixed boulders. In the middle part there are two large boulders surrounded by – secondarily excavated ? – cavities. The surfaces, however, are covered with lichen. h = 7.5 (levelled), shore zone dating 670 ± 210.

Kalvholms fladan 2, Dragsfjärd (338). A round cairn (6.9 m, 6.8 m, 0.9 m) of rounded and edged boulders. In the middle part, a precipitous crater, probably of secondary nature because there is a great number of small stones lying on its borders. h = 6.3 (levelled), shore zone age 730 ± 230.

Kalvholms fladan 1, Dragsfjärd (337). A stone setting of indeterminable shape, with a plane surface (7.8 m, 5.4 m, 0.5 m) of mostly rounded boulders, in the south-western and western edges there is a border collected of larger rounded and edged boulders. h = 5.6 (levelled), shore zone age 900 ± 200.

Djupklevsudden, Korpo (364). A round, crater-like stone setting (7.1 m, 6.2 m, 0.7 m) of mostly rounded stones and boulders with large rounded erratics in the northern part. h = 6.4 (levelled), shore zone age 940 ± 160[99]

Fig. 58. The cairn at Djupklevsudden, Korpo, is situated in the village of Kälö in the Southwestern Archipelago National Park. The pasture habitat is kept up by cattle grazing (see Lindgren 2000). Photographed by the author.

The determination of shore zone datings brings about an approximate order of the highest possible ages of the cairns, but it is of course only a stochastic order for their real ages. From the distribution of the shore zone ages, conclusions cannot be drawn, for instance, of the average real age of the cairns. In the *post quem* -datings, the mean value is not sensible as a concept because the real age of the cairns cannot vary on both sides of the *post quem* -age, but the real age is, according to the definition, higher than it or at least equal. Although half of the cairns built on land uncovered after the year 500 BC date back to the Pre-Roman Iron Age at the earliest, it does not mean that half of the Iron Age cairns would date from the Pre-Roman Iron Age. On the contrary, as we saw in the

99. The field data are included in reports by Tuovinen 1985 (TYA); Heikkinen & Näränen 1992 (TYA); Tuovinen 1992 (TYA); Tuovinen 1995b (FFPS); Tuovinen 1996 (FFPS); Tuovinen 1997 (FFPS).

sample study (chapter 4.5), the cairns are, on an average, later than an overall survey of topography would suggest.

Testing the group membership against shore zones indicates that the classification into groups *P* and *R* is not perfectly identical with a division into Bronze Age and Iron Age cairns. *P* and *R* represent two groups, the former of which is typically Bronze Age and the latter occurs primarily in the Iron Age. Group membership must be interpreted as a suggestive and stochastic, not an absolute feature.

7.4.5 The classification functions

The classification functions can be used to determine which group an earlier unknown burial cairn is closer to. The observed values of variables are put into classification functions and the cairn is entered into the group the classification function of which acquires a higher value. Let us assume that a cairn has been found the length of which is 9.2 m and the width 6.9 m, the convexity on the burial place 1.1 m and the difference of height to the highest top 17.0 m. By putting into classification functions, we get $y_P = 0.22$ and $y_R = 7.28$. The burial cairn, thus, belongs most closely into the group *R*.

7.4.6 Discussion

The chronological characteristics of burial cairns in Åboland partly seem to agree with the ones dealt with in earlier studies on the Finnish SW mainland area and on Åland. The small size of the cairn and the location in a low-lying terrain indicate an Iron Age dating. However, the clustering of the cairns, the tendency to group into cemeteries, is not typical of the group *R* in the same way as in the Iron Age cairns of the mainland – as a characteristic distinctive for Iron Age graves.

Another difference is in the range of sea in the landscape surrounding cairns of different ages. According to Helena Edgren (1983), the Bronze Age cairns of Åland are typically situated by the sea and they have been built by seal hunters and fishers. Because the environment of the cairns is still in our days maritime, it must have been significantly more so during the Bronze Age when the land surface of Åland was 15–20 m lower than at the present. In Åboland, the maritime landscape of the cairns of the *P*-group has, instead, in the process of shore displacement, shifted to an inner archipelago and mainland (figure 61).

While the landscape of Iron Age burial cairns on Åland can be characterized as mainland or inner archipelago (Edgren 1983), the cairns of group *R* in Åboland have been built on a broad zone ranging from the largest islands, such as the mainland of Kimito, to the outer archipelago zone in Hitis, Nagu and Korpo (figure 62), yet a more maritime environment than on Åland. It seems that the tradition of the selection of the place of burial cairns changed more towards a land-based landscape in the course of time from the Bronze to the Iron Age on Åland, while the tradition remained its maritime character in Åboland.

Due to shore displacement, the maritime character of the present day landscape is a different thing than the same characteristic at the times the burial cairns were built. In the large-scale topography of the peneplane inclining towards the Baltic Sea, the toposequence has moved over from NE towards SW as land has risen up from the sea. According to the hypsographic curve of Åboland (fig. 2), the earliest skerries that rose up from the sea were the highest summits of the peneplane, having steep slopes, while the later exposed land was plainer. The high relief, characteristic of the burial places of group *P* and the terrain surrounding them, can partly be explained by the exposure of the peneplane: when the Bronze Age cairns were erected, the sea was deeper and the islands were smaller and further away from each other than during the Iron Age. The present day Bronze Age cairns are typically not located in a maritime landscape any more, they are rather surrounded by forests and agricultural land. The spatial distribution of the *R*-cairns indicates that there was a direction for the building of new cairns: as land rose from the sea further out in the archipelago, cairns were built on the newly formed and enlargening islands. The result is *a stochastic time gradient from the present day mainland zone through the inner zone to the present day outer archipelago zone*. Along this gradient, the morphology of the cairns and the topographic characteristics of the burial places can be interpreted as a part of the mortuary ritual while the present day topographic setting in a larger sense, and the presence of the sea, can be rather than, or in addition to cultural preferences, associated with the prehistoric stage of the development of the shore displacement.

8 Visual Dimensions of the Burial Sites

8.1 To See And To Be Seen

The sample from Houtskär, Korpo, and Nagu demonstrated that the grave sites were typically located on elevated (but of very varying heights) rock outcrops. The graves were frequently constructed on the tops – or near the tops – of the rocks, at elevated sites in comparison with their vicinity, on horizontal or slightly sloping surfaces, often close to each other, and near the sea. This means that the visibility from the grave sites was wider in scope than from its neighbourhood. The grave sites also provided visual contacts with each other. The distribution of the grave sites in the sample indicates that the basis of the cultural significances of the grave sites lay in the visual ingredients of the landscape, in the relief, in the perspective, in the mosaic of land and sea, in the horizon.The significances seem to have been connected with the network of visual contacts between the grave sites and the surrounding land and sea in the ancient landscape.

What is said above, concerns the grave sites only, not the graves themselves: extremely few cairns are visible from the sea or from the adjacent terrain. The grave at Bussö, Korpo (349), for example, can be discerned from the sea in the south and in the southwest but not from very far although the rocks of the southern section of Bussö are treeless, and there is a wide stretch of open sea in the south. The same applies to the grave at Kalholm, Dragsfjärd (362) from where there is an unobstructed view to the sea (fig. 23). The cairn was barely discernible in the profile of the island if the boat was suitably close to the shore. It is impossible to see the grave when walking along the shores of Kalholm. Also the graves at Österudden, Pargas (265) and Falkön, Dragsfjärd (007) can be seen with the naked eye from the sea; they are located at the distance of four kilometres from each other at two heads of capes, on opposite sides of the waterway from the open stretch of the sea called Gullkrona fjärden into the inner archipelago towards the Peimari, and the Paimionlahti. They are not visible from a distance without optical aids, either, and never simultaneously, but the rocks of the graves can be recognized even from afar. The site of the grave at Ernholmsberget, Nagu is an even terrace at the height of 35 metres, 60 m SE of the highest point of the rock. The constructors have desired to find a site which is slightly lower than the highest point of the rock, and yet with an unobstructed view towards the waters in the surroundings in all directions apart from NW. Also the stone setting is more than one metre high but nevertheless the grave can only be seen from a boat sailing far enough in the southwest – and even then with binoculars only. Cairns which are not very close to each other, are occasionally within a visual contact with one another, as at Simonby, Nagu and Prostvik, Nagu (223 and 220).

Fig. 59. The graves at Österudden, Pargas, and Falkön, Dragsfjärd (encircled) were visible from the sea when sailing north from the archipelago towards the Paimionlahti and the coast – at least if the boat was close enough, and one knew where to look. The map image corresponds the landscape in the year 500 BC. © National Board of Survey, lic. No. MAR/103/98.

Observations of the terrain in the present topography of the grave sites thus suggest that the cairns have been far too small to be discerned in the landscape save in exceptional cases. Most grave sites are too far off from the shore, and the stone settings of most graves are so low that they cannot be discerned in the profile of the island regardless of the forest. It should be remembered, however, that the visibility of the stone settings of the cairns from the sea has been reduced from the Metal Age to our day. With the land uplift from the sea the mutual height differences of the rock tops have not changed – in terms of the scale of the range of vision – but the exposure of the sea bottom has reduced the sea area. Simultaneously the number of the grave sites which are not visible from the sea has increased as the land uplift has raised up rocks which may hamper the visual contact. The change in visual contacts applies naturally also to the visibility in the opposite direction: the sea area visible from the grave sites has decreased during the millenniums.

As an example we might use the grave at Båtkullaberget, Kimito; this cairn in the eastern part of Kimitoön is almost 12 m long and 1.3 m high (139). The grave site is located at the height of 36 m, on a rock outcrop rising 30 m above the surrounding cultivations, NW of the highest point of the rock. At the end of the Bronze Age the site was located on a cape above a steep slope inclining down to the shore, at the height of about 23 m above the sea. The present cultivated fields were covered by a 4–9 m deep water. From the site there was a wide scope of view (radius 5000 m) of 13.6 km², 53 per cent of which was water. The present scope of view of 11.4 km² consists of only three per cent of water. The changes in the visual contacts from Båtkullaberget illustrate both the effect of the silting sea bottom on the view to the sea, and the effect of the land uplift on increasingly hampered visibility (fig. 60).

Land uplift does not necessarily influence the recognizability of the distinctive topographic forms of the grave site – rock peaks, terraces, capes, or mouths of straits. The discernability of the cairn from far is not any prerequisite of the signification of the site; it is sufficient that the grave site is linked with a characteristic form of the landscape, a milieu dominant, which distinguishes it from the rest of the sites. Such a grave site agrees with Felipe Criado's concept of an ambiguous monument (Criado 1995: 199). While the visual properties of natural places belong to the usual material of Swedish and old Finnish place names in Åboland (Pitkänen 1985 a: 162–188; Zilliacus 1989: 56–64 etc; Fortelius 1999: 269–329), it might be analogically presumed that features in landscape, such as trees, bird colonies, soil, boulders, the colour or shape of rocks, the location or topography of an island in reference to other islands, could have made a prehistoric grave site extraordinary and recognizable. The grave at Bussö, Korpo mentioned above, is a possible example: it is located on a cape pushing south, with red, at places pegmatitic granite. The cairn and the reddish colour of the rock are distinctly discernable from the sea and from the same distance, but when walking on land the colour easily remains unnoticed. Consequently, the grave must be watched from the south or from the southwest, and from the sea. The reddish stone seems to appear only on the southern shore of Bussö.

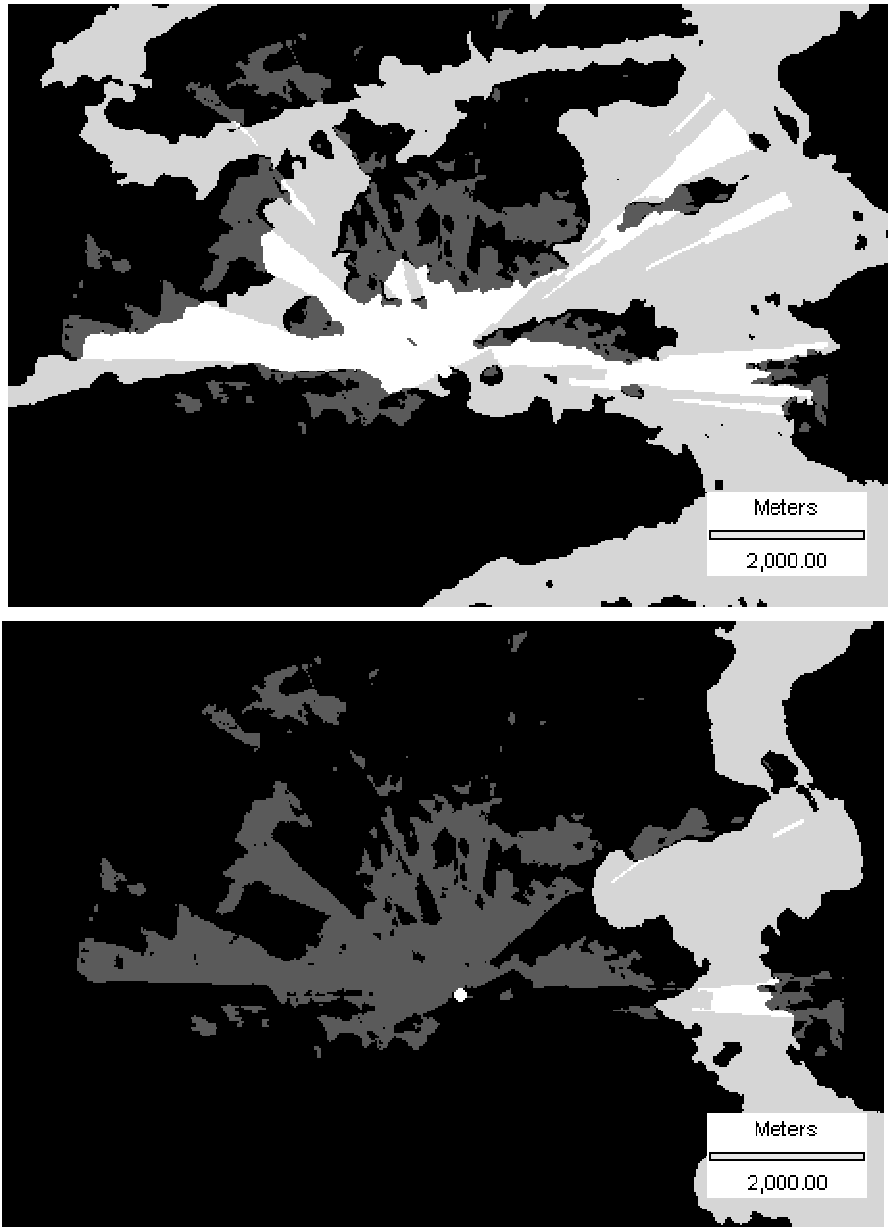

Fig. 60. **The effect of shore displacement on the view from the grave at Båtkullaberget, Kimito (139). The upper image presents the view in about 500 BC, the lower the present view (cf. Zilliacus 1994: 14–15). The blackened area describes the land area outside the visual contact, the light grey sections denote the sea area outside the visual contact, the whitened area denotes the visible sea area, and the dark grey signifies the visible land area. © National Board of Survey, lic. No. MAR/103/98.**

8.2 The Development of the Landscape in the Archipelago of Åboland

8.2.1 Shore displacement

The bedrock of the archipelago of Åboland and Kimitoön has since the early Bronze Age risen approximately 18–22 m in reference to the sea level. In the Late Iron Age the land level was still 5–7 m lower than today (fig. 62). Locally, shore displacement has caused an essential change in the relief and in the relations between land and sea areas; in terms of the toposequence, the archipelago zones have shifted towards the Baltic Sea, from NE to SW. To be able to investigate the relations between the Bronze-Age and Iron-Age grave sites and the landscape, and the grave sites in reference to the landscape, we have to reconstruct the preceding phases of development in the landscape. The broad chronology of the cairns does not allow the reconstruction of the phases of too many shore displacements of varying age since in most cases we can only tell whether the grave in question belongs to Group *P* of Bronze Age character rather than to Group *R* of Iron Age character.

Most graves in Group *P* were probably erected by the end of the Bronze Age. By examining the land uplift landscape in about 500 BC, we can thus design a general image of how the Bronze Age graves, constructed during several centuries, were located in the ancient archipelago. By selecting the time level of the end of the period we try to avoid the mistake of locating the grave site in surroundings where it cannot possibly have been situated: in too early a phase of shore displacement. This would induce errors and noise in the data. Instead, the grave site may be located in a later phase of shore displacement than the actual date of the construction, in which case the assumed surroundings are several generations later than the grave constructors. This is, however, in accordance with the nature of the grave monument. Correspondingly, the Late Iron Age – in this study the year 1000 AD was selected – is used as the time level in investigating the graves in Group *R*. The reciprocal comparison of these time levels illuminates the change in the landscape during 1500 years, and in the location of the grave sites in reference to the landscape.

The elevations corresponding to 500 BC and 1000 AD were determined using the DEM. A trend surface was fitted into 14 data points in the ratio diagram given by Glückert (1976). After determining the trend surface coefficients, a raster map containing the altitude corresponding to the year 500 BC for every cell was computed using overlay operators (figure 61). Because of the deflection of the land surface during the land uplift, the map is correspondingly deflected so that the altitudes in the southeastern part of the map are 12.0 m lower than today; in the northwestern section the figure is even 16.5 m.

The elevations for the year 1000 AD were determined by using Ekman's (1993) formulas, the isobase map of the shield of Finland and Scandinavia, published by Kakkuri (1997), was used as initial data. The result was a raster map where the altitudes in the southeastern part of the research area are 4.0 m, and in the northwestern part 5.7 m lower than today (fig. 62). The standard error in Ekman's formula is ± 0.8 m; additional sources of error are the inaccuracy of the DEM and the inaccuracy of the land uplift isobases (appr. ± 0.5 mm/y or better (Kakkuri 1994 b: 9)). Besides, the calculations based on the DEM do not guarantee the correct image of gravel and sand shores because sedimentation and the formation of shore morphology have not been taken into consideration (Granö

1977; Pyökäri 1979; Mansikkaniemi 1989) in the effect of shore processes and land uplift.

Fig. 61. The archipelago of Åboland in about 500 BC, and the cairns in Group *P* (*n* = 147). © National Board of Survey, lic. No. MAR/103/98

In the previous discussion on the chronological characteristics of the cairns it was established that the graves in Group *R* were, on the average, located much further out in the archipelago than the graves in Group *P*, at least if the toposequence is measured for the proportion of sea area in a relatively large window, and for the mean height of the terrain. Before drawing too rash conclusions concerning the regional difference between the two groups one should investigate first what effect the shift of the archipelago zones caused by land uplift has on the difference between the groups. The direction is in accordance with the age difference of the groups: from the mainland towards the outer archipelago.

The difference in the toposequence between the groups will gain comparability when the landscape under observation is returned to the phases of the shore displacement reconstructed previously. For this purpose, windows with a side length of 2025 m (4.1 km²) were opened in the maps for the time levels 500 BC and 1000 AD; then the relative proportion of land area in the window surrounding each burial site was calculated for Group *P* and Group *R*, respectively.

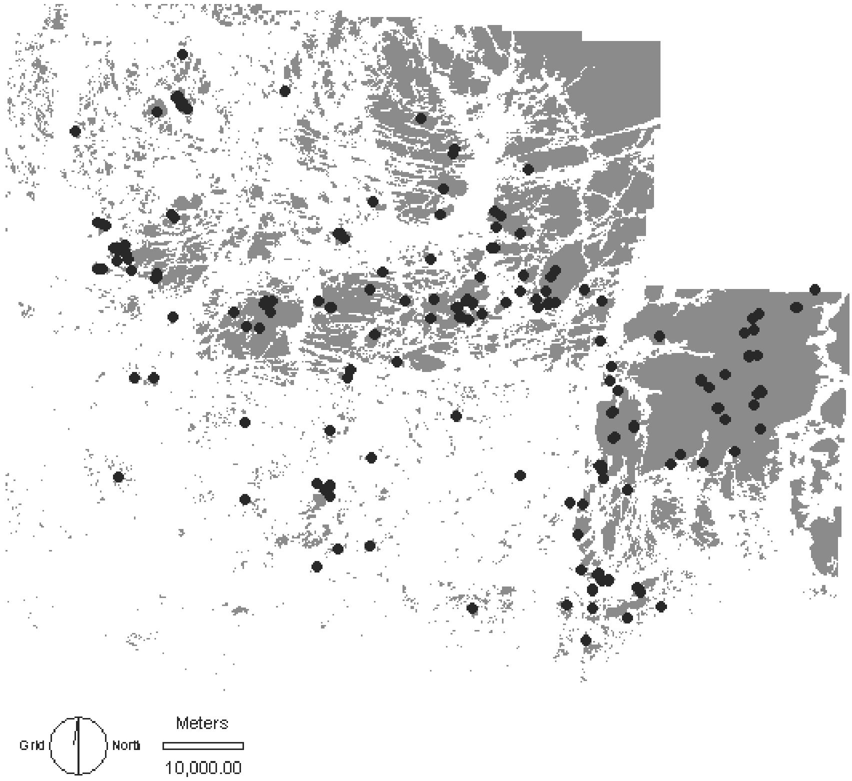

Fig. 62. The archipelago of Åboland in about 1000 AD, and the cairns in Group *R* (*n* = 218). © National Board of Survey, lic. No. MAR/103/98

The distributions of land area were largely in accordance. The most distinct difference was seen in the greater proportion of Group *R* in grave sites for which the proportion of land area in the window was almost or precisely 100 per cent (fig. 63). These were grave sites on large islands. For the grave sites in Group *P*, the proportion of land area in the window was, on the average, 0.509 (51 per cent) (standard deviation 0.289). In group *R* the average proportion of land area was 0.549 (55 per cent) (standard deviation 0.288). In comparison, Student's $t = -1.259$, with degrees of freedom $df = 362$, and significance level $\alpha = 0.202$. Even if the present map image suggests that the surroundings of the grave sites in Group *R* are more maritime than those of the grave sites in Group *P*, the difference is not, however, statistically significant when the age differences of the graves and the changes of landscape caused by shore displacement during 1500 years are taken into consideration. At the time of their construction, the sites of the graves in Group *P* were, in fact, as maritime as those of the graves in Group *R* but by the Iron Age, shore displacement had changed the surroundings of the oldest grave sites so that they were more like mainland terrain (cf. fig. 62).

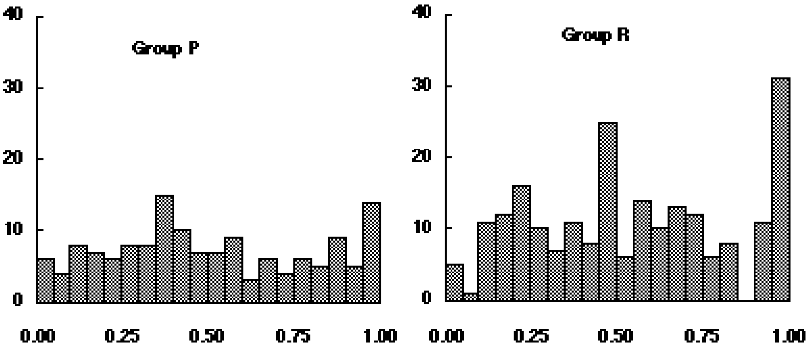

Fig. 63. The relative proportion of land in a window with a side length of 2025 m in about 500 BC for the grave sites in Group *P*, and in about 1000 AD for the grave sites in Group *R*. *n* = 364.

The minute difference between the grave sites in Group *P* and in Group *R* concerning the maritime landscape at the time of the construction implies that graves were erected further out in the archipelago and in a more extensive area than before when new islands emerged out of the sea as a result of land uplift, and the islands became larger in size. In the Iron Age cairns appeared, above all, in the present outer archipelago zone and in the middle zone in Iniö, Houtskär, and Hitis while the construction of graves continued on the large islands in Rymättylä, Nagu Lillandet, Pargas and Dragsfjärd, and the mainland-like areas of Kimitoön. In today's archipelago this means that *the gradient from the inner zone to the outer archipelago zone* – from an older shore displacement environment to a younger one – *is, at the same time, a stochastic age gradient of the cairns*. It is impossible that the oldest graves should have been constructed in the outmost archipelago and on the lowest sites. An occasional old grave further out in the archipelago or an Iron-Age grave in a mainland-like environment does not influence the general trend of the age gradient.

8.2.2 Forests and pastures

The outward aspect of the landscape in the southwestern archipelago in the Metal Age was probably largely determined by the topography. The appearance of the landscape and the visual contacts within the landscape were, however, also influenced by forests. Forests have passed through a long development due to the land uplift succession, climatic changes, and human activity. The skerries which emerged out of the sea received their first pioneering trees in the most sheltered places, and developed gradually into the more or less wooded islands that they are today. The last phase of development of the forests in the archipelago began in the 19th century after the obstacles imposed by legislation concerning parcelling of the land to crofters and fishing outside the villages had been abolished. The population of the archipelago of Åboland rose by the year 1910 up to the highest figure known so far (Jaatinen 1960; Jaatinen 1961; Vainio 1981; Moring 1994: 62–70). Sheep and cattle were grazing wherever they could find anything to eat. Grazing and collecting fodder for winter led to a deterioration of the forest to the extent that ”original” wild nature had disappeared a hundred years ago. In the 20th century the market powers made traditional forms of small-scale fishing, agriculture, and cattle-raising impossible, which, in its turn, led to large-scale emigration and diminishing population. After the cessation of grazing, the forests of the archipelago are today growing again (Lindgren & von Numers 1999; Lindgren 2000).

The forests of the archipelago are divided into zones. The inner and the middle archipelago zones are dominated by coniferous and mixed forests which are replaced by maritime deciduous woodland when moving further out towards the outer archipelago zone. They are characterized by shoreline alder groves (*Alnus*), and patches of low-growing birch (*Betula*), occasionally even dry pine woods (e.g. Lindgren & Stjernberg 1986: 11–14; Granö *et al*. 1999: 27–38). The outmost islands of the skerry zone are totally or largely treeless.

The development of the forests of the southwestern archipelago in the subboreal and subatlantic periods has been investigated mainly by using pollen analyses. According to the research conducted by Gunnar Glückert, the forests of the subboreal period on the mainland of Åland abounded in birch and alder, and the more southern deciduous species were more common than today (Glückert 1978: 79–87; see also Huntley & Birks 1983). The florescence of the oak-dominated mixed forests (*QM*) and deciduous forests came to an end in the late subboreal period, at the latest, when pine and spruce forests became common on the mainland of Åland. The forests on the island of Kumlinge in the eastern archipelago of Åland were of more maritime type than those on the mainland of Åland. The development of the forests on Kumlinge can be investigated since about 1700 BP when the bog of Gunnarsmossen was isolated from the Baltic Sea, and the pollen analyses indicate that rocky Kumlinge remained almost treeless for about 1000 years. Deciduous maritime trees were, however, not uncommon at low-lying and sheltered sites (Glückert 1989).

The Bronze-Age dwelling place of Otterböte is located in the parish of Kökar, Åland, which borders on the western edge of the research area. The place was inhabited in the subboreal period, about 1300–1000 BC. On the basis of pollen and macrofossil analyses the type of the forest was at that time close to the present maritime deciduous forest type on Kökar (Gustavssson 1997: 17–21; Núñez *et al*. 1997). The most significant species in terms of visibility were probably birch, alder, aspen (*Populus*), hazel (*Corylus*), oak (*Quercus*), ash (*Fraxinus*), and elm (*Ulmus*). No coniferous trees seem to have grown on the island apart from juniper (*Juniperus*).

Irmeli Vuorela has been investigating the bog basins on the mainland coast of south-western Finland and in the archipelago (Vuorela 1991 a; Vuorela 1999). In the swamp of Lalaxkärret, Nagu, one can distinguish a shore phase with an overrepresentation of coniferous trees due to the pollen concentrations brought to the shore by the waves. Due to land uplift, a bog developed at the site during the younger Bronze Age and the Pre-Roman Iron Age, and the tree pollen analyses indicate a typical shore forest dominated by deciduous trees. After this the pollen of coniferous trees becomes predominant; the samples lack, however, the surface section stratified during the past 2000 years because of the subsequent peat harvesting in the area. The oldest layer in the sample from the bog of Mossen, Korpo (Vuorela 1991 b: 126–130) is about 2000 years old. The shore phase, characterized by alder, birch and the more southern tree species such as hornbeam (*Carpinus*), and the subsequent development of marshland typified by the predominant proportion of pine pollen, is seen also at Mossen. At Mossdalen, Kimito, pine, birch, alder and the more southern tree species abound in the Bronze Age (Asplund & Vuorela 1989). At the same time, spruce becomes more common but in about 2850 BP its proportion seems to diminish due to human activities, probably grazing. Also in the swamp of Isokärret, Kimito, the forest vegetation consists of coniferous trees, birch, alder, and the more southern deciduous trees after the shore phase (Asplund & Vuorela 1989).

The natural geographic zones of the archipelago from the mainland coast to the open sea (Granö 1981; Jaatinen 1982: 45; Granö *et al*. 1999: 27–38) probably existed in the subboreal and the subatlantic periods because the zonal differences were due to differences in the distribution of land and sea, and the maritime climate. The pollen analyses do not challenge such a concept. Judging from the samples, the stand of forest at Kumlinge and Kökar was dominated by deciduous trees to a greater extent than at Korpo, Nagu and Kimito, and was thus close to the forest type in the outer archipelago. Several islands which today grow with maritime birch forest were at the time of the grave construction probably treeless outer skerries.

The fact that such ancient Finnish loan names as Korpo (from *Fi*. **Korpi* 'a damp forest') and Mossala (from *Fi*. **Mustasalo* 'a black island') denote large forested islands provides interesting indirect evidence (Pitkänen 1985 a: 148–149; 179–180; Zilliacus 1994: 26; Zilliacus 1997: 35; Fortelius 1999: 14–16). But due to the absence of more detailed knowledge one must, however, keep in mind when studying the landscape that this is rather a reconstruction of potential visual contacts than anything else. The chances of making the correct conclusions are greater in the outer than in the inner archipelago.

8.3 Views from the Grave Sites

8.3.1 Altitudes of the Grave Sites

The graves whose age can be determined with considerable certainty allow an investigation of the height difference between the grave site and the shoreline at the time of the grave construction. The graves at Långnäsudden, Dragsfjärd (041, 042) which date back to the II period of the Bronze Age are located at the height of about 25 m. We can assume that the graves were erected at the height of less than 10 metres above sea level, in the northern corner of a skerry with an area of less than a hectare. The graves at Hammarsboda, Dragsfjärd (043–046) were constructed on a narrow headland belonging to the ice-marginal formation of Salpausselkä III at the heights of 20.9, 22.3, 21.3, and 20.0 metres, respectively. By inference from the finds, the graves belong to the second or the third period, and thus they must originally have been located only 3–5 metres above the shoreline. The inlet of the sea around the headland was so shallow that it silted up by the end of the Bronze Age. The site of the grave at Trollberg, Houtskär (087, dating back to about 1200 BC) was rather different: the rock outcrop reaches today the height of 37 metres. At the time of the construction of the grave, the rock was only 16–18 m high.

The grave at Stora Ängeskär, Dragsfjärd on the southern shore of the island at the height of 8.2 m, dates back to the Viking Age. The rock outcrop at the grave site overlooking the sea was, at that time, 3.9–5.0 m (± 0.8 m) lower than today in reference to the mean water level. The grave was thus constructed at the height of approximately 3–4 m only a few steps from the shore but nevertheless on a horizontal terrace-like rock outcrop. In the cemetery at Furunabb, Houtskär the graves are located in a terrain whose height ranges from 14 to 17 metres. The original height difference between the graves and sea level was less than 10 metres. The two cairns at Sundbergen, Nagu were erected in the younger Iron Age at a site which was quite different, on the top of a rock; at the time of their construction the top was 21–26 m above sea level, today the cairns stand at the heights of 27.6 and 29.9 m, respectively.

On the presumption that cairns were no longer, at least generally, erected in the times of recorded history, the graves at the lowest sites must have been constructed close to the shoreline. Some of these graves were, for instance, the grave at Kaldoholmen 2, Dragsfjärd (033, h = 7.2 m, shore zone dating AD 560 ± 270), the atypical grave at Gånganberget, Nagu (370, h = 7.2, about 620 ± 240), the grave at Kistskär, Korpo (350, h = 7.5, 670 ± 210), the grave at Kalvholms fladan 2, Dragsfjärd (338, h = 6.3, 730 ± 230), Kalvholms fladan 1, Dragsfjärd (337, h = 5.6, 900 ± 200), and the grave at Djupklevsudden, Korpo (364, h = 6.4, 940 ± 160). These graves, like that at Stora Ängeskär, were probably constructed only a few metres above mean water level.

In the light of the examples above, the height difference between the grave sites and the shoreline is highly varying. The distribution of the heights concerning the graves in Group *P* (fig. 55) indicates, however, that most of the graves were constructed ten metres, at the most, above the Bronze-Age shore zone, and definitely not on the highest tops of the region although elevated sites were favoured when selecting sites of graves. The grave sites in Group *R* are located in roughly the same or slightly lower present height zones (fig.56), which implies that *Iron-Age graves were not located any closer to the shoreline than Bronze-Age graves*. If the graves in Group R had been constructed closer to the shore, their sites should be on considerably lower levels. In terms of the view from the grave site, the height above sea level was not, however, the only significant factor in selecting the grave site; other important determinatives were the height of the grave site in reference to the surrounding terrain, the presence of visual obstacles in the surroundings, the amount of sea and low-lying terrain in the landscape, and how uninterrupted the skyline is on the horizon. The landscape opening from a 10-metre-high cliff on a skerry in the outer archipelago may be as extensive as one from a 50-metre-high rock in the inner archipelago or on the mainland coast (figure 64). But also the view from a grave site in the outer archipelago maybe rather limited if the grave site is located within a group of islands or in a so-called miniature archipelago (Lindgren & Stjernberg 1986: 13). In the outer archipelago or on its edge, one can find grave sites belonging to Group R with limited views at Kistskär, Korpo (350), at Härön, Dragsfjärd (347), at Västra Granholmen, Dragsfjärd (Hitis) (341), and at Bötesön, Dragsfjärd (Hitis) (363).

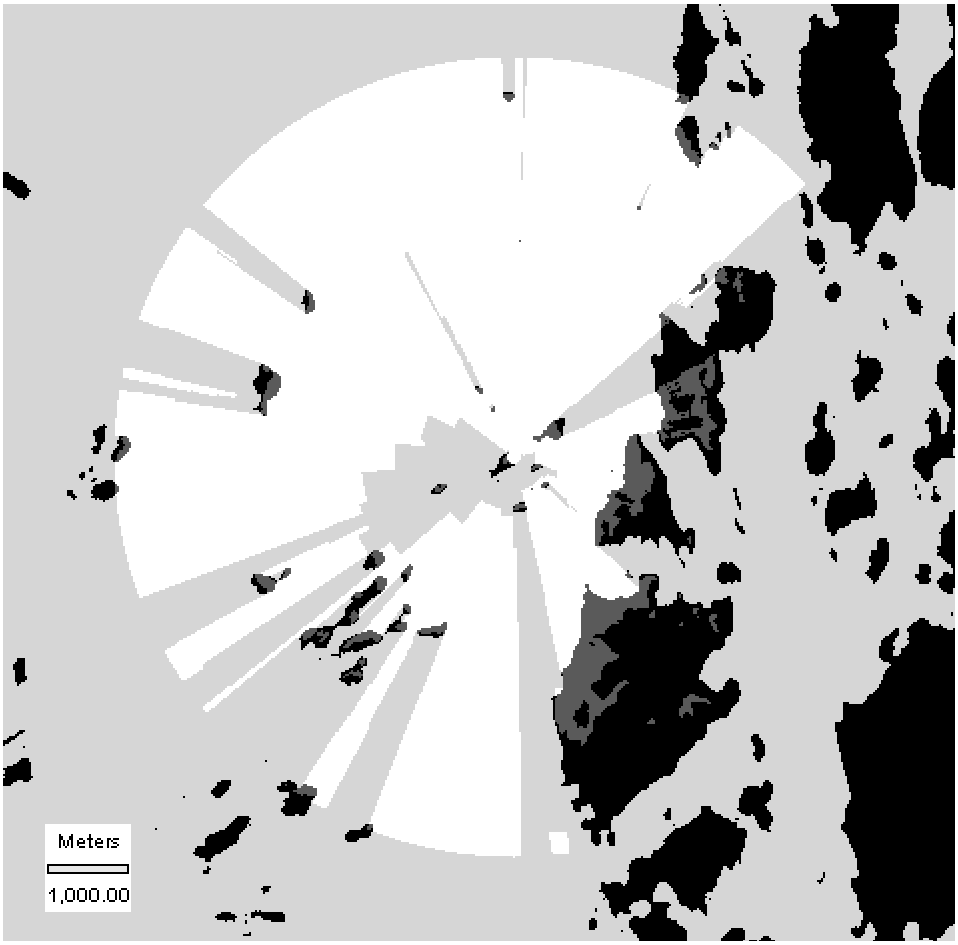

Fig. 64. The visibility to the sea (white) and to the land (dark grey) within a radius of 5000 metres round the grave site at Långfuruholm, Dragsfjärd (060) in about 1000 AD. At that time the height of the grave site was 4.5 m above sea level. © National Board of Survey, lic.no. MAR/ 103/98.

8.3.2 Terrain Observations And Digital Elevation Model

Landscape is mediated to us by sensory perception. If we want to understand and interpret a landscape from the point of view of a prehistoric observer and perceiver, the most natural way is to set about studying the landscape in reference to the prehistoric landscape, and to try to discover the remaining dimensions which may have existed and received significances in the prehistoric period. Christopher Tilley, for instance, made terrain observations of the sites of the barrows and megalithic monuments in the landscape of southern England. Among other things, he gathered the importance of the reciprocal visual contacts between the monuments, and the exactness in the choice of the monument sites (Tilley 1994; Tilley 1996). The paths connecting significant places in the landscape, emerge in his analysis as a narrative metaphor: during a walk in the landscape one reads the significances of the different places in reference to each other. They form sequences of connotations which proceed along the connecting paths (Tilley 1994: 27-33). The idea of reading the landscape by means of close contact is also included in the successions of observations made by Carl Olof Cederlund of the places on the Swedish east coast, mentioned in the medieval so-called Danish itinerary (Cederlund 1988; Cederlund 1991). In Norway, Christian Keller mapped the landscape entities bordered by Iron-Age barrows, and their mutual relationships (Keller 1993; see also Gansum *et al.* 1997). An analysis of visibilities conducted as field research is well-adapted to observing the reciprocal visual contacts between sites, to mapping visually obstructed areas, and to establishing the visual sequences which a mobile observer is able to discern. At the same time an observer today preserves the closeness to the position of a prehistoric observer and perceiver in the landscape because the representation of the same locality and landscape can be perceived with one's own senses.

As stated previously, shore displacement after the Metal Age has transformed the landscape essentially, and deteriorated the visibility towards the sea from the grave sites. At many places, if not at most, one gets a biased image of the prehistoric landscape when one walks to the grave site and stops to have a look around. – I am saying this in spite of the fact that I regard real authentic observations as almost indispensable for the understanding of the nature of the grave site. Even they have, however, their limitations. In this research it is thus necessary to approach the visual landscapes by reconstructing them with the help of a map. At the same time the landscape must be modified into a two-dimensional cartographic plane, which in its turn involves a transition from a world perceived with senses into a geometrically measured milieu, and, correspondingly, the sensory perceptions are lost (Raivo 1997: 205–206).

The digital elevation model (DEM) of the National Board of Survey in Finland provides a suitable material in mapping and analyzing the visual contacts. With this elevation model it is possible to produce quantified and extensive descriptions of the visual contacts at the site of observation. The conventional GIS line of sight (LOS) function between the cell of observation and any other cell will produce a binary-coded value (0 or 1) according to whether the latter cell is visible from the cell of observation or not. The viewshed operation determines the cells which are visible from the observation site. Visual contacts may be combined to involve mutual reciprocal visual contacts of points, lines, and areas. In computations, the height of the observer's eyes from land level and the longest distance of visual contacts must be known or assumed. – The range of vision is not a more exact GIS-function than any other raster operations of maps. The DEM errors tend to enlarge the calculated range of vision (Fisher 1991), and different implementations produce differring ranges of vision (Fisher 1993). The accuracy of the variables derived from a DEM is also affected by the spatial structure of DEM errors (Li & Jezek 1999).

8.3.3 Map Scale

The curvature of the earth confines the longest possible distance of visual contact between two places. A geographic range of vision across the surface of the sea can be determined if both the height of the site of observation from sea level and the height of the object from sea level on the horizon are known (Bowditch 1981: 132; Bowditch 1984: 347–348; National Board of Navigation 1991: 14–15). For instance, seen from a 10-metre-high shore cliff, the surface of the sea joins the horizon at the distance of 12.4 km from the observer (refraction and meteorological visibility are not taken into consideration). If the object to be observed is 5 metres high, it can be seen from the shore cliff from a distance of 21 km, at the most; five-metre-high objects further off cannot be seen on account of the curvature of the earth.

Since the islands in the archipelago of Åboland are low (Granö *et al.* 1986) – in the prehistoric period they were even lower – most of the silhouettes of the islands are not, on account of the curvature of the earth, visible to the observer at such long distances, and even high islands shrink into streaks on the horizon. The study of the visual ranges of grave sites must therefore be confined to distances shorter than the longest theoretical visual sphere of observation. Long-distance visual observations may provide us with too remote details which, in fact, have never been discernable with the naked eye. The prolongation of the radius of the range of view to be observed will, besides, overemphasize the share of high places within the viewshed (van Leusen 1999).

Studying the visual range towards the sea from a grave site, requires, however, observing a sufficiently extensive area. If the visibility of fishing waters or seal ices from the grave site are assumed to have been of great significance, it must have been important to have a sufficiently long unobstructed view towards the open sea from the land. In the inner archipelago the distance to the sea was longer – if there was any visual contact with it – than in the outer archipelago. Mapping the visual contacts must apparently be extended at least to the topographic specific wave length, 1200 m (see chapter 7.3.3).

When studying the scale of significant visual contacts it is also possible to direct one's look in the opposite direction: from the sea towards the land. In the archipelago land is almost always visible in some directions, if the visibility is not hampered by darkness, fog, or rain, sometimes right close, sometimes far off on the horizon. To determine position, direction, and distance in the archipelago has thus been possible, unlike on the open Baltic Sea, on the basis of terrestrial fixed points. The best fixed points were provided by islands whose silhouettes on the horizon were in some way or other extraordinary (fig. 65). We know on what insight we have into fishing in the historical period that the localization of the best fishing grounds was based on terrestrial fixed points at a distance of several, occasionally even more than ten kilometres (Ahlbäck 1955; Gardberg 1966; Storå 1985: 193–194; cf. Hovda 1948: 51–66; Igarashi 1984). If and when these fixed points formed a significant array of natural places in orientation, their significances may have obtained even a sacral nature.

The scale effect appears also in the reciprocal relations of the visual ranges of various grave sites. A more generalized image of the views is obtained when the area under observation is enlarged. As a result, the ranges of vision embrace areas which are more and more varying in topography, and at the same time it will be more and more possible that the observed differences in visual contacts are caused by differences in local topographies within the research area. When the area under observation is reduced, the proportion of the area of each field of vision will increase with regard to the area of the whole research field, and the local small-scale topography will be accentuated in the distribution of the ranges of vision. This situation will emerge when mapping ranges of vision in a very small area on account of a high frequency of graves. The scale effect can be influenced by choosing as homogeneous areas as possible, by using this method one may, however, omit contrasts in studying the ranges of vision of graves of varying ages.

Fig. 65. Typical grave islands against the horizon – milieu dominants – north of Nötö, Nagu, seen from WSW, from the stretch of open sea called Berghamns fjärden. The peaks on the left were the highest points of the grave island of Boskär, the peak to the right from the middle belonged to the grave island of Ådön. The reconstruction describes the silhouette in about 1000 AD, and was made with the help of a DEM. © The National Board of Survey, lic. No. MAR/103/98.

The fields of vision in the archipelago can thus be studied using radiuses ranging from a good kilometre to more than ten kilometres. In the following analysis the fields of vision have been mapped to the distance of 5000 m from each grave site.

8.3.4 The Statistical Significance of the Differences in the Distribution of the Fields of Vision

Almost any place selected at random provides a visual field of at least some extent into its surroundings. In the archipelago one can see the sea shore or even further out to the sea from many places. The ranges of vision given by the DEM must therefore be interpreted with the greatest caution if it is not known whether they are in some consistent way different from the rest of the fields of vision in the archipelago. We already know by the sampling investigation studied in chapter 4 that the grave sites of the archipelago were not chosen at random; it is, however, necessary to analyze specifically how the grave sites differ from other places concerning their ranges of vision.

In the analysis of visible areas the individual finite populations consist of the values of variables derived from the DEM; the fields of vision from empirically determined observation points can then be compared with those values. The significance tests may be conducted by using, for instance, Kolmogorov-Smirnov's test (Wheatley 1995; cf. Fisher *et al*. 1997: 584).

Also Monte Carlo-tests have been used in solving such problems (Fisher *et al*. 1997; Kvamme 1997). In this approach the empirical data are compared with a sequence of samples which have been generated from the finite population according to the randomization procedure determined by the null hypothesis. The estimator T of the parameter under observation is used in this comparison. The material consists of m + 1 samples representing the distribution of *T*, *m* generated by random selection (reference set), and one by observation. Each sample comprises *n* observations. The test result is determined by the rank *k* of the value of *T*, derived from the observations, when the $m + 1$ samples have been arranged into the mutual order of magnitude of *T*. In one-sided tests the probability of the observed value of *T* being the *k*th lowest in ranking or lower when the null hypothesis is assumed to be true, is $\alpha = k/(m + 1)$; correspondingly, the probability of the observed value of *T* being the *k*th highest in ranking or higher is $\alpha = 1 - k/(m + 1)$, depending on the direction of the alternative hypothesis (Ripley 1987: 171–174).

The Monte Carlo-tests involve a relatively simple procedure. No massive reference sets are necessary on the significance level $\alpha = 0.05$, the normally employed magnitude of the reference set is $m = 19$ if no rigid demands have been set on the power of the tests (Hope 1968; Jöckel 1986). This does not mean, however, that the computing will be a trivial task in all cases; on the contrary, the calculation time used up by the computer will be rapidly prolonged as the size of the maps and the number of cells are growing.

8.3.5 The Ranges of Vision towards the Sea and the Land in Four Different Regions

In the following we will investigate, by using Monte Carlo-testing, four different sections within the research area (fig. 66) to be able to achieve a detailed mapping of the viewsheds from the grave sites. These regions represent the best-investigated areas in the archipelago and on the island of Kimitoön, and so it seems apparent that an essential part of the preserved graves have been discovered in these areas. In the choice of the sections we have also aimed at having a representative sample of inner, middle, and outer archipelago in the Metal Age, varying spatial densities of graves, and areas where the grave sites in Group *P* and Group *R* differ from each other in location.

To eliminate the edge effects, only the grave sites which are located at a distance of at least 5000 m from the edge of the area, have been analyzed in each section. The selection of the places in the reference set was chosen in the same frame by using a simple random sampling without replacement. All the points in the random selection which were at the height of 1.2 m or below from the determined sea level or the surface of a lake were dismissed. The specific viewsheds for the grave sites in Group *P* and Group *R* have been determined on the maps in 500 BC and 1000 AD.

The area and the perimeter of the visible area can be determined from the DEM by using standard GIS-functions. The combination of the maps by using overlay operations allows us to determine the magnitudes of the visible sea and land areas and their mutual relations. The perimeter of the visible area indicates the unbrokenness of the visible horizon and the sinuousness of the outline of the visible area. The perimeter of the outline increases when the high places in the visible area overshadow the lower-lying places behind them. The perimeter and the extent of the field of vision are thus measures of how enclosed the landscape is.

The assessment of the sharpest angle from which a certain place in the surrounding terrain is seen obliquely both upwards and downwards will furnish the smallest and the greatest viewing angle; the difference is the relief index. The relief index measures the depth effect and the three-dimensionality created by the height differences. The index can be calculated by using standard GIS-functions as suggested by Jonathan Baldwin and others (Baldwin *et al*. 1996). The viewing angle is determined from the difference of heights between the observer's eyes and the object to be observed in the terrain, and the horizontal distance to the object to be observed; these quantities will yield the tangent of the viewing angle (fig. 67). There is, however, one problem: how to determine the viewing angle in the very same cell in which the elevation model is used. In this cell the distance is shortened into the distance of the cell midpoint from itself since the assumed observer looks down at his feet. Therefore the index suggested by Baldwin and others is susceptible to distortion. It can be corrected by making use of the cells adjacent to the viewing point which give a more realistic image of the true appearance of the terrain in the vicinity of the observer. The calculated inclination in the cell of the viewing point is replaced by a median-filtered value which is determined from the cell of viewing and eight adjacent cells. Also the adaptive box-techniques can be used for this purpose (Eliason & McEwan 1990).

Fig. 66. The regions to be analyzed for their fields of vision. 1. Björkö – Kittuis – Hyppeis; 2. Brunskär – Nötö – Lökholm; 3. Hertsböle – Hammarsboda – Högsåra; 4. Lillandet. © The National Board of Survey, lic. No. MAR/103/98.

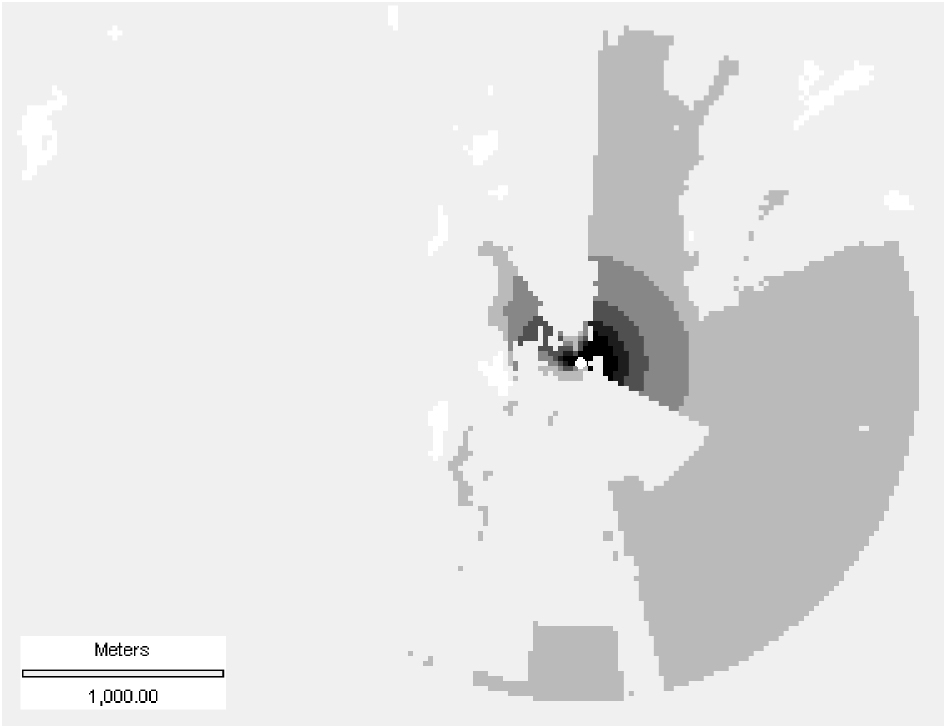

Fig. 67. The viewing angles from the grave site at Rövik (042), Dragsfjärd in about 500 BC. The fan-shaped figure looking NE from the grave site indicates the strongest depth effect. The sharpest oblique viewing angle downward from the grave site towards the strait which linked the sheltered waters of the inner archipelago with a long inlet (nowadays a lake called Dragsfjärden), was 10 degrees. The light grey colour demonstrates the invisible or horizontally visible areas, the darker grey shades the downwards visible areas; the white colour indicates the land areas which are higher up than the grave site. © The National Board of Survey, lic. No. MAR/103/98.

In this context, the concepts of *composition* and *configuration* of landscape ecology can be used in studying and interpreting the fields of vision in the ancient archipelago (Dunning *et al*. 1992; Li & Reynolds 1993). Composition refers to the part of the landscape which is covered by the place, to what visual spaces the landscape involves, to their extent, and to their variation. It refers to the presence, absence, or relative proportions of the landscape components. Configuration denotes the spatial patterning of landscape or habitat. Configuration describes the position of the place in the landscape, the relative positions of the various visual spaces of the landscape, how they are bounded, and what shape they are. Composition variables consist of the *extents* of the field of vision, and the spaces it embraces; configuration variables include the *shape* of the field of vision, the *three-dimensionality* created by the height differences and the depth of the landscape, and the *range* of the visual contact.

8.3.5.1 Region 1: Björkö – Kittuis – Hyppeis

The Grave Sites in Group P

The area of the present parish of Houtskär was part of the outer archipelago in the Bronze Age. In about 500 BC, 4.8 per cent of the area consisted of land. The highest point of the land was 25 metres. In the area bounded by the villages of Björkö, Kittuis, and Hyppeis there are three grave sites in Group *P*. From the grave site at Kummelbergen (077), Kittuis there was an unobstructed view into the sector between SW and SE and in a sharp oblique angle downward towards the sheltered strait and the inlet between the islands. From the grave site at Sunsveden (081) one could see the sheltered water area between the islands and the adjacent inlet shore in two sectors: NW and E. At that time, Trollberg (087) was already a prominent place from where the view and the depth effect were rather evenly distributed in all directions. In the open landscape of the Bronze Age outer archipelago, Trollberg was well discernible from the sea.

Comparison between the grave sites and the reference set (table 31) demonstrates that the extent of the sea view from the grave sites in Group *P* does not differ statistically significantly from that of the rest of the places, but the land area visible from the grave sites was significantly larger than elsewhere. The average land area visible from the grave sites (3.53 km²) was 1.4 times larger than the greatest average of the areas in the reference set. While the total of the visible area from the grave sites was only indicatively greater than that in the reference set, the perimeter of the visible area from the grave sites is significantly greater. The outline of the visible area from the grave sites is more sinuous since the visible area comprises islands which overshadow each other. The graves were thus constructed on large islands, which, in turn, were surrounded by several other islands. The grave islands were embraced by sheltered waters which were separated from the open sea in all directions by land. The viewing angles from the grave sites differ from those of the reference set in the fact that the average viewing angle is smaller – the oblique downward angle is sharper than when viewing the landscape from elsewhere. The grave sites are thus prominent in terms of landscape but the visible areas from them are more limited than one might expect.

The cumulative map of the visible areas (fig. 68) demonstrates the overlapping visible areas from the grave sites, and the differences revealed by Monte Carlo- tests in the map image. The cumulative map of the visible areas is obtained by summing two or more maps of visible areas so that – in this case – the number of the grave sites from which the cell is visible is recorded for every cell of the map (Wheatley 1995; Llobera 1996; Fisher *et al*. 1997; Lake *et al*. 1998; van Leusen 1999).

Table 31. Region 1, Björkö – Kittuis – Hyppeis. Comparison of the visible areas. Group P, n = 3, m = 19.

	Minimum for reference set	Maximum for reference set	Values for burial sites	Rank of burial sites	Significance
Area of the viewshed (km²)					
Mean	9.55	39.87	32.38	18	0.15
Maximum	13.40	52.28	51.92	19	0.10
Minimum	0.20	25.35	8.82	15	0.30
Area of visible sea (km²)					
Mean	7.75	38.05	28.85	18	0.15
Maximum	10.72	49.31	48.28	18	0.15
Minimum	0.07	24.09	6.95	15	0.30
Area of visible land (km²)					
Mean	0.50	2.56	3.53	20	0.05*
Maximum	0.69	4.26	5.08	20	0.05*
Minimum	0.13	1.99	1.87	19	0.10
Ratio of sea area to land area					
Mean	4.87	54.22	7.73	4	0.20
Maximum	6.66	133.56	13.27	4	0.20
Minimum	0.56	16.57	3.73	8	0.40
Perimeter of the viewshed (km)					
Mean	69.38	212.71	264.95	20	0.05*
Maximum	87.30	323.23	392.51	20	0.05*
Minimum	4.45	190.50	113.45	17	0.20
Ratio of the perimeter to the area					
Mean	5.43	14.75	9.74	12	0.45
Maximum	6.33	27.35	12.87	7	0.35
Minimum	2.08	12.12	5.56	14	0.35

Table 32. Region 1. Comparison of viewing angles and distances. Group P, n = 3, m = 19.

	Minimum for reference set	Maximum for reference set	Values for burial sites	Rank of burial sites	Significance
Smallest viewing angle (º)					
Mean	-11.04	-5.03	-1.03	2	0.10
Maximum	-9.31	-3.89	-6.62	6	0.30
Minimum	-17.12	-5.71	-14.79	4	0.20
Greatest viewing angle (º)					
Mean	0.99	5.60	0.84	1	0.05*
Maximum	1.51	10.65	2.47	6	0.30
Minimum	0.06	3.27	-0.03	1	0.05*
Mean viewing angle (º)					
Mean	-0.34	0.05	-0.44	1	0.05*
Maximum	-0.33	0.53	-0.26	2	0.20
Minimum	-0.45	-0.14	-0.53	1	0.05*
Relief index (º)					
Mean	7.55	13.82	11.15	12	0.45
Maximum	8.88	21.74	14.76	12	0.45
Minimum	5.28	11.08	9.09	16	0.25
Mean length of LOS (m)					
Mean	2184	3258	3032	13	0.40
Maximum	3035	3417	3395	19	0.10
Minimum	312	3146	2458	8	0.40

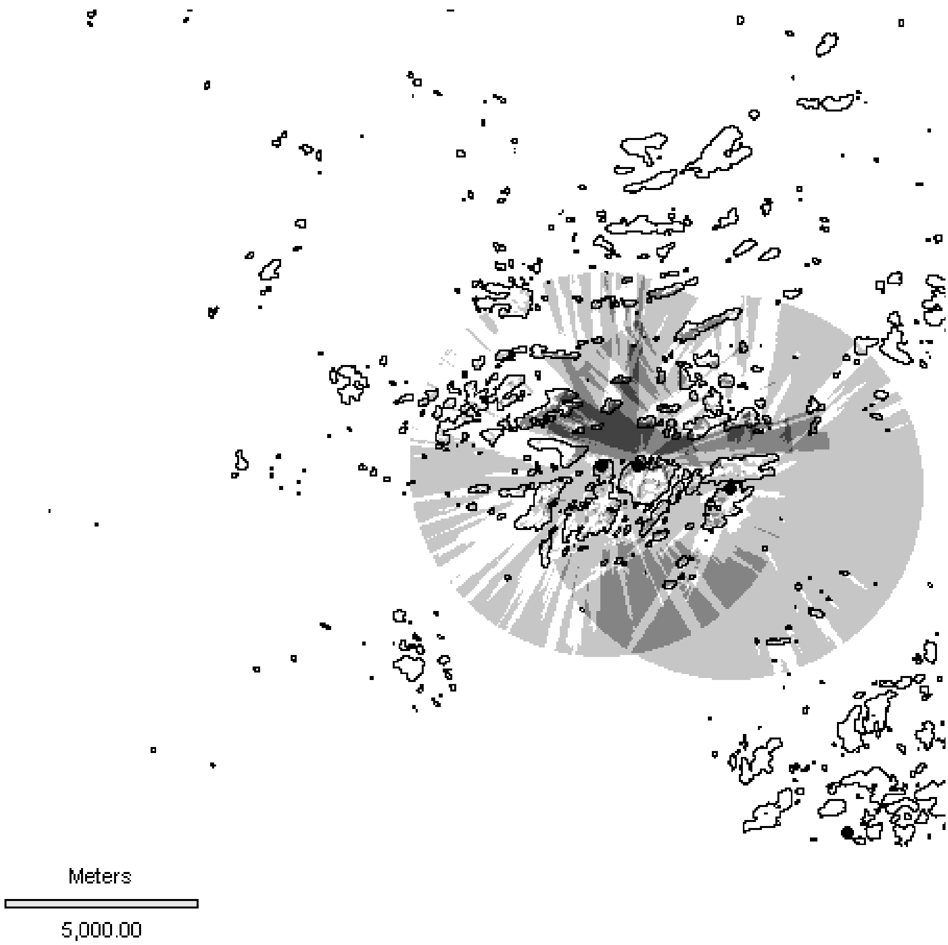

Fig. 68. Region 1, Björkö – Kittuis – Hyppeis. The cumulative map of the visible areas from the grave sites in Group *P* (*n* = 3, the greatest number of overlapping visible areas *cmax* = 3). © The National Board of Survey, lic. No. MAR/103/98.

The Grave Sites in Group R

In about 1000 AD, 16.4 per cent of the area of Houtskär consisted of land, and the highest rocks reached the height of 35 metres. Group *R* consists of 32 grave sites. In Houtskär the graves in Group *R* stand in the landscape either detached or at a distance of a few hundred metres from the closest neighbour. The cemetery at Furunabb is, however, an exception with its twelve graves constructed side by side. When studying the visible areas a strong spatial autocorrelation can be established between the graves at Furunabb, and therefore only one grave at Furunabb, a large quadrangular large setting (088), was included in the analysis of the visible areas. The remaining 21 grave sites[100] give, however, a more extensive picture of the variation of the visible areas of the grave sites in Group *R* than the three grave sites in Group *P*.

Table 33. Region 1, Björkö – Kittuis – Hyppeis. Comparisons of the areas visible from burial sites and random sites. Group R, n = 21, m = 19.

	Minimum for reference set	Maximum for reference set	Values for burial sites	Rank of burial sites	Significance
Area of the viewshed (km²)					
Mean	3.72	12.52	24.07	20	0.05*
Maximum	10.30	49.85	47.43	19	0.10
Minimum	0.22	1.97	2.01	20	0.05*
Area of visible sea (km²)					
Mean	2.35	10.52	20.86	20	0.05*
Maximum	8.80	47.43	44.84	18	0.15
Minimum	0.00	0.95	1.38	20	0.05*
Area of visible land (km²)					
Mean	1.30	2.40	3.22	20	0.05*
Maximum	2.43	7.65	7.46	19	0.10
Minimum	0.22	0.67	0.63	19	0.10
Ratio of sea area to land area					
Mean	1.45	7.43	8.03	20	0.05*
Maximum	5.86	99.83	26.09	14	0.35
Minimum	0.00	0.82	1.49	20	0.05*
Perimeter of the viewshed (km)					
Mean	60.52	135.85	193.84	20	0.05*
Maximum	119.35	314.48	332.13	20	0.05*
Minimum	6.25	36.35	35.45	19	0.10
Ratio of the perimeter to the area					
Mean	13.99	20.76	10.38	1	0.05*
Maximum	23.76	40.50	22.16	1	0.05*
Minimum	1.98	9.05	3.96	10	0.50

In the northeastern section of the area, the visible area from the grave sites of Surnon and Björkö Kummelbergen comprised a stretch of open sea in the north, the neighbouring islands, and *flada*-waters (fig. 68; cf. Pitkänen 1985 a: 170; Zilliacus 1994: 34–35). On the island of Svinö, which has a more northwestern position, there are three graves with relatively extensive visibility towards the sea. The island of Hyppeis with a few adjacent islands constitute the third group of grave sites from where one could see fairly extensive land areas and waters on both sides of the main island. The grave at Kalnäs, Hyppeis (065) is very typical in terms of the choice of site; it is constructed on an even terrace from which there is an unbroken view towards the stretch of open sea called Skiftet (*Fi*. Kihti) in the west. This terrace is like a theatre stand with a view towards the sea. In the vicinity of the graves at Furunabb there is a site with a narrow sector of visibility to the sea in the west. Also the clayey dale in the west and the high rocky slope in the northeast can be seen from the cemetery; the top of the rock rises at an oblique angle of 4 degrees upwards. The view at Furunabb is fairly different from that at the rest of the grave sites in

100.The graves in Group *R* are Björkö Kummelbergen (064), Kalnäs (065), Sälgnäs (066), Vårdberget (067), Edjärdan (068), Ekholm (069), Flakbergen (070), Svinö Svälteskär (071), Hästkilsbergen (072), Hästkil (073), Hästö Timmerholm (074), Järvis (075), Västerskogen (076, 078, 079, 080); Norrnäs (082), Surnon (083), Hästkil (086), Furunabb (088) (excavation report by Seger 1986, NBA), and Högberget (100).

Houtskär. In the southeast there are three graves at Medelby; their site in the terrain allows a line of sight towards Hyppeis in the west.

Table 34. Region 1, Björkö – Kittuis – Hyppeis. Comparisons of viewing angles and distances from burial sites and random sites. Group R, n = 21, m = 19.

	Minimum for reference set	Maximum for reference set	Values for burial sites	Rank of burial sites	Significance
Smallest viewing angle (º)					
Mean	-10.75	-6.82	-8.66	5	0.25
Maximum	-5.03	-3.24	-5.48	1	0.05*
Minimum	-23.94	-14.14	-11.75	20	0.05*
Greatest viewing angle (º)					
Mean	3.55	5.60	1.38	1	0.05*
Maximum	7.07	21.41	5.03	1	0.05*
Minimum	0.23	1.99	0.04	1	0.05*
Mean viewing angle (º)					
Mean	-0.28	-0.06	-0.35	1	0.05*
Maximum	-0.06	0.62	-0.11	1	0.05*
Minimum	-0.85	-0.43	-0.69	7	0.35
Relief index (º)					
Mean	10.37	15.18	10.04	1	0.05*
Maximum	19.51	42.77	16.34	1	0.05*
Minimum	4.87	7.79	6.69	15	0.05*
Mean length of LOS (m)					
Mean	1978	2615	3009	20	0.05*
Maximum	3452	3007	3350	17	0.20
Minimum	310	1379	2285	20	0.05*

The analyses of the viewsheds and the viewing angles (tables 33 and 34) disclose the fact that the viewsheds from the graves in Group *R* are extensive in every respect. The systematical choice of site is indicated by the average area of the viewsheds from the grave sites (24.07 km^2), which is 1.9 times greater than the greatest average of the randomly selected reference set. The difference between the grave sites and the reference set was particularly prominent when it comes to visible sea areas; the coefficient was as high as 2.0. The perimeters of the visible areas suggest an openness of the views from the grave sites. The values of the viewing angles indicate that observing the surroundings required oblique downward viewing angles. The high values of the relief index, on the other hand, describe the great topographic variability of the terrain surrounding the grave sites in reference to the rest of the terrain.

The predominance of the visible sea area, the openness of the landscape, and the high relief index with the graves in Group *R* in comparison with the graves in Group *P* constitute the main difference. The graves in Group *R* were, at the time of their construction, erected at sites which, in terms of their lines of sight, were at least as prominent as those in Group *P*. This difference does not become apparent from the map image or during a stroll in the terrain since, due to the land uplift, the early grave sites have risen higher than the later ones.

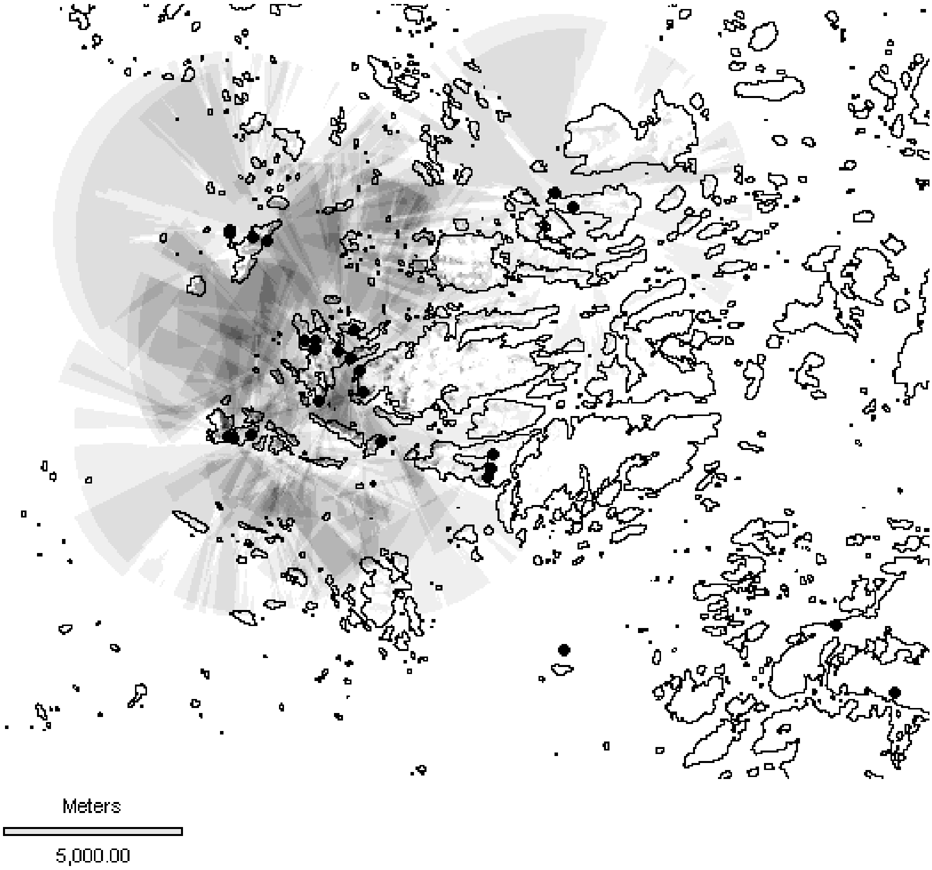

Fig. 69. Region 1, Björkö – Kittuis – Hyppeis. The cumulative area of the visible areas from the graves in Group *R* (*n* = 21, *cmax* = 14). © The National Board of Survey, lic. no. MAR/103/98.

The cumulative map of visible areas will again shed additional light on the structure and significance of the viewsheds (fig. 69). The most conspicuous overlap of the viewsheds is seen west of the island of Hyppeis on the stretch of open sea called Svinö fjärden, and on the stretch of sea called Hästö fjärden which is a sheltered water area surrounded by islands off the island of Hyppeis. In view of the small area of the Hästö fjärden it deserves attention that the grave sites have been selected so that the water area is visible, at least partly, from 10–14 various grave sites. The graves at Medelby in the east, for instance, have been constructed on rock outcrops from which the Hästö fjärden is visible in the west in a narrow sector at a distance of four kilometres. The visible sea areas west and east of Hyppeis are likely to indicate important fishing waters in the Iron Age.

8.3.5.2 Region 2: Brunskär – Nötö – Lökholm

The region bounded by Brunskär, Korpo in the northwest, and Nötö and Lökholm, Nagu in the southeast belonged to the outer archipelago in the Iron Age. In 1000 AD 3.1 per cent of the area of the region was land with a maximum altitude of 35 m. On account of the openness of the landscape, the reconstruction of the lines of sight is more reliable than in the inner archipelago. The 16 graves of the region belong to Group *R*, and shore zone dating has established that many of them have been constructed in the Iron Age[101]. I have explored more than half of the land area of the region (Tuovinen 2000 b), which suggests that a considerable share of the preserved graves have been detected.

Nine of the graves in the region form a group at the northern end of the island of Nötö, and on the adjacent islands of Granholm and Mjoö, all of which boast a fairly unobstructed visibility. The other seven graves have been constructed on middle-sized islands in the surroundings of Nötö; even these boast an extensive visibility in regard to the elevation of the grave sites, particularly in the southern part of the region where the range of vision reaches the horizon.

In the analyses of the viewsheds (tables 35 and 36), the total area of the viewshed, the area of the visible sea, and the perimeter of the viewshed proved to be statistically significant variables. At the grave sites the mean area of visible sea 36.69 km^2 is 1.2 times higher than the maximum mean in the reference set. In the maximum values of the area of the viewshed, there is, however, no systematic difference between the grave sites and the reference set, which indicates that the sites with the most extensive viewsheds have not been selected as grave sites. On the other hand, the ratio of the sea area to the land area is significantly higher for the maximum values, and indicative for the mean values. Also this emphasizes the significance of an extensive and open visible sea area in the choice of the grave site. The coefficients of the difference between the viewsheds of the grave sites and those of the reference set are not as high as in Houtskär. The reason for this is the more maritime environment where the influence of the choice of the site on the visibility of the sea is not as strong as in Houtskär.

101.The graves are Bussö (349) and Aspö (351) in Korpo, and the following graves in Nagu: Boskär (365), Ådön (366), Granholm (368), Sundbergen 1 (258), Sundbergen 2 (259) (excavation report on these two graves at Sundbergen by Tuovinen, 1988, TYA), Sundbergen 3 (250), Sundbergen 4 (251), Sundbergen 5 (252), Mjoö 1 (253), Mjoö 2 (254), Mjoö 3 (369), Gånganberget (370), Sandholm (371), Revberget (372).

Table 35. Region 2, Brunskär – Nötö – Lökholm. Comparisons of visible areas. Group R, n = 16, m = 24.

	Minimum for reference set	Maximum for reference set	Values for burial sites	Rank of burial sites	Significance
Area of the viewshed (km²)					
Mean	19.34	32.19	38.12	25	0.04*
Maximum	34.46	73.84	54.67	14	0.48
Minimum	0.133	10.04	12.42	25	0.04*
Area of visible sea (km²)					
Mean	18.28	30.94	36.69	25	0.04*
Maximum	34.01	73.28	53.23	15	0.44
Minimum	0.00	9.13	11.16	25	0.04*
Area of visible land (km²)					
Mean	0.73	1.57	1.44	23	0.12
Maximum	1.64	4.01	2.59	11	0.44
Minimum	0.11	0.61	0.19	2	0.08
Ratio of sea area to land area					
Mean	18.29	40.55	39.15	24	0.08
Maximum	40.47	174.78	188.48	25	0.04*
Minimum	0.00	9.05	8.88	24	0.08
Perimeter of the viewshed (km)					
Mean	96.28	142.87	160.69	25	0.04*
Maximum	141.70	280.74	237.65	12	0.48
Minimum	4.55	70.75	71.80	25	0.04*
Ratio of the perimeter to the area					
Mean	4.95	9.30	4.51	1	0.04*
Maximum	7.89	34.02	7.65	1	0.04*
Minimum	1.47	3.57	1.98	4	0.16

Table 36. Region 2. Comparisons of viewing angles and distancess. Group R, n = 16, m = 24.

	Minimum for reference set	Maximum for reference set	Values for burial sites	Rank of burial sites	Significance
Smallest viewing angle (º)					
Mean	-10.55	-7.23	-8.47	19	0.28
Maximum	-5.71	-3.43	-4.80	5	0.20
Minimum	-23.26	-11.75	-13.06	21	0.20
Greatest viewing angle (º)					
Mean	2.79	5.85	2.42	1	0.04*
Maximum	5.94	18.31	8.10	11	0.44
Minimum	0.02	1.39	0.03	2	0.08
Mean viewing angle (º)					
Mean	-0.27	-0.12	-0.33	1	0.04*
Maximum	-0.10	0.61	-0.07	1	0.04*
Minimum	-0.66	-0.28	-0.53	2	0.08
Relief index (º)					
Mean	10.21	15.27	10.89	2	0.08
Maximum	17.47	32.30	16.97	1	0.04*
Minimum	3.84	9.88	4.83	9	0.36
Mean length of LOS (m)					
Mean	2859	3196	3305	25	0.04*
Maximum	3295	3709	3511	21	0.20
Minimum	289	2921	3031	25	0.04*

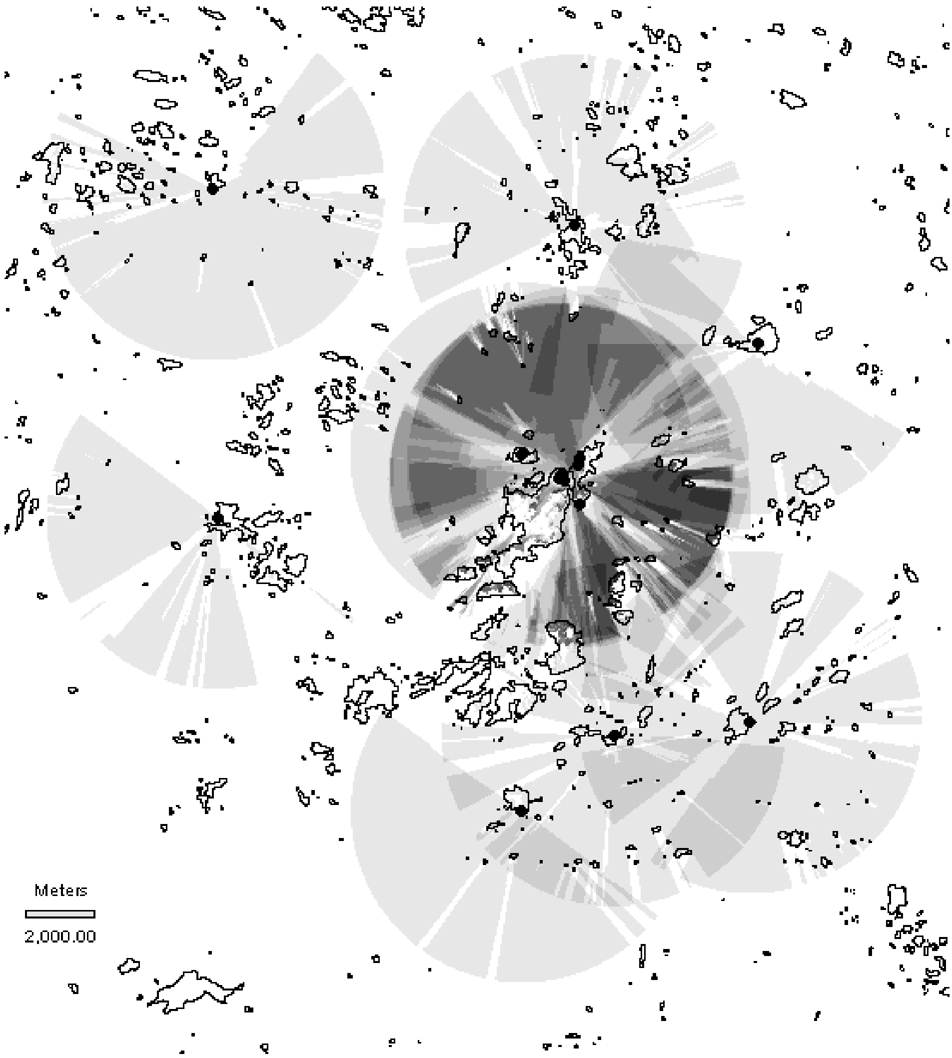

Fig. 70. Region 2, Brunskär – Nötö – Lökholm. The cumulative map of viewsheds from the graves in Group *R* (*n* = 16, *cmax* = 10). © The National Board of Survey, lic. no. MAR/103/98.

In the cumulative viewshed the overlapping viewsheds were mainly grouped around the island if Nötö (fig. 71). South and southeast of Nötö there were water areas which were visible from 6–8 grave sites. The slopes of some islands east, southeast, and northwest of Nötö were visible from as many as ten grave sites. The most extensive unbroken stretch of open sea which was visible from several grave sites was the Berghamns fjärden north of Nötö. This water area is exceptionally deep, at places more than 100 metres. If the water areas visible from the grave sites have been important for fishing, the topographic features here refer to catching deep-water fish, for instance, the Baltic cod (*Gadus morhua*) (Koli 1998: 212–216), which, in the historical period, has been traditionally caught in the parts of the archipelago where the underground shoal abruptly slopes downwards into a steep depression (e.g. Gardberg 1966).

The cumulative viewshed may, on the other hand, link the graves at Sundbergen also with an erratic boulder called Klockarstenen, in the northern part of Nötö. On the edges of the boulder there are 13 cup-like hewn depressions. The boulder sends forth a very loud metallic sound when knocked with a stone, and the adjacent rocks echo the sound far out north precisely where the Berghamns fjärden is located. Previously I have presumed that Klockarstenen might have been used to give out sound signals to boats lost in the fog north of Nötö, or fishermen walking on the ice (Tuovinen 1988). It is, however, unknown when the stone could have been used for this purpose. The overlap and the resemblance of the viewshed of the Iron-Age graves and the range of audibility of the sounds of the boulder, do not alone suffice to prove their simultaneousness, even if it is no doubt an indication of some weight.

The lines of sight into the adjacent landscape from the grave sites in the archipelago surrounding Nötö were also largely unobstructed. The most southeastern grave site at Revberget, Lökholm (372) offered the most extensive viewshed. The sea was visible all around the horizon, the open Baltic Sea could be seen in the south, and most of the island of Lökholm was visible too. The most northwestern grave at Bussö (349) was constructed on a cape pushing out into the south, and although it was located at the height of less than 10 m above the sea level at that time, the visibility towards the southern stretches of the sea and the distant island clusters of Nötö, Björkö, and Aspö was nearly unobstructed in a sector of almost 300 degrees. In the north, the adjacent rocks hampered the visibility. In the northeast at Ådön (366) the viewshed was very much the same: sea and islands were visible in an extensive southern sector while the viewshed was obstructed by rocks in the northeast.

8.3.5.3 Region 3, Hertsböle –Hammarsboda – Högsåra

The Grave Sites in Group P

In the Metal Age the region bordered by the villages of Hertsböle, Genböle, Ölmos, and Högsåra (Dragsfjärd) consisted of two large land blocks and the surrounding archipelago. A structurally controlled N–W valley separated the mainland-like southwestern part of the island of Kimitoön from a ten-kilometre-long island, which today constitutes the region of Ölmos – Söderlångvik. Later, this island grew together with the island of Kimitoön whereby the lake of Dragsfjärden was formed in the south, and the inlet of Norrfjärden in the north.

Table 37. Region 3. Comparisons of the visible areas. Group P, n = 24, m = 19. Owing to ties, no reliable values were obtained for some minima (marked with dots)

	Minimum for reference set	Maximum for reference set	Values for burial sites	Rank of burial sites	Significance
Area of the viewshed (km²)					
Mean	5.63	14.35	13.84	19	0.10
Maximum	18.20	65.81	38.60	10	0.50
Minimum	0.15	1.04	0.46	12	0.45
Area of visible sea (km²)					
Mean	2.78	12.64	9.92	18	0.15
Maximum	16.69	63.22	28.31	5	0.25
Minimum	.	.	.	.	.
Area of visible land (km²)					
Mean	1.68	3.31	3.92	20	0.05*
Maximum	2.74	13.65	20.80	20	0.05*
Minimum	0.15	0.59	0.45	15	0.30
Ratio of sea area to land area					
Mean	1.42	10.57	4.49	10	0.50
Maximum	9.21	158.07	12.52	3	0.15
Minimum	.	.	.	.	.
Perimeter of the viewshed (km)					
Mean	69.65	109.52	114.17	20	0.05*
Maximum	172.90	336.63	342.58	20	0.05*
Minimum	4.30	26.60	15.65	12	0.45
Ratio of the perimeter to the area					
Mean	13.39	19.85	12.76	1	0.05*
Maximum	26.44	43.67	34.07	14	0.35
Minimum	1.44	7.19	3.91	17	0.20

Table 38. Region 3. Comparisons of the angles and distances. Group P, n = 24, m = 19.

	Minimum for reference set	Maximum for reference set	Values for burial sites	Rank of burial sites	Significance
Smallest viewing angle (º)					
Mean	-7.83	-5.61	-11.25	1	0.05*
Maximum	-3.24	-3.89	-5.03	1	0.05*
Minimum	-20.33	-9.00	-21.74	1	0.05*
Greatest viewing angle (º)					
Mean	2.80	4.48	3.63	16	0.25
Maximum	6.57	14.57	7.00	4	0.20
Minimum	-0.15	1.24	0.20	4	0.20
Mean viewing angle (º)					
Mean	-0.19	-0.05	-0.16	6	0.30
Maximum	0.15	1.82	0.59	7	0.35
Minimum	-0.81	-0.40	-0.87	1	0.05
Relief index (º)					
Mean	8.57	11.93	14.88	20	0.05*
Maximum	14.26	27.47	27.91	20	0.05*
Minimum	4.15	5.90	8.49	20	0.05*
Mean length of LOS (m)					
Mean	2041	2673	2426	14	0.35
Maximum	3102	3704	3191	2	0.10
Minimum	284	1198	615	12	0.45

In 500 BC, the proportion of the land area of the region was 24.7 per cent, and the height of the highest rocks was 56 m. In this region, there are 24 graves in Group *P*, among others the cairns at Hammarsboda and Långnäsudden which date back to the Bronze Age, as indicated by the artefact finds[102]. The ten graves which have been constructed on the shores of the Bronze-Age inlet and the islands off the shore in Hertsböle constitute the most distinct group in consideration of the viewsheds. The rest of the grave sites are to be found mainly in the structurally controlled valley of Dragsfjärden.

The land areas visible from the burial sites are significantly larger than those from the reference set (table 37). The mean value of the land area visible from the grave sites, 3.92 km^2 is 1.2 times higher than the maximum mean in the reference set. The perimeters of the viewsheds are also significantly longer. The ratio of the perimeter to the area of the viewshed at the burial sites is significantly lower: the graves have been constructed at sites from which the lines of sight are, on the average, more unobstructed in all directions than from those in the reference set. The views from the grave sites were unobstructed even if the graves were constructed in regions where land was visible in every direction, i.e. the viewshed resembled that in the inner archipelago. The significantly smaller minimum viewing angles, the significantly smaller minimums of mean viewing angles, and the significantly higher relief indexes for the grave sites (table 38) indicate also that the viewsheds from the grave sites were characterized by a sharp visual depth effect. The sea was not of any essential significance in the choice of the burial sites in Group *P*, apparently it was much more important to have a large visible land area in every direction, and that the feeling of exaltation was impressive. The burial sites were solitary and prominent.

The cumulative map of viewsheds (fig. 72) demonstrates a considerable variation in the viewsheds from the grave sites in Group *P*. Ten graves were constructed in the southeastern part of the region on the inlet of Hertsböle; from most of these the viewshed towards the south, in the direction of the stretch of open sea now called the Bruksfjärden, was relatively unobstructed. Most of the rest of the graves were constructed on the rocks rising up from the seashore with views towards the sheltered inland waters and the other graves. The graves were actully turned away from open stretches of sea.

Only the southernmost grave site at Rövik (042) offered a view towards the sea in the south but even there the sea opened in the far distance, in an almost horizontal viewing angle. The grave at Rövik had been constructed at the end of a rocky cape, and the most attractive depth effect opened towards the east and the north (fig. 67). The grave site was like a gate guard of the strait leading to the north into the structurally controlled valley of the Dragsfjärden and the Norrfjärden (stretches of open sea). A boat sailing northwards passed beneath the grave rock at Rövik at a very close distance but the line of sight remained uninterrupted. Sailing further up the boat arrived on the Dragsfjärden, the large water area separating the big island of Ölmos and the mainland of the island of Kimitoön; here the viewsheds from the grave sites overlapped each other the most after Hertsböle.

102. The graves in Group *P* are Rövik (042), Kosackkullan (002), Petersknallen 2 (050), the graves 106 (043), 107 (044), 108 (045) (excavation report by Högman 1886, NBA), and 109 (046) at Hammarsboda, the graves 100 (040) (excavation report by Högman 1886, NBA), 101 (041), and 101+ (009) at Långnäsudden, Labbnäsåsen (012), Björkboda (034), Genböle (001) (fig. 42), Malmsberget (011), Svartholmsskatan (025), and the graves 10 (031), 17 (024), 18 (023), 19 (020), 21 (028), 22 (027), 23 (026), 24 (022), and 26 (030) at Hertsböle.

The water area of the Dragsfjärden was visible from 4–7 grave sites, and even the shores lining this stretch of open sea could be seen from 2–7 burial sites. On the western shore, the dwelling sites at Jordbro and Knipäng which date back to the late-Neolithic culture of Kiukais, have been discovered (Meinander 1954 b: 61–66; Asplund 1997 a: 243–245). The rocky upland area rising behind the dwelling site at Ansvedja is visible from several grave sites on the eastern shore, but this is presumably of no significance since the dwelling site is older than the Bronze Age, it dates back to the comb-ceramic period (Cleve 1942 b; Myhrman 1990: 29).

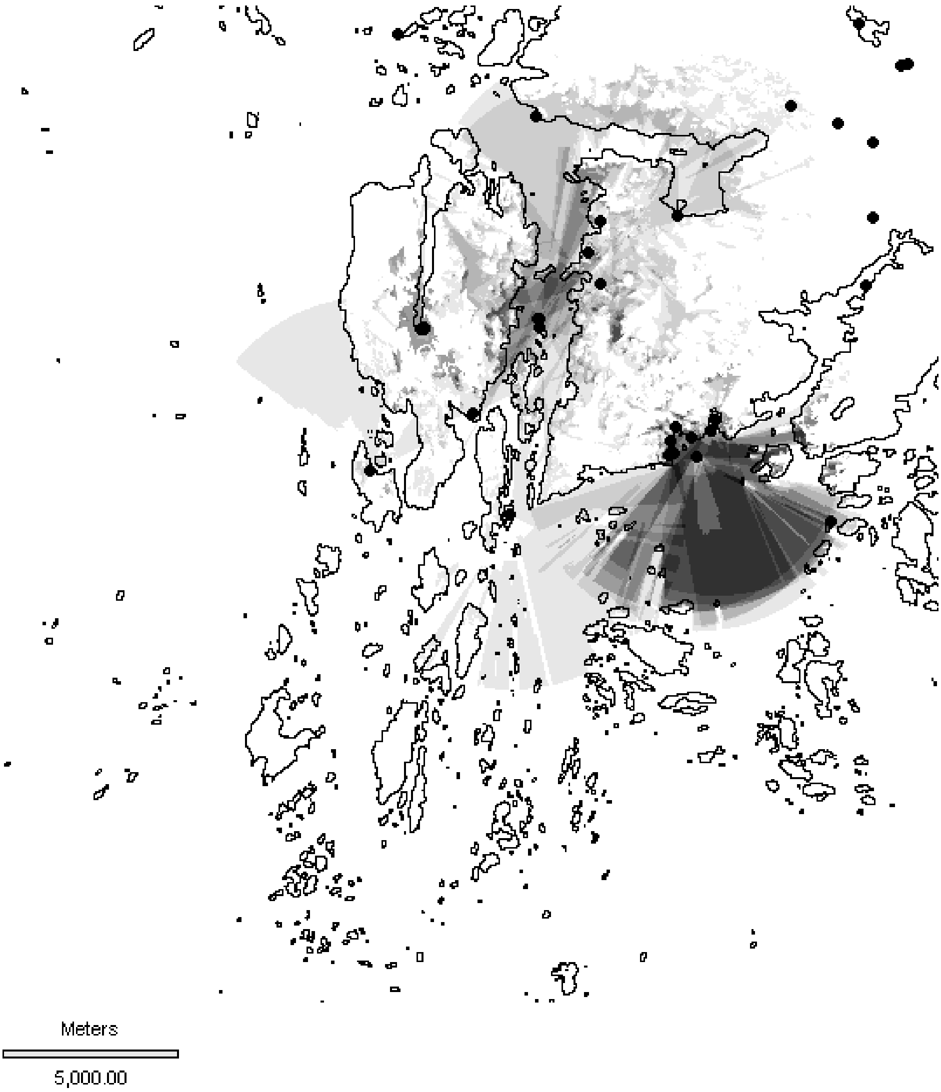

Fig. 71. Region 3, Hertsböle – Hammarsboda – Högsåra. The cumulative map of the viewsheds from the graves in Group *P* (*n* = 24, *cmax* = 10). © The National Board of Survey, lic. no. MAR/ 103/98.

The viewshed from the most southwestern site of graves in Group P in this region, at Petersknallen (050), includes a narrow viewing sector towards the stretch of open sea in the northwest, but the rest of the viewshed comprises only visible land area and the sheltered strait off the grave site. If the grave had been constructed just 300 metres more to the west, the viewshed would have comprised a large sector in the west consisting of outer archipelago, open stretches of sea, and horizon. Such a site was not, however, selected; the viewshed was turned away from the sea. The four cairns in the cemetery at Hammarsboda (043, 044, 045, and 047) also turn their backs to the sea: they have been constructed in a valley, at the upper end of a firth-like inlet pushing from the north.

The Grave Sites in Group R

In 1000 AD, 32.9 per cent of the area of the region Hertsböle – Hammarsboda – Högsåra consisted of land with the maximum height of 65 metres. Twenty-three graves in Group *R* have been discovered in this region[103]. The figure does not include all the graves discovered; at Jordbro and at Söderby several graves have been destroyed, and their precise sites cannot be determined any longer; for this reason they have not been incorporated in the analysis of the viewsheds.

The Monte Carlo-tests demonstrated that the area of the viewshed from the grave sites was significantly larger than that from the reference set (table 39). In studying separately the areas of visible land and that of visible sea, the difference is evident with regard to the extensive views from the grave sites towards the sea. The mean area of visible sea, 9.06 km^2, was 1.4 times higher than the greatest mean of the samples forming the reference set. When it comes to land areas, the only statistically significant difference is seen in the maximum visible land area, which is significantly smaller from the grave sites than from the reference set. The burial site in question is Nämanön, Dragsfjärd (006), and the visible land area is 6.24 km^2. As there are no significant differences between the viewing angles (table 40), the extensive viewsheds have not been achieved by constructing the graves on high places, as was the case with the graves in Group *P*, but by erecting them on small islands in open landscape. Ties deriving from the inaccuracy of the digital elevation model are involved in the lowest values of the viewing angles.

103.The graves in Group *R* are Högsåra Hemlandet (019), Långfuruholm (060), Nämanön 1 (061, excavation report by Högman 1886, pp.80–82, 131–133, NBA), Nämanön 2 (006), Söljeholmen (048), Krogarudden (059), the graves at Östergård 2: 7 (052), 8 (053), 9 (054, excavation report by Tuovinen 1990, TYA), 10 (055), 11 (056), 12 (057), and 13 (058), Hamnholmssundet (051), Petersknallen 1 (049), Hammarsboda 10 (335), Hammarsboda 11 (336), Västersjälsmalmen (008 and 017), Jordbro 86 (036), Söderby 93 (037, excavation report by Ella Kivikoski 1935, NBA), Hertsböle 16 (021), and Hertsböle 25 (029).

Table 39. Region 3. Comparisons of the visible areas. Group R, n = 23, m = 19.

	Minimum for reference set	Maximum for reference set	Values for burial sites	Rank of burial sites	Significance
Area of the viewshed (km²)					
Mean	4.87	9.49	11.78	20	0.05*
Maximum	12.04	38.65	47.49	20	0.05*
Minimum	0.12	0.98	0.73	19	0.10
Area of visible sea (km²)					
Mean	2.06	6.66	9.06	20	0.05*
Maximum	10.34	34.37	41.68	20	0.05*
Minimum	.	.	.	.	.
Area of visible land (km²)					
Mean	1.83	3.25	2.73	9	0.45
Maximum	6.43	15.28	6.24	1	0.05*
Minimum	0.12	0.78	0.73	19	0.10
Ratio of sea area to land area					
Mean	0.75	5.10	2.76	11	0.50
Maximum	3.61	66.21	17.45	9	0.45
Minimum	.	.	.	.	.
Perimeter of the viewshed (km)					
Mean	62.98	100.41	91.90	17	0.20
Maximum	164.05	390.72	241.85	12	0.45
Minimum	3.70	26.50	24.50	19	0.10
Ratio of the perimeter to the area					
Mean	14.79	20.43	19.07	13	0.40
Maximum	30.34	43.11	33.42	9	0.45
Minimum	2.05	10.34	3.34	10	0.50

Table 40. Region 3. Comparisons of the viewing angles and the distances. Group R, n = 23, m = 19.

	Minimum for reference set	Maximum for reference set	Values for burial sites	Rank of burial sites	Significance
Smallest viewing angle (°)					
Mean	-11.90	-6.43	-8.87	3	0.15
Maximum	.	.	.	.	.
Minimum	-22.02	-11.97	-13.71	18	0.15
Greatest viewing angle (°)					
Mean	3.02	5.49	3.84	5	0.25
Maximum	7.75	18.46	8.42	4	0.20
Minimum	0.09	0.94	0.30	3	0.15
Mean viewing angle (°)					
Mean	-0.31	-0.01	-0.15	10	0.50
Maximum	0.13	1.91	0.49	7	0.35
Minimum	-0.89	-0.47	-0.64	12	0.45
Relief index (°)					
Mean	9.45	16.46	12.71	13	0.40
Maximum	16.32	39.15	21.13	5	0.25
Minimum	4.41	7.07	4.64	7	0.35
Mean length of LOS (m)					
Mean	1999	2526	2310	15	0.30
Maximum	3177	3633	3250	3	0.15
Minimum	301	1337	1225	19	0.10

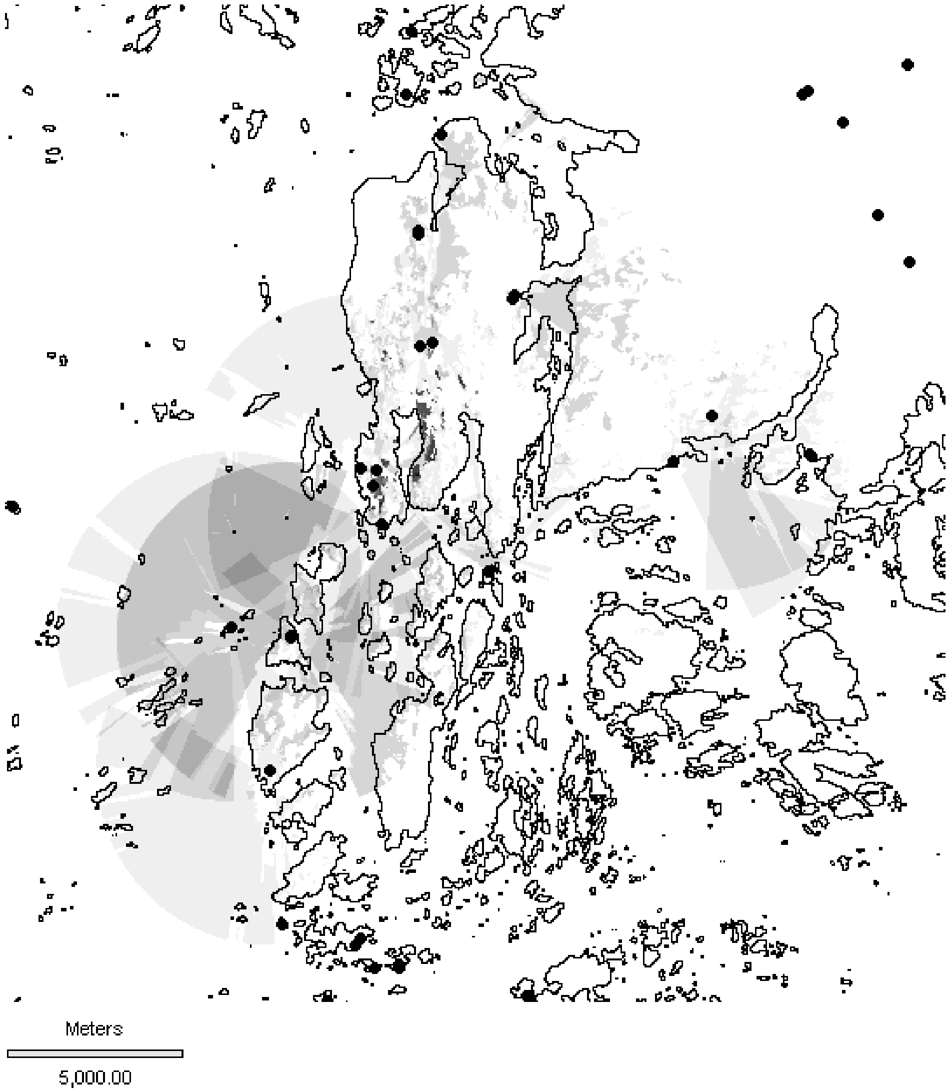

Fig. 72. Region 3, Hertsböle – Hammarsboda – Högsåra. The cumulative map of the viewsheds from the graves in Group *R* (*n* = 23, *cmax* = 12). © The National Board of Survey, lic.no. MAR/ 103/98.

The cumulative map of the viewsheds (fig. 73) gives a lucid idea of the fact that the graves in Group *R* – like the graves dating back to the Bronze Age – were built on the hills rising from the shores of the island of Kimitoön, but also in the archipelago, which was not done in the Bronze Age. Several graves were constructed at sites with viewsheds towards the sea. Off the island of Högsåra there was a stretch of sea opening towards the west, which was visible from as many as five grave sites, whereas the graves on the large land block of Ölmos were surrounded by more closed landscapes, dominated by land views.

The differences between the viewsheds from the graves of Group *P* and Group *R* in the region Hertsböle – Hammarsboda – Högsåra do not derive solely from the effect of the continuous land uplift process in the Bronze Age and the Iron Age. The viewsheds from the grave sites in Group *P* were turned away from the sea whereas those from the grave sites in Group *R* were directed towards the sea. In spite of the mainland-like location the viewsheds from the grave sites in Group *P* were open because the graves were constructed at high places with a strong feeling of depth and exaltation. The openness of the grave sites in Group *R* was based on the unobstructed visibility towards the sea rather than on the elevated sites of the graves. A considerable variation prevails, however, in the viewshed variables in both groups; this variation is mainly due to the fact that the landscape in the region is divided into two scenically different parts: archipelago in the south and the west, two mainland-like blocks (the island of Kimitoön and the present-day peninsula of Ölmos) in the north and the east.

8.3.5.4 Region 4, Lillandet

The Grave Sites in Group P

In 500 BC the region of Lillandet, Nagu belonged to the middle archipelago, and 14.1 per cent of its area consisted of land. The highest top reached 45 m in height. The relief of Lillandet and that of the archipelago of Själö north of Lillandet is very sharp but, simultanously, very fine-drawn. The tops of the rocks were relatively high and easily discernable even in the Bronze Age, the waters were, correspondingly, very deep.

Lillandet belongs to the regions in the archipelago of Åboland with the highest spatial density of burial cairns. On account of the high frequency of the graves, a relatively small and limited area in the middle part of Lillandet with seventeen registered graves in Group *P* was chosen to provide material for the discussion of the viewsheds[104]. The local topography is thus easily distinguishable in the distribution of the viewsheds. The seventeen graves include three large long cairns: the cairn at Öijen (232) which is the largest grave in the research region being 49 m in length, 6 m in width, and 1.4 m in height, furthermore, the grave at Sandö (233, measuring 33, 6, and 1.2 m, respectively), and the grave 42 at Käldinge (243, measuring 22, 5, and 0.4 m, respectively).

104.The graves in Group *P* are Sandö (233), Öijen (232, 215, and 216), Öbergen 51 (358), Käldinge 2 (374), Käldinge 4 (356), Käldinge 7 (377), Käldinge 42 (243), Käldinge 83:9 (211), Hangslax 83:2 (205), Hangslax 11 (226), Simonby 9 (224), Simonby 46 (353), Simonby 45 (352), Simonby 47 (354), and Kiuasvuori (222). None of these has been excavated.

Table 41. Region 4, Lillandet. Comparisons of visible areas. Group P, n = 17, m = 19.

	Minimum for reference set	Maximum for reference set	Values for burial sites	Rank of burial sites	Significance
Area of the viewshed (km²)					
Mean	7.23	17.19	10.88	2	0.10
Maximum	16.49	61.62	23.16	2	0.10
Minimum	0.46	4.14	3.93	19	0.10
Area of visible sea (km²)					
Mean	5.64	15.17	8.53	2	0.10
Maximum	13.29	60.88	20.96	3	0.15
Minimum	0.00	2.77	2.58	19	0.10
Area of visible land (km²)					
Mean	1.59	2.45	2.35	19	0.10
Maximum	2.77	7.60	5.48	15	0.30
Minimum	0.27	0.77	0.80	20	0.05*
Ratio of sea area to land area					
Mean	12.11	17.34	13.82	9	0.45
Maximum	21.67	43.76	20.33	1	0.05*
Minimum	5.05	8.90	6.88	12	0.45
Perimeter of the viewshed (km)					
Mean	85.49	135.37	111.53	11	0.50
Maximum	158.95	340.87	232.20	10	0.50
Minimum	13.80	56.10	52.55	19	0.10
Ratio of the perimeter to the area					
Mean	3.75	12.41	4.70	3	0.15
Maximum	8.95	83.22	14.44	4	0.20
Minimum	0.01	2.64	1.24	18	0.15

Table 42. Region 4, Lillandet. Comparisons of viewing angles and distances. Group P, n = 17, m = 19.

	Minimum for reference set	Maximum for reference set	Values for burial sites	Rank of burial sites	Significance
Smallest viewing angle (º)					
Mean	-11.68	-8.32	-10.30	3	0.15
Maximum	.	.	.	.	.
Minimum	-30.28	-13.98	-17.58	13	0.40
Greatest viewing angle (º)					
Mean	3.72	6.44	3.52	1	0.05*
Maximum	8.00	17.54	7.41	1	0.05*
Minimum	0.14	1.97	0.55	8	0.40
Mean viewing angle (º)					
Mean	-0.34	-0.18	-0.28	5	0.25
Maximum	-0.09	0.64	0.01	8	0.40
Minimum	-0.82	-0.43	-0.70	8	0.40
Relief index (º)					
Mean	8.99	14.31	11.37	10	0.50
Maximum	12.79	40.10	15.35	2	0.10
Minimum	1.87	5.28	4.82	17	0.20
Mean length of LOS (m)					
Mean	2411	2857	2372	1	0.05*
Maximum	3104	3650	3166	2	0.10
Minimum	582	2311	1562	14	0.35

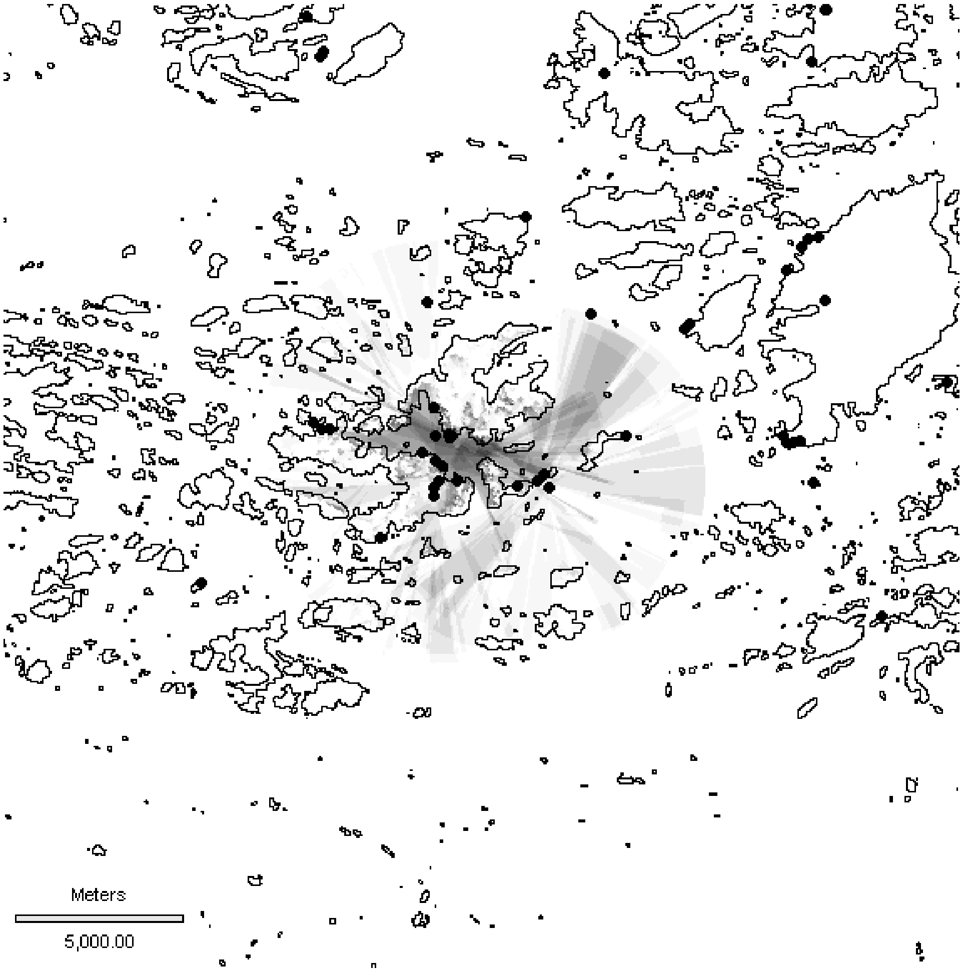

Fig. 73. Region 4, Lillandet. The cumulative map of the viewsheds from the grave sites in Group *P* (*n* = 17, *cmax* = 16). © The National Board of Survey, lic. no. MAR/103/98.

The Monte Carlo tests indicate a tendency to select the grave sites to allow only narrow viewsheds towards the sea while those towards the land are, as a rule, fairly extensive (table 41). In terms of the mean areas, the difference between the grave sites and random sites is indicative, the level of significance being $\alpha = 0.10$. On the level of significance $\alpha = 0.05$, two significant differences are found: the smallest visible land area from the grave sites 0.80 km^2 is larger than that from any of the random sites, and the maximum ratio between the sea and the land area within the viewshed from the grave sites 20.33 is lower than that from any of the reference set. The greatest viewing angles from the grave sites are significantly smaller than those from the reference set (table 42); this difference indicates an evasive attitude towards constructing graves in low-lying dells. On the other hand, the differences between the grave sites and the reference set do not suggest any systematic tendency to choose high tops of rocks as grave sites. The average length of the line of sight for the grave sites is significantly shorter than that for the reference set. In terms of linear units the difference is, however, only 40 m.

The image of the grave sites with relatively narrow viewsheds towards the sea becomes more accurate when examining the cumulative viewsheds (fig. 74). The graves were, almost without an exception, constructed close to the shore. The grave sites in the villages of Hangslax, Simonby, and partly Käldinge line a narrow strait which divided Lillandet into two parts, and formed a sheltered inland water between the islands (205, 211, 224, 226, 243, 352, 353, 354, 222). Due to the land uplift this narrow strait has subsequently contracted into a sea inlet called Sundvik. The viewsheds opened towards the strait, the opposite shores, and the highest rock tops of Lillandet. The water of the strait was visible from 7–12 grave sites, and the northern shore of the strait from 3–16 grave sites.

The viewsheds from the grave sites at Käldinge (356, 374, 377) were slightly narrower. They comprised particularly the sandy valley which connects the inlet of Sundvik and the lake of Storträsket. This valley turned to dry land at the end of the Bronze Age; if the graves in Group *P* at Käldinge date from the middle or the beginning of the Bronze Age, the valley towards which their viewsheds opened was covered by shallow sea water and formed an extension of the strait of Sundvik. The easternmost graves, on the other hand, were constructed at places with principal viewsheds towards the south, the east, and the northeast.

The Grave Sites in Group R

In the year 1000 AD the region of Lillandet belonged to the middle archipelago where 27.2 per cent of the area was land. The highest rock top in the northern part of Lillandet reached the height of 55 m. There are 15 graves in Group *R* in this region[105]. They include, for instance, the long cairn Hangslax 13 (228, measuring 15 m in length, 5 m in width, and 0.7 m in height), the long cairn Hangslax 14 (229, measuring 10m in length, and 4 m in width), the long cairn Käldinge 9 (378, measuring 17, 6, and 0.5 m, respectively), and the long cairn Käldinge 10 (379, measuring 12, 3, and 0.3 m, respectively). The graves in Groups *P* and *R* stand close to each other in the terrain.

The graves were located around the inlet of Sundvik but further off from the shore than the graves in Group *P* and the shoreline zone in 500 BC. The analysis of the viewsheds and the viewing angles (tables 43 and 44) indicates that the area of visible land within the viewshed from the grave sites was significantly larger than that from the reference set. The mean area of visible land from the grave sites was 1.5 times higher than the maximum mean for the reference set. The mean perimeter of the viewsheds from the grave sites is significantly greater than that for the reference set. The ratio of the perimeter to the area of the viewshed, on the other hand, is significantly smaller than that for the reference set: the mean value is approximately 50 per cent of the minimum mean for the reference set. The landscapes surrounding the grave sites were thus open. The greatest viewing angles and the mean viewing angles from the grave sites were significantly smaller than those for the reference set – the grave sites were at elevated

105.The graves in Group *R* are Käldinge 83:8 (210), Prostvik 1 (219), Prostvik 2 (220), Prostvik 4 (221), Prostvik 8 (223), Hangslax 10 (225), Hangslax 12 (227), Hangslax 13 (228), Hangslax 14 (229), Hangslax 48 (355), Öbergen 50 (357), Käldinge 1 (373), Käldinge 3 (375), Käldinge 9(378), and Käldinge 10 (379).

places. The relief indexes from the grave sites are higher than those for the reference set but only indicatively on the level $\alpha = 0.10$.

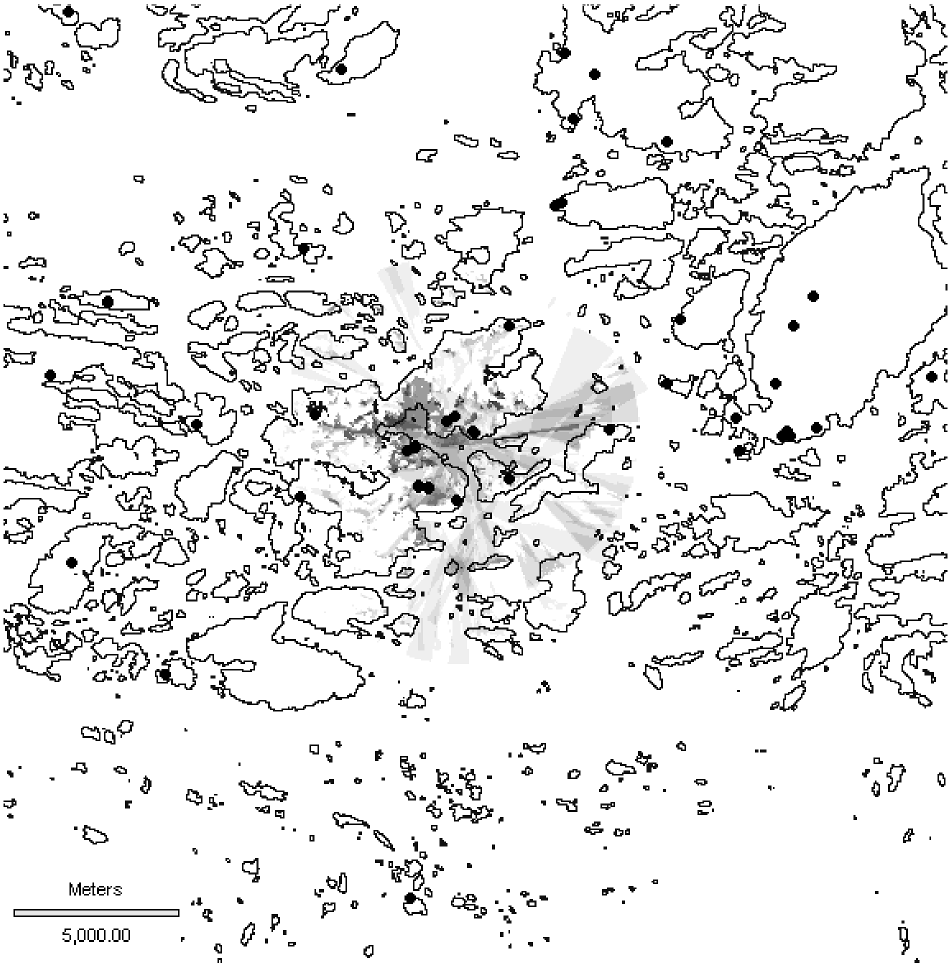

Fig. 74. Region 4, Lillandet. The cumulative map of the viewsheds from the grave sites in Group *R* (*n* = 15, *cmax* = 13). © The National Board of Survey, lic. no. MAR/103/98.

Table 43. Region 4, Lillandet. Comparisons of visible areas. Group R, n = 15, m = 19.

	Minimum for reference set	Maximum for reference set	Values for burial sites	Rank of burial sites	Significance
Area of the viewshed (km²)					
Mean	4.81	10.13	7.28	10	0.50
Maximum	11.87	59.04	18.82	7	0.35
Minimum	0.46	1.84	0.93	14	0.35
Area of visible sea (km²)					
Mean	3.05	7.90	3.54	3	0.15
Maximum	8.06	57.37	10.68	3	0.15
Minimum	.	.	.	.	.
Area of visible land (km²)					
Mean	1.50	2.54	3.74	20	0.05*
Maximum	2.21	9.93	8.98	19	0.10
Minimum	0.32	0.77	0.93	20	0.05*
Ratio of sea area to land area					
Mean	10.94	18.06	11.48	2	0.10
Maximum	18.55	52.76	22.14	4	0.20
Minimum	4.20	8.77	6.10	9	0.45
Perimeter of the viewshed (km)					
Mean	66.54	100.91	115.66	20	0.05*
Maximum	113.25	343.63	264.04	19	0.10
Minimum	10.15	28.55	22.25	14	0.35
Ratio of the perimeter to the area					
Mean	1.80	5.78	0.90	1	0.05*
Maximum	6.63	34.25	4.20	1	0.05*
Minimum	.	.	.	.	.

Table 44. Region 4, Lillandet. Comparisons of viewing angles and distances. Group R, n = 15, m = 19.

	Minimum for reference set	Maximum for reference set	Values for burial sites	Rank of burial sites	Significance
Smallest viewing angle (º)					
Mean	-11.17	-6.69	-8.59	12	0.45
Maximum	.	.	.	.	.
Minimum	-31.30	-11.53	-19.39	8	0.40
Greatest viewing angle (º)					
Mean	3.96	7.00	2.89	1	0.05*
Maximum	8.21	25.81	7.29	1	0.05*
Minimum	0.15	2.71	0.39	2	0.10
Mean viewing angle (º)					
Mean	-0.31	-0.10	-0.50	1	0.05*
Maximum	0.03	0.94	-0.06	1	0.05*
Minimum	-1.16	-0.49	-0.92	2	0.10
Relief index (º)					
Mean	13.41	18.61	18.35	19	0.10
Maximum	24.21	37.40	24.69	2	0.10
Minimum	3.47	8.82	9.64	20	0.05*
Mean length of LOS (m)					
Mean	2022	2591	2067	2	0.10
Maximum	2999	3409	3084	3	0.15
Minimum	518	1710	928	15	0.30

Principally, much the same areas were visible from the grave sites in Group *R* as from those in Group *P* (figure 75). The highest rock tops could be seen from 9–12 grave sites, the low-lying shores around the inlet of Sundvik from 5–10 burial sites, and the waters of Sundvik from 3–9 grave sites. A few islands could be seen in the east and in the south, particularly Stora Bårnholm and Korpholm in the south. The viewsheds from the grave sites at Käldinge (373, 375, 378, and 379) opened, however, exclusively or almost exclusively towards the land where one could see, between rocky highlands, a valley with a sandy bottom which, in the Late Iron Age, lay at the height of 10 m above sea level.

8.3.6 Grave Sites And the Symbolic Implications of the Landscape

8.3.6.1 Comparison of the Viewsheds

At this point it seems appropriate to sum up the the evidence concerning the viewsheds available up till now. The comparison between the regions discussed above indicates that, in the Metal Age, Region 1 (Björkö – Kittuis – Hyppeis) belonged to the outer and the middle archipelago, characterized by a broken mosaic of land and sea, and a gently sloping topography. Region 2 (Brunskär – Nötö – Lökholm), on the other hand, belonged to the outer archipelago where the proportion of land was only a few per cent of the area. Here, large stretches of open sea dominated the landscape. So far, all the graves registered in this region belong to Group *R*. Region 3 (Hertsböle – Hammarsboda – Högsåra) belonged to a transitional area between the archipelagian zones. It consisted of two large land blocks and the broken, small-featured middle and outer archipelago off these blocks. Region 4 (Lillandet) belonged to the middle archipelago, characterized by a broken landscape and a relatively sharp-featured relief.

A common feature with the viewsheds from the grave sites in Group *P* is the fact that they are directed towards the land. The area of visible sea from the grave sites was, on an average, 5–14 times larger than that of visible land, and the graves in Group *P* were typically constructed on rocky hills rising from the seashore. Despite the propinquity of the water it seems apparent that the sea view had no crucial significance when choosing a grave site; on the contrary, it was essential to have an extensive viewshed towards the land with a feeling of depth and exaltation. The site was frequently elevated but not the highest top in the region. The landscape could be open with a wide, unobstructed horizon, as in Dragsfjärd, or closed, at least to some extent, by the surrounding islands, as in Houtskär.

The grave sites in Group *R* were typically located close to the sea shore with an unobstructed view towards an extensive sea area – with the exception of Lillandet where the grave sites in Group *R* were directed towards the land. In terms of area, the proportion of visible sea within the viewsheds from the grave sites was, on an average, 3–39 times greater than that of visible land, and the viewsheds from several grave sites could be directed towards the same water area, as for instance in Houtskär towards the stretch of open sea called Hästö fjärden, and on the island of Nötö towards the water area called Berghamns fjärden. The landscape was open. An unobstructed viewshed towards the horizon was of certain significance in choosing the grave site, and this was frequently achieved by constructing graves on minor islands where the terrain does not interrupt the line of sight towards the sea and the horizon in the same way as on large islands. Graves were frequently constructed at elevated sites where the difference in height and the depth effect were perceptible, but not on the highest tops in the region.

The most conspicuous difference between the grave sites in Group *P* and those in Group *R* seems to be linked with the composition of the landscape: the grave sites in Group *P* were directed towards the land whereas those in Group *R* were directed towards the sea. When it comes to the configuration of the landscape, the most essential difference between the two groups can be demonstrated in the openness of the landscape: in three regions out of the four, the viewshed from the grave sites in Group *R* was open, whereas in Group *P* the viewshed from the grave sites was open in one region out of three. The openness of the landscapes within the viewsheds from the grave sites in Group *R* does not, however, appear to be as easily generalized as the difference between the two groups in the extents of the visible land and sea areas. Besides, the openness of the landscape is connected with the topography of the region: the viewshed towards the land may vary between closed and open whereas the sea landscape is by nature open.

Irrespective of the differences between the two groups, the choice of the grave sites in the terrain is characterized by continuity. The features which are common with the two groups, are the choice of elevated sites, the perspective, and the effect of depth and height. In terms of area, the viewsheds are extensive with local variations. The continuity and the variation of the viewsheds of the grave sites are compatible with the morphological continuity and variation of the graves. *The burial ritual varied in time and space, but, basically, its nature was conservative*.

8.3.6.2 Burial Sites in the Taskscape

In the following, the author's interpretation of the nature of the cairns in Åboland as monuments will be presented. When the interpretation of the differences between the compositions of the viewsheds from the grave sites in Group *P* and Group *R* is being pursued, one tends, primarily, to consider the land and the sea as symbolic representations of subsistence strategies. Is it possible that those who constructed a grave at a site directed towards the land, thought of the surrounding landscape as cultivated land, meadows, and pastures? Viewsheds from grave sites opening towards the open sea and certain water areas between the islands might suggest that these graves were the last resting places of fishermen or seal hunters. The archipelago landscapes were thus scenes of labour in a material form, or taskscapes (Ingold 1993). The graves may have represented the insight of bygone generations into arable land and its cultivation, into fishing waters and their exploitation, and into the best procedures on ice to be observed when hunting seals. This knowledge sheltered people against the risks of subsistence such as crop failures or misfortunes on the spring ice during the seal- hunting season. The burial sites were chosen to form one part of what Orvar Löfgren (1981) calls a production landscape, an open book containing the acquired knowledge and skills which helped in interpreting, categorizing, and exploiting the available natural resources.

We need not, however, submit to the notion that the spatial reference of the grave sites should have referred to the landscape solely through their actual socioeconomic implications because the mortuary ritual frequently presents an idealized version of social relationships. Idealization legitimizes the prevailing reality, and makes it a part of the order which can be retraced back to the idealistic past, or presents an image of a desired or aspired social order (Pader 1982: 36–44; Härke 1993). According to my understanding, the viewsheds from the grave sites in Group *P* represent idealized landscapes, they express a request to gods of desired success rather than a reference to the factual yield of cattle and land. Early farmers had long-term expectations concerning the yield of cattle and land. These expectations were expressed in the building of durable monuments. As stated by Holtorf, agriculture and cattle raising brought results only after continuous and protracted labour, and therefore the farmers were compelled to outline their subsistence strategies for years ahead (Holtorf 1997). The Bronze-Age grave sites in the archipelago of Åboland may be interpreted as sites of symbolic charges, linked with the insight of ancestors creating security in coping with life.

Then, how to understand the fact that the grave sites in Group *R* were directed towards the sea? According to Marek Zvelebil the Bronze Age in the eastern part of the Baltic region was characterized by a subsistence strategy emphasizing minimal risks and low productivity. As long as tools of iron were non-existent the yield of an agricultural household was, under the circumstances, very insecure: it was life close to the extreme limits of subsistence. The circumstances varied drastically according to the seasons of the year but there was more to it: the risk of a total crop failure occurred once a generation or once a century due to extremely cold years. The introduction of iron was the most significant technical and economic feature of development in the Iron Age; this development was of particular importance since it decreased the risks involved in agriculture by increasing the yield of cultivation (Zvelebil 1985; Zvelebil 1981: 26–27). Consequently, a change in the composition of the landscapes of the grave sites does not necessarily imply increased importance of fishing or decreased significance of agriculture but a change of life following from reduced risks within agriculture. The expectations and implications linked with the mortuary ritual gained more and more foothold and involved eventually fish, even seals. Although we do not yet possess any osteological evidence of fishing or seal hunting in the archipelago of Åboland in the Iron Age (cf. Gustavsson 1986; Gustavsson 1987; Núñez *et al*. 1997), these activities must have been fairly important sources of livelihood. In Houtskär, for instance, fishing was the main source of livelihood up to the Middle Ages (Kuvaja 1997).

The subsistence strategies provide a possible solution to the problem why graves were not, as a rule, constructed at the highest sites in the region: their viewsheds were not apparently what was expected of a burial site. The highest tops were generally rocks located far from the sea and low-lying arable land. On the other hand, several events following the prehistoric erection of the graves have focused on the highest tops which provide the most extensive viewsheds of the surrounding area. Military beacon fires in the Middle Ages (*Sw. böte*), and subsequently in the historical period (*Sw. kas* and *vård*) were put up on the very highest tops (Orrman 1991 a: 213–219; Sjöstrand 1992). Triangulation stations were constructed from the end of the 19th century on the highest tops. These manoeuvres have contributed to the devastation of cairns at the most elevated sites.

8.3.6.3 The Symbolic Landscape of the Burial Sites

The grave builders were obviously inclined to bury their deceased in the vicinity of existing graves; the morphology and locations of earlier graves influenced the construction and positioning of new graves. This principle is exemplified by the cemeteries of Furunabb in Houtskär, and Hammarsboda in Dragsfjärd, as well as by the cairns on the islands of Nötö, Mjoö, and Granholm in Nagu, and the cairns in the forests of the villages of Hertsböle in Dragsfärd, and Söderby in Iniö. Cairns which have been constructed close to each other tend to be alike morphologically. This does not, however, imply that there were no changes in the burial tradition during the period in course of which deceased members of the community were buried in the cairns which belonged to a cemetery or were, in any case, visible from each other. Gradual transformations do seem to have occurred, but adherence to the tradition was, nevertheless, the predominant trait. According to my understanding, morphological and spatial continuity reflects a consciousness of ancestors, a sense of ancestral existence in the sphere of specific sites and spaces in the landscape. Bygone generations were in conjunction with present as well as with future generations.

On the other hand, when ancestors were recalled during the mortuary ritual, an occasion may have emerged at which the competition of predominant interpretations of the social order escalated, and the ancestral prestige was challenged. According to Mizoguchi, the mortuary rituals might have included a basis of continuity as well as tensions striving to change the internalized control maintaining the prevalent social order. Mortuary rituals were thus an occasion of both continuity and change. The members of the community felt that they observed faithfully the traditions of mortuary practices although transformations were in reality taking place (Mizoguchi 1996: 231–233). The difference between the natures of Bronze-Age and Iron-Age cairns in the archipelago of Åboland can thus be understood as a result of the accumulation of ’unintended’ transformation processes during the cycles of generations.

The landscapes around the grave sites were open, and the sea was almost without an exception visible within the viewsheds, which frequently were associated with an effect of depth and exaltation. Elevated burial sites which were frequently discernable from the sea, were easily recognizable even from a distance, and could be found in the terrain with facility; occasionally the grave sites were milieu dominants but had rarely been erected on the highest tops in the region. Elevated sites could be easily interpreted as places to be ascended, and to be visited in ceremony, observing specific traditions, in order to behold the grave and its surroundings. Grave sites were intended to be visited and revisited, over and over again, from generation to generation. From the grave sites the living members of the community watched the land and the sea; accomplishments, skills and knowledge, social relationships, and agreements were reviewed, effected, and negotiated at these places. There the children adopted their parents’ knowledge of the significances of the landscale and the different places, essential beliefs, and ethical commitments – but, above all, they were places which actualized the presence of the ’sacred’. At the grave sites one could encounter the consciousness of the presence of one’s ancestors and superhuman powers.

Elevated places are in religious symbols frequently associated with the fundamental spatial dimension, the so-called forwards-upwards -motive. The path from the profane world towards sacred sites runs longitudinally, and on the way, in passing gradually higher and higher up, the participants of the procession encounter symbolic expressions and arrive, eventually, at a sacred site or space which is higher up than the profane world with its life, closer to heaven. This motive is well-known from ancient Egypt, and the Christian, Gnostic, and Islamic traditions (Holm 1997: 87–88). Even though the grave sites were not sacred places of worship in the same sense as churches or mosques[106], visiting a cemetery gave, according to my interpretation, a somewhat similar experience of a symbolic space. The burial site on the rock was approached either by boat or by land, the slope was ascended, and a sequence of familiar places were passed. The whole sequence of experiences was then transformed into a narrative expressed and shared orally (cf. Tilley 1994: 27–33).

The explanation to the larger mean size of the graves in Group *P* in reference to those in Group *R* may be derived from the renewed visits to the grave site. A proposal might be that during the longitudinal procession new stones were collected to be taken into the cairn. In this way more and more of the very material, which originally made the place into something specific (Kaliff 1997: 106) – or at least marked out a specific, different place –, was added to the structure of the grave. Revisiting the grave site may have involved a secondary interment in the old grave construction (Salo 1981 b: 144–148) or some other rebuilding and ritual reactivation of the cairn (cf. Bolin 1999: 55–68). Simultaneously, the cairn gradually accumulated and grew larger and larger. The older the grave, the longer it has been able to grow in size.

Elements, objects, and phenomena in nature do not contain merely references to natural resources and sources of subsistence; they also constitute a basis for cultural symbols and categorizations of the world. We may imagine that in the archipelago, nature talked to human beings in phenomena and transformations, such as rough seas, thunderstorms, the freezing over of the waters, or the movement of the celestial bodies. The sea separated the islands and skerries from each other, and created a mosaic of land and water where an abundance of identifiable landmarks made up a cognitive map of places. On the other hand, within the viewsheds from the burial sites which were typically more or less elevated, the sea created also a continuum towards the horizon, a sense of being at the starting point of a nearly infinite distance to the horizon, which – as a suggestion – may have constituted a liminal zone between this world and the other world. Another important natural element was the earth, its fertile soil, its stones, and its bedrock. The grave was a continuation of the bedrock, a focusing point where the deceased came close to the rocks and the sea – and here the fertile and productive power of the earth and the sea flowed into the granitic stones and the deceased.

106.The close relationship between graves and altar places has, however, been emphasized by Anders Kaliff, see Kaliff 1997.

8.3.7 Discussion

8.3.7.1 Graves, Communities, and Territoriality

In chapter 3 we have discussed several theories concerning cairns which have been published in recent decades. In the beginning the investigators were interested in the origin of the Bronze-Age grave builders, in later days this interest has expanded to focus, among other things, on the connection between the monumentality, location, and number of the cairns on one hand, and power, control over the earth and natural resources, and territoriality, on the other.

According to Unto Salo, there was a two-way visibility at the grave sites located on high rock tops. On one hand, the viewshed opening from the grave site represented the unity of nature, a scale in time and space outdoing the human being. On the other hand, the stony grave preserved the memory of the deceased, ”and this was sustained best if the cairn was in sight, at a visible site, discernible from the sea, in particular ” (Salo 1981 b: 125). The cairns constructed on panorama sites should be interpreted as monuments of the family heralding the position or status of the family. The use of power was necessary to safeguard the fields, the cattle, and the natural resources belonging to the family against rivals (Salo 1981 b: 122–130). Monuments were an expression directed both to the members of the community and to the outsiders indicating that the land had been taken into possession, that there was a permanent symbolic link between the spatial entities and the values, norms, and proprietary relationships guiding social practices (Anttonen 1996: 108). According to this interpretation, the graves were directed against exterior rivals, but consolidated, at the same time, the internal social practices of the community.

Woodcutting, building, and cultivated fields were in themselves conspicuous signs of propriety and the legitimation of propriety, produced by such activities. But the perimeter of the territory was indicated by constructing graves, and the viewsheds opening from these restricted the territory in the propriety of the family. Trespassers and neighbours were not to enter this territory without permission. The landscape of the grave constructors was an inhabited region where each family and each house attempted to safeguard themselves an adequate share of the limited natural resources (Salo 1981 b: 130). When investigating the cairns in Södermanland, Sweden, Sonja Wigren came to the conclusion that the cairns could not possibly have marked the boundaries of the propriety but they must have been located to cover the whole territory if they, in the first place, were any signs of the propriety of the territory (Wigren 1987: 109–120, 144; see also Ramqvist 1982). The opinions of Salo and Wigren are, in this respect, different from those published in the classical general review of the prehistoric settlement of Ångermanland, Sweden by Evert Baudou which presents the interpretation that the graves were constructed to mark the boundaries of the territory (Baudou 1968).

According to Salo’s thoughts the appreciated burial under a huge mass of stones was granted to worthy members of the peasant community who had a close historical link with the clearing of the terrain and the taming of nature into a culture. He sees even the Scandinavian immigrants in an agrarian and fairly egalitarian light: they were seal hunters and farmers who brought the tradition of cairns and the use of metals with them to their eastern neighbours. Christian Carpelan, again, describes the Scandinavian immigrants as an upper class who settled among the population representing the culture of Kiukais, inhabiting their homesteads and living at their cost. The population belonging to the culture of Kiukais adopted the new burial tradition only after the newcomers had settled down permanently (Carpelan 1982). Tapio Seger suggested a third version of the communities on the Finnish coasts in the Bronze Age; he saw these communities as strictly ranked and hierarchic economic units led by professional chiefs, who organized working teams to build grave constructions. These communities were well-organized and had noticeable regional centres on the Finnish coast and on Åland (Seger 1982 a). Torsten Edgren goes along the same line of thought as Unto Salo when emphasizing the role of the kinship in the Bronze Age coastal society. However, on the other hand he considers bronze artefacts as signs of aristocratic landowner families, the internal cohesion and continued existence of which were maintained by chiefs and through ritual forms of cultic performances (Edgren 1999 b: 2–3).

8.3.7.2 Problems of Territorial Interpretations

The conception which accentuates territoriality and land propriety includes the idea that a cairn, due to its appearance, size, and position, was apt to inform everybody where the line between permitted and prohibited land or activity was running and who held the power in the region. The problem here is the apparent overestimation of the visibility of the graves. In the prehistoric period, as well as today, the cairns in the archipelago were probably better discernible than on the mainland on account of the fact that one could see them also from the sea. Even in the archipelago the cairns were, however, very rarely, if ever, discernible from the sea without modern optic aids. The cairns were simply too small details in the landscape to be distinguished if the distance was even a little longer. In other words, the cairns could not possibly have meant anything to people who came from somewhere further away, and did not know the landscape before. The grave sites which had the nature of being milieu dominants were better visible than the graves but an outsider could never know that there was a grave linked with the milieu dominant because the stone setting of the grave could not be seen until one had come very near the grave site. As the graves were constructed on dry land, frequently at elevated sites and at some distance from the shore, they belonged, in the view of outsiders, to the periphery, they were not within the viewshed: the archipelago could be reached by outsiders only by boat or across the ice. An outsider sees the landscape primarily from the sea whereas the members of the community may approach it from the sea or from the inland.

Consequently, graves or grave sites cannot possibly have been signs of propriety directed at an outsider. If the graves were signs of land propriety, they must have been directed at somebody else, in some other sense. It is possible that they reminded the more penurious members in the community, who did not themselves possess any land property, of the status of land proprietorship, they may have indicated to one's neighbours who also possessed land what resources the land proprietor had at his disposal, or they may have consolidated the identity of the family as a group to confirm that they were entitled to exploiting natural resources or that they had claims concerning these. *If* the graves were signs of land propriety, they represented the *internal* spatial categorizations within the community, the sustaining values and rules concerning the control over the land; cognitive, normative, and valuational principles were written down in them. ”Knowledge of the landscape became bound into them” (Tilley 1996: 175). The graves legitimated the prevailing established order by indicating the symbolic link between the spatial and the social categories: the proprietorship was achieved and guaranteed by labour which originally was done on something non-possessed, as put by Salo (Salo 1997: 87–93). According to this conception the graves can be interpreted as part of a process where the community was constructing its own identity with reference to the outside world: other communities, alien people encountered in goods exchange, otherness.

If we abandon the idea that the graves were directed at outsiders in the concurrence for natural resources, it will not be necessary to assume that the grave monument should be visible from a far distance to be able to give significance to the site. One should rather argue that the visibility of the grave site maintained the memory of the deceased who had been buried there. The summit of a rock, a cape, the mouth of a strait, or any other milieu dominant could be seen from a distance of several kilometres; it reminded the spectator of the existence of the grave site and of what had been told about it – provided he knew the coding of the landscape.

In the archipelago of Åboland the relative visibility of the grave sites does not actually advocate the notion that the cairns should have served as landmarks of a territory belonging to a family, an extended family, a tribe or some other local community. This notion was presented by Baudou concerning the cairns on the eastern coast of Sweden, and argued his opinion by the fact that the occurrence of the graves on the coast is not evenly distributed; in fact, they are grouped in dense clusters separated by areas where the graves are more sparse. Such clusters could be interpreted as centres of settlement units (Baudou 1968: 124–152). Lars Forsberg has remarked, and with good reason, that if the graves were landmarks of territorial boundaries, they should be located peripherically at the territorial boundaries, not centrally within the territories (Forsberg 1999: 254; cf. Wigren 1987: 109–120, 144).

A far-reaching concept of the peripheric location of the graves has been proposed by Henrik Asplund. According to his notion cairns were constructed outside the sedentarily settled areas in the Bronze Age and the Pre-Roman Iron Age. In South-West Finland the deceased of the valleys of the river Aura and the river Paimionjoki were transported to the archipelago to be buried in the wilds for which reason the number of graves in the river valleys remained fairly small. The graves in the wilds were associated with the competition with those who were from outside the community: the graves were necessary landmarks of proprietorship where there were no other means to control strangers and to prevent them from appropriating illegal economic advantages (Asplund 1997 b: 42–43). Indeed, the number of the graves in the river valleys mentioned above was previously regarded as utterly small; Tallgren enumerated several regions with sparse finds in 1931 (Tallgren 1931 a: 91[107]). In the light of the available material today (Salo *et al*. 1992)

107.Few, if any, Bronze-Age cairns were known on the coastal zone between Laitila and Turku until the 1950s. According to Meinander (1954 a: 114) this may, at least partly, be due to the fact that no efforts were made after the 19th century to discover cairns. Nevertheless the absence of finds in this region was real in his opinion. The situation has changed after the surveys conducted in the area, although the coastal zone from Mynämäki to Salo is still rather poor in finds (Salo *et al*. 1992; Vuorinen 2000 c).

concerning the distribution of cairns in the scope of the whole of Finland Proper (SW Finland), the river valleys do not appear as extensive vacuums in comparison with the rest of the mainland coast in this respect. Similar areas with sparse graves can be found also elsewhere, for instance in Perniö, which, generally speaking, is regarded as rich in graves. The sparse occurrence of graves in the river valleys is thus a question of scale and scope: if the region to be examined is limited to be sufficiently small, the frequency of the graves remains often small, too. On the other hand, it is well known that, in the valley of the river Aura, archaeological remains have been ravaged by the urban building activity in Turku (Kivikoski 1971; Salo 1982: 76–77). According to old records, the cairns or ”Lapp graves” (*Sw. lappgrav*) in the region of Turku in particular, have been ransacked with the purpose of discovering hidden treasures (Holmberg 1858). The hypothesis of graves being located in the wilds implies also that dwellings and cemeteries were not located in the same areas. All information of the relative locations of cairns and dwellings has, however, remained fairly deficient so far. It is easy to state that no cairns have been discovered in the surroundings of certain dwelling sites on the mainland coast but there are several examples of dwelling sites which are close to or even surrounded by cairns (e.g. Salo 1981a: 15, 19; Salo 1981b: 42–96; Lähdesmäki 1987; Strandberg 1996; Strandberg 1998; Asplund 1997 a: 255–259). Thus, on the basis of all available material, the notion of graves being constructed as a rule in the wilderness is not plausible.

The hypothesis of cairns serving as beacons, marking out waterways in the archipelago (Krantz 1940; Jansson 1985; Wigren 1987: 121–125; Broadbent 1983) has not been supported in Finland as much as in Sweden[108]. The morphology and the topography of the graves in the archipelago of Åboland do not favour this hypothesis, either. The cairns were so small details in the landscape that they were discernible from the sea only in exceptional cases or circumstances, and could thus not serve as beacons: there are several other fixed – and better visible in bad weather – marks in the archipelago than the cairns. A beacon in the present sense of the word denotes an aid in navigating a vessel. One of these aids is a heap of stones (*Sw. kummel*) erected on a shore cliff, which facilitates the recognition of a cape, island, strait, skerry, or some other natural place in the archipelago where sailing is often complicated and hampered by impediments. These stone heaps are of great help to the shipper or the pilot, who is able to compare his visual observations with the sea chart or sailing instructions where the location of the stone heap has been indicated. In the modern sense, marking out waterways in the archipelago of Åboland did not begin, however, until the reign of Gustavus Vasa when the fairway Utö – Turku was marked out; marine surveying in detail was started in the 18th century (Öhman 1993; Öhman 1996; Ehrensvärd & Zilliacus 1997). In the prehistoric period a grave site may, of course, have been a milieu dominant which could be recognized from afar, and be of great help in determining the position at sea provided that there was somebody on board with local knowledge – but that is an entirely different matter.

The theories concerning territoriality in Finland reflect the Nordic trend of the last few decades which regards Bronze-Age communities as chief-dominated and as based on the

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108.Judging from the clerical reports included in the extensive inquiry concerning the ancient monuments in 1666–1693, delivered to the Crown by priests in Sweden-Finland, the stone cairns seem to have been interpreted by peasants as ancient landmarks for seafarers, at least in Ostrobothnia. See Edgren 1995 c: 56–57.

relationship between centres and peripheries. Archaeological evidence has been sought for in petroglyphs, the morphology of the graves, their number and distribution, and the central areas of agricultural and metal production. In this, southern Scandinavia has been used as a model. The aim of several approaches has been to separate the centres from the periphery on the local, the regional, or the interregional level (Widholm 1998: 10–21; Broadbent 1983: 11–14). The concept of centres is closely related to the interpretation of cairns as part of territorial private proprietorship. The interpretations whose central idea is to establish the territory in the landscape opening from the grave site seem, on the basis of the discussion above, to be best in accordance with the empiric observations. In a way, the graves were inclined to cover the territory rather than limit it, their significance in the community opened inwards rather than outwards. Economic, political, and ritualistic centres might thus be found at places where there are several graves and dwelling sites together.

The location of the graves cannot, however, be determined by the relative positions of the centre and the periphery only. In the archipelago the graves have been constructed sufficiently high up in the terrain at sites which have not been subsequently taken up by cultivation or any other human activity. The location of the grave is thus determined by the size of the islands, their relative positions, and on each island individually, by the pattern of moraine or rock terrain in reference to that of low-lying soil sediments. On the mainland coast, the sea does not, apart from the shoreline, divide the natural landscape into separate sections in the same way as in the archipelago but the river valleys and the bogs, for instance, form their specific patterns which affect the location of the cairns, and even where these have been able to endure. When searching for territories, central places, and peripheries on various levels one should thus be able to distinguish the characteristic wavelength of the topography of the landscape from a possible local structure connected with the territoriality, and much more should be known about the relative locations of the graves and the dwelling sites than today.

Territories, central places, and expressions of power have connections with the structure of Western communities, perhaps even with male-dominated research traditions. Therefore it is not surprising that our culture displays analogies to the significances which organized community, competition, power, their legitimization, and subordination of nature are thought to have had in the prehistoric past. Archaeology is, in fact, present-day discourse of the past (Olsen 1991). For instance, our deliberation of the organizational requirements in constructing cairns is not free from 21th-century Western concepts of physical work, its values, status, gender aspects, and significances. As previously stated, the construction of a cairn which, on an average, weighed more than 10 tons, was apparently not an exceedingly heavy effort for the local community in the archipelago. But even if we are able to estimate and express the required amount of work as physical quantities, the problem of the relationship of the grave builders towards their task remains unsolved. Did they think of the effort of carrying stones as a duty which was done at the cost of one's livelihood or perhaps as forced labour; was it a token of emotionality towards the deceased or part of the rites of passage where conventional social categories were dissolved? Were all the stones brought at a time or during several generations when the grave was being revisited? Were the same significances involved in constructing large graves as with small ones; most graves were in fact small? Was the work part of a ritualistic demonstration of power, or did it symbolize the building and sharing of the experienced world, did it involve expressions of beliefs and those of the need of social cohesion, or was it part of the continuation of life?

8.3.7.3 Land And the Human Being

The purpose of the comments above is not to deny the significance of graves as expressions, safeguards, and reproduction of power in the Metal-Age communities in the southwestern coastal regions of Finland. They do not question, either, the priority of certain regions as better candidates than others, on account of findings, when tracing economic centres or sites of political institutions, or, as suggested by Dag Widholm (1998), ritualistic scenes where people from far and near have gathered. Yet my firm belief is that the conceptual constructions of territoriality and manifestations of patriarchal power do not sufficiently grasp the mortuary culture whose material remains the cairns in fact are. The Metal-Age communities should evidently be regarded as fairly local and egalitarian; the cairns should be approached as part of the religious sphere of life and the symbolic constructing of reality. We may imagine that the ancient landscape of the archipelago was filled up with places carrying cultural meanings pertaining to religion, tradition, and social relations and their reproduction. Thus, ancestral beings, enculturation, social cohesion, and the continuity of life should be incorporated in our understanding of the mortuary ritual.

As a possible illustration of this view, we may think of the landscape as ancestral transformation, as the Australian aboriginals do. Where their ancestors hunted, gathered, sang, or moved through the world, their actions became timeless parts of the place for ever. The ancestral beings transformed themselves into features of the landscape, and so were the ancestral events transformed into the order of the world. The flow of ancestral action was fixed all the time into the landscape; through such a transformation the ancestral actions and experiences became ”a structure that exists outside the ancestral world” (Morphy 1995: 189). This structure is a liminal zone between this world and the other world. Naturally, this does not suggest any close cultural parallels between the Australian aboriginals and the prehistoric islanders of Finland. But I do suggest that there are other ways to relate to the landscape than mere proprietorship. Perhaps the islanders did not possess the land; maybe they were integral to and dedicated to the land – and to the sea.

9 On Continuity, Settlement, and Subsistence

9.1 A Summary of Empirical Results

Five cairns were excavated for this study. Sundbergen 1 in Nagu is a medium-sized cairn where a young person was cremated in the Late Iron Age. The body was interred with a comb of antler. The grave had probably been constructed on a bare rock. Judging from the results of the weathering investigations the stone setting of the grave was damaged when a crater was dug in it essentially later than at the time of the interment. Sundbergen 2 in Nagu is a small cairn where a grown-up person was interred in the Late Iron Age. Some iron rivets, probably from a clinker-built boat were buried with the body. Parts of faunal remains, cattle, pig, goat or sheep, and cat were also detected in the cairn. The construction of the grave had been started by carrying a layer of earth on the bare rock outcrop. The interment was then implemented in this earth layer which was covered up with stones and boulders. The cemetery at Sundbergen is comparable with the cairns at Piiloinen in Vehmaa which, however, date from the Early Roman Iron Age (Salo 1968: 67–69). The stone setting at Lilla Kuusis in Nagu, and the minor cairn at Östergård in Dragsfjärd remained without finds. The same applies to the medium-sized cairn at Ängesnäs bergen in Nagu, but in this case the excavation observations and the weathering investigations indicated that it was an ancient man-made construction, probably a grave.

The purpose of the study was to complete previous investigations by increasing the number of field observations. The field work programme included both probable locations of burial cairns and locations which were not likely to have been selected as burial sites, and the area of the investigation was extended to embrace the outer and skerry zones of the archipelago because in this way a more representative sample of burial cairns was acquired. The number of registered burial cairns increased from 240 to 444; some of the graves were mentioned in old field reports but could not be relocated. The number of the graves in the outer archipelagian zone was considerable with regard to its limited land area. The nature of these graves refers to the Iron Age, which was confirmed by the excavations at Sundbergen in Nagu. In a sampling study of the recent topography at the burial sites in Houtskär, Korpo, and Nagu, it was established that, typically, rocky and even places which were elevated in relation to the adjacent topography, were selected as burial sites. They were preferably near each other, and close to the sea. An examination of the locations of the burial sites reveals also that, due to shore displacement, the graves are generally later than the local topography implies.

A rough estimate of the total weights of burial cairns suggested that the majority of cairns measured less than 20 to 30 tons in weight. Graves with more than 100 tons of stones are obviously very rare. A comparison between the minerals and rocks in the graves Sundbergen 1 and 2 and those excavated from the wave-washed tills in the vicinity suggested furthermore that the stones used in grave constructions were fetched from the immediate vicinity of the graves whereby no special attention was paid to the colour or other visual properties of the stones. There are, however, certain intimations of red or glimmering stones being the most popular. The stones close to the burial site were used first, and, as no more stones were available on the adjacent bare rocks, the rest of the stones had to be transported from more and more distant places, often from low hill slopes.

The most common shape of the stone setting is round or oblong, and several stone settings which now are indistinct and diffuse, have probably been round originally. The area of the stone setting as the product of length and width is seldom more than 150 m^2. The long cairns may, at will, be discussed as a separate group. A special case among these is the 49 meter-long grave at Öijen, Nagu (232) which is the longest cairn in southwestern Finland. In large graves in particular, there are stone chains, stone cists, and prominent central boulders.

The graves were frequently fairly close to each other. The distribution of the relative distances between the graves suggests, however, that more than half of the graves were located individually in the terrain. When there were several graves close to each other, the number of adjacent graves was seldom greater than four.

When comparing the distinctive features of the dated cairns on the coast of southern Finland and those of the non-dated (through excavations or by other means) cairns in Åboland, the most essential distinctive differences between the graves from the Bronze Age (Group *P*) and those from the Iron Age (Group *R*) are to be found in the area of the cairns, the differences in elevation in the vicinity of the grave sites, and in the differences in elevation between the grave site and the highest rock summit within the radius of 1200 metres. On the other hand, the graves display continuity from the Bronze Age to the Iron Age: for instance, the typical location of graves close to each other does not change essentially in course of time. More than half of the cairns belong to the Iron Age rather than to the Bronze Age. The shoreline datings of the graves indicate that 58 graves must have been built in the Iron Age, part of them in the Late Iron Age.

The viewsheds opening from the grave site were of great importance for the constructors when they were choosing the location for the last resting place of the deceased. Shore displacement has certainly changed the landscapes around the grave sites in an essential way as the previously visible sea became dry land. The graves in Group *P* (dating from the Bronze Age) as well as those in Group *R* (dating from the Iron Age) were in their day built at equally maritime sites. The present gradient from the inner towards the outer archipelago – from the earlier shore displacement milieu towards the later – is the stochastic age gradient of the cairns.

A common feature to the viewsheds of the graves in Group *P* in all the four selected regions was that they were turned towards the land. In general, the visible sea area from the grave sites was fairly extensive, and several graves had been built on the hills rising up from the sea shore. Despite the proximity of the sea it is apparent that the sea view was of no primary importance in the choice of the grave site; on the contrary, an extensive view towards the land and the effect of depth and exaltation were of greater importance. The sites of the graves in Group *R* were typically close to the sea with an obstructed and extensive sea view – Lillandet in Nagu was, however, an exception; there the sites of the graves in Group *R* resembled those of the graves in Group *P*. The viewsheds from several graves in Group *R* were directed towards the same water area. Also the viewshed to the horizon seems to have been of importance in the choice of the grave site, and therefore the grave was frequently constructed on a minor island where the terrain did not interrupt the line of sight towards the sea and the horizon to the same extent as on a large island.

In spite of the differences in viewsheds, the choice of the grave sites in the terrain is characterized by continuity from the Bronze Age to the Iron Age. The choice of elevated sites and the pertaining perspective with the effect of depth and height were the common features for the locations. In terms of areas, the viewsheds were extensive with certain local variations. In the mortuary ritual, the viewsheds from the graves seem to be associated with expressions of desired livelihood and success. They may be interpreted also as exalted places which were ascended and visited ceremonially, and where the grave and its surroundings were beheld. The graves were meant to be revisited over and over again, from generation to generation. These sites were places which were dedicated to recollecting, narrating, reiterating and negotiating, there the children adopted from adults their beliefs, ethical commitments, and the significances of the landscape and the sites – but, above all, at the grave sites everybody was conscious of the ’sacred’. There one could encounter the awareness of the presence of one’s ancestors, and superhuman powers.

9.2 The Iron-Age Settlement of Åboland Reconsidered

9.2.1 Graves As Indicators of Settlement

The hypothesis concerning the peripheral nature of the archipelago which was introduced in the 1930s has a central position in the research history of the archaeology of the archipelago of Åboland; according to this hypothesis the archipelago was, in view of the agrarian population which is the focal point of archaeology, a remote and barren wild region whose settlement came to an end at the end of the Bronze Age with no resettlement in the Iron Age. The first new settlers came to the archipelago only in the 12th century with the Swedish colonization (see chapter 2). On the mainland coast of South-West Finland the course of events was different: according to the present conception the settlement there was uninterrupted all through the Iron Age (e.g. Salo 1995). Field archaeological investigations have, however, brought forth observations which are not in favour of the hypothesis mentioned above. In the following, the problems associated with the hypothesis, the archaeological evidence of the settlement of Åboland in the Iron Age, and the aspects of pollen analysis and place name studies in reference to the problem of settlement, will be discussed.

9.2.1.1 The Direction of the Null Hypothesis

The concept according to which the absence of finds in a certain region within a given prehistoric period *B* implies the disappearance of settlement in that period (*B*) despite the reported presence of such finds from the preceding period *A*, occurs over and over again in the research tradition of Finnish settlement archaeology. This concept may be based even on a conspicuous scarcity of finds in that period (*B*), or on finds which might be associated with the economic exploitation of uninhabited wilds. It has been thought that the principle of caution results in a conditional statement according to which there has been no settlement, if its existence cannot be demonstrated specifically. This condition may, of course be completed with additional statements concerning the field archaeological research situation. In the following, a remote example will be given: In J.R. Aspelin's days in the 1870s some ten Bronze-Age metal artefacts had been reported from Finland, and by virtue of the scarcity of the finds, the possible settlement of Finland was, in his opinion, at any rate questionable.

The concept described above leads to certain problems if applied indiscriminately. In the first place one must assume generally speaking that the biological survival of man must, for a long period of time, have been the principal rule at least in regions where the natural conditions have allowed the subsistence of man. The population in Finland could not have multiplied in course of millenniums if this assumption did not prevail: according to calculations made by Eino Jutikkala the population of Finland in the Stone Age was 2500–10000 people, and by the Famine Years 1695–1697 the population had risen up to half a million. The growth of the population was not monotonous but the trend of the development must have been ascendant in the long run (Jutikkala 1987). Consequently, also the long-term trend of the settlement must have been mainly ascendant and increasing. Otherwise it is rather difficult to discuss the settlement processes in the prehistoric period and in the Middle Ages (e.g. Orrman 1991 b), or to vindicate conclusions which have built culture-historical bridges across dozens, even hundreds of generations when discussing continuities in material culture or archaic cultural practices, categories, and phenomena, such as beliefs, rituals, and institutions pertinent to the cultural traditions of wildernesses (Sarmela 1984), the linguistic footprints of early iron industries (Salo 1993), simple boat constructions (Itkonen 1941), the use of vessels (Salo 1989), the history of agricultural tools (e.g., Vilkuna 1971), and old etymologies (Häkkinen 1984; Anttonen 1996; Häkkinen 1999).

The disappearance of settlement, its desolation is thus a specific process in prehistory, a phenomenon deviating from the general expansive trend, which should have one or more locally and temporally limited explanations. Case studies from Europe, Africa, the Middle East, and the two continents of America suggest that permanent abandonment of dwelling sites took place only in exceptional economic, demographic, ecological, or regional sociocultural circumstances (Tomka & Stevenson 1993), to say nothing about whole large areas being depopulated.

Differences in excavation or survey methods, or in the coverage of the field research between various regions cannot be considered responsible for such depopulation. Also the intensity of the survey affects strongly what is observed and what remains unobserved; this, on the other hand, is drastically reflected in interpretations and conclusions (Plog *et al*. 1978). The same applies, naturally, to the effect of survey methods, the abundance, clustering, obtrusiveness, visibility, and accessibility of the archaeological remains (Schiffer *et al.* 1978) on the result of the field work. Strict caution should be observed in interpretations, if the field research is in its initial phase, or if the finds derive from other operations than field research. The artefacts registered by J.R. Aspelin were obtained from such specific situations in field research. The continuity of settlement through the Bronze Age has no more been questioned for a long time (Salo 1984 a). Generally speaking, the contemporary notion is that there is an obvious continuity of culture and settlement on the coast of Finland from the Subneolithic Stone Age to the Iron Age (Salo 1981a). Being wise afterwards does not, however, justify us to ignore the fact that we are still facing the same problems as Aspelin because there are regions and periods where the registrations of finds are very scarce.

Another problem of methodology in the interpretation of real or seeming shortcomings in the find material concerns the regional scope. Its significance is illustrated by the debate concerning the development of the settlement of southern Ostrobothnia in 800–1200 AD. For a long time the only prevailing concept was that the Iron-Age settlement which is represented by cemeteries and graves with abundant finds until the 7th and the 8th centuries, began to vanish from this area in the 9th century, and Ostrobothnia was desolated (e.g. Meinander 1977). Sporadic finds have been reported from this area from the Late Iron Age but according to the traditional opinion they do not indicate a continuity of settlement; instead, they have been interpreted as being left there by hunters and other travellers in the wilds who came from the more southern province of Satakunta. The present settlement of the region did not start until the beginning of the Middle Ages with the colonization from Sweden. The research team of Evert Baudou joined together archaeological excavations and pollen analyses during their field research in southern Ostrobothnia in the years 1986–1991. Attention was paid not only to central settlement regions with abundant finds but also to regions exposed by rapid shore displacement with very few, if any, registered finds from the Iron Age. According to the reports given by the research team (Baudou *et.al.* 1991; Baudou 1991), the results of the investigations indicated that the discontinuity of settlement was only local, not regional. The conditions of cultivation and cattle raising in the region changed in the Late Iron Age because shore displacement in the flat and even landscape of Ostrobothnia (e.g. Jones 1988) resulted in grazing lands turning into marshy ground. For this reason the settlement moved closer to the sea shore where shore meadows still provided pasture land for the cattle.

Critical views have been presented about the interpretation of the pollen analyses from southern Ostrobothnia (see Orrman 1994 a; Orrman 1999) but, nevertheless, the investigations conducted by Baudou's team demonstrate very clearly the significance of independent methods and of a sufficiently extensive local scale. If the area surveyed in questions about the continuity, enlargement, and structure of the settlement is rather small – the banks of a river or the shore of a Finnish lake and the like – one easily ends up with a situation in which the conclusions have to be based on a very limited number of finds, occasionally even on one single find. In such a case the possibility of studying the settlement as a regional process adapting to gradual changes like shore displacement etc. is wasted on one hand, and, on the other hand, every new find will change ostensibly the image of the settlement of the region.

The presumption that a certain region is uninhabited, does not thus necessarily turn out to be the simplest and most cautious null hypothesis because it must be altered every now and then with increasing find material. To assume that every region should be regarded as potentially inhabited if such a notion is not challenged by obvious evidence, seems to be more in accord with the nature of the field archaeological material. Such ”obvious evidence” might purport, for instance, natural conditions which make human settlement impossible, natural catastrophes, or an absolute absence of evidence of any settlement, in spite of systematically and purposefully conducted field archaeological investigations[109]. The latter assumption – ”it is there, if only we can find it” – is, with increasing find material, more sustainable than the assumption of desolation or depopulation, but it deprives, naturally, the finds of the fascination which is inextricably linked with finding something new and unexpected.

9.2.1.2 Settlement And Cemeteries

A dwelling site is a primary indication of settlement in an archaeological material. As Bronze-Age and Iron-Age dwelling sites are usually difficult to trace, the location and the development of settlement have been traditionally investigated by means of the location and distribution of graves and cemeteries. Due to the obtrusiveness of cemeteries and graves they are often more easily discovered than the remains of buildings and dwelling sites which have been covered by earth. Graves have, at least in some cases, been ravaged more seldom than dwellings by construction work and haulage of gravel. As the graves and the cemeteries are often located in the vicinity of known dwelling sites, the graves – particularly those from the Iron Age – are regarded as reliable indications of sedentary settlement even where no dwelling sites have been registered. Indirectly deduced settlement has been called cemeterial settlement (*Fi. kalmistollinen asutus*, Salo 1995; Salo 1999). The development of settled areas, cultural regions, and barter trade in Finland Proper and Häme (SW and S Finland) in the Late Iron Age, as described by Kivikoski, is an example of writing prehistory on the basis of cemeterial settlement (Kivikoski 1961: 290–293).

It would, however, be unwise to conclude inversely that the absence of cemeteries or graves is a direct indication of the absence or desolation of settlement. Matti Huurre expresses this notion as follows:

109.I will not discuss here rare phenomena which are characterized by the fact that their very discovery and detection require a fairly extensive number of samples, and thus a particularly strenuous archaeological work, especially when the phenomenon is concentrated in regional clusters (Nance 1983: 312–318), which is not unusual. These phenomena are represented by rarities which may occur, say, once in a century.

> Focusing research exclusively on cemeteries involves certain risks. As a cemetery can be regarded as a distinct implication of Iron-Age settlement, it may lead easily to the concept that the absence of cemeteries is an indication of the absence of settlement. One may, however, pose the question why stable settlement could not have been possible even without a certain type of cemetery. In fact, cemeteries demonstrate only a certain type of burial which, again, is associated with religion and beliefs. Thus the increasing prevalence of cemeteries reflects the distribution of new religious concepts which need not have anything to do with the spreading of settlement. It has been frequently emphasized that one might believe that Finland had turned into a totally desolate country by the advent of Christianity if one relied on cemeterial finds only (Huurre 1979: 141).

The presence of graves and cemeteries is thus not a necessary but often a sufficient condition for the conclusion that the finds indicate a sedentary settlement. The historical-geographical context has been of significance for various researchers in the interpretations of cemeterial settlement. A 12th-century grave with a cremated female body was discovered in Suomussalmi in northeastern Finland. In the otherwise sparse Iron-Age find milieu this grave was interpreted as an isolated interment in the wilds, and not as an indication of sedentary settlement (Huurre 1973 b; cf. Huurre 1992). In western Finland, in Satakunta, 14 cairn cemeteries have been regarded as indications of sedentary settlement from the Late Roman Iron Age, and this has resulted in inferring changes in the assumed central regions of settlement (Salo 1999: 8). The arguments of these interpretations are differentiated by the difference between the remote northern taiga and the fertile south-western agrarian region on one hand, and by the frequencies of the graves on the other. In both cases it is, however, a question of interments in river valleys. Where does the line run within archaeological finds between sedentary settlement, mobile residential settlement, and desolate wilderness? On the mainland coast of Finland Proper there are more than 600 registered Iron-Age graves and cemeteries which have undoubtedly been interpreted as indications of sedentary agrarian settlement. But what about the more than 200 Iron-Age cairns in Åboland at the distance of 10–70 km from the mainland coast towards the archipelago; are they wilderness interments or graves within sedentary settlement?

The basic assumption of cemeterial settlement, the location of Metal-Age graves and dwellings close to each other, seems to be valid in several contexts. With the help of graves we are able to outline the regions which undoubtedly have been inhabited but burial sites cannot throw much light on the location of dwelling sites or on desolate regions. Even a small number of registered graves may be an indication of sedentary settlement but the less and fewer the archaeological indications are, the more cautious one should be. The graves contain, however, also other intimations of prehistoric communities than of their location: they may provide knowledge of beliefs, rituals, the relationship between man and nature, subsistence strategies, gender, and the biological qualities of the deceased. When these traits contain local contexts, connections with the ecological settings of the grave sites, it is not too audacious to regard the graves as culturally significant monuments of locally anchored people whose dwelling sites were somewhere in the vicinity.

9.2.2 Images of Wilderness And Isolation in the Construction of National Prehistory

For decades it has been a common conception that the Iron Age archipelago of Åboland was a desolate wilderness, exploited mainly for long-distance utilization only and thus resembling the wilderness regions of the inland of Finland. However, in the imagery of the Finnish national prehistory writing the archipelago has never acquired the same prominence as the wooded inland regions. Derek Fewster has characterized the early 20th-century national construction of the Finnish Iron Age with its heroic spirit of the Kalevala, the conquest of wild uninhabited forests, and the tribal organization into semi-state communities whose military power was based on hillforts. In this scenery the worst enemies of Finns were the Vikings (Fewster 1999). In the (pre)historical archtypes of Finnishness the maritime archipelago seems to have been an alien region and therefore left outside of the mainstream of research. The archipelago was the pillaging nest of the Vikings, there was no network of hillforts as there was in the interior and on the south-western coast of the country. And the starting point of the settlement in the archipelago, the Bronze Age with its predominantly Scandinavian tokens – Tallgren used the term the "Scandinavian" Bronze Age in Finland (Tallgren 1937) – was not a very important part of prehistory in the construction of Finnishness because early prehistorical populations were not regarded as predecessors of today's Finns.

The urban bourgeoisie discovered the fashion of spending summer in the archipelagos of Sweden and Finland in the late 19th century. For them the archipelago was a more homelike equivalent to an alpine or wilderness milieu, it was an aesthetically appreciated untamed virgin territory. There was no contradiction between this milieu and its inhabitants, the islanders who made their humble living by doing hard work (Eklund 1985; Montin 1996). The literature concerning the archipelago, and the belles lettres with ethnographic characteristics in particular (see e.g. Nygren 1989) has contributed to defining the islanders as diligent people who lived a modest life in harsh and isolated circumstances close to nature. The archipelago came to represent intact nature, an old-fashioned way of living, and freetime experiences, and the natural esthetics of the archipelago was placed on a par with the fascination of Lappish nature (Huuhtanen 1983).

The image of the archipelago has supported the concept of the modesty of the archipelagian culture and its submission to the harsh circumstances even in the learned interpretations concerning the past. This accounts, at least partly, for the idea of the archipelago as a many-thousand-year-old wild and desolate region. Kenneth Gustavsson has paid attention of the description of the medieval monastery of Kökar in the archipelago of Åland by Reinhold Hausen, the State Antiquarian (1850–1942): it was

> (…) a poor convent on a few out-of-the-way and almost forgotten islands where the main task of the brothers was to pacify the wild islanders" (Gustavsson 1994: 494).

Contrary to Hausen's image, the historical records of Åland indicate that the inhabitants of Åland and the archipelago of Åboland maintained active trade contacts with Stockholm as early as the 16th century; the fishermen took the main surplus of their catch to be sold there (Friberg 1983; see also Kerkkonen 1978 and Orrman 1991 a: 262–264). Nor can the peasants or fishermen of later days be described as isolated or wild

(Villstrand 1993). The socio-economic recession of the archipelago, the emigration of the population, and the change from a central production area into the present-day economic and social periphery began only in the early 20th century, largely as a consequence of the economic crisis of coastal fishing. The adverse development has continued until recently (e.g. Vainio 1981; Eklund 1994; Andersson 1998).

9.2.3 Critical Comments on the Periphery Hypothesis

The empirical props of the periphery hypothesis – the image of the archipelago as a remote and desolate wilderness – were the comparison of frequencies of artefacts in Åboland with those of the mainland coast of South-Western Finland on one hand and the absence of Iron-Age burials in the archipelago on the other hand. The severe natural conditions in the archipelago, and the insecurity caused by the political contradiction between the east and the west were regarded as responsible for these phenomena; the political contradiction led often to dangerous or unstable circumstances, particularly in the Viking Age. Another alternative was provided by Kivikoski's notion according to which the absence of finds was only seeming: in the Viking Age and in the period of Crusades, the archipelago was inhabited by a Christian Swedish population which, due to its burial customs without artefacts, was archaeologically invisible (see chapter 2).

The comparison between find frequencies involved certain questionable traits since the field archaeological research situations in the regions to be compared were not comparable. In the south-western part of the Finnish mainland, more than 600 Iron Age sites have been excavated during the past 100 years. In particular, the parishes of Laitila, Kalanti, and the region of Turku have been well represented when the sites for excavation have been chosen. The focal point has been directed into investigations of graves and cemeteries, particularly into Iron Age cremations, inhumations and burial mounds. This obviously reflects the interests of many scholars of the first half of the 20th century, particularly those of Helmer Salmo, Alfred Hackman, A.M. Tallgren, and Ella Kivikoski (see Vuorinen 2000 b). Of course, the construction of houses and roads has directed where the rescue excavations were located, too.

In the early 20th century and long after the Second World War, Åboland was disregarded in the field archaeological activity. Despite certain commentary statements (Cleve 1941), no field archaeological investigations were launched which might have brought any further elucidation on the periphery hypothesis. The results of the comparisons between the find frequencies in the archipelago and on the mainland were thus as arbitrary as the choice of the regions to be compared.

What then was the reason for Åboland being disregarded in field archaeology? Salo is probably quite right in accentuating the sparseness of antiquarian and research resources and the cumbersome accessibility of archaeological remains in the archipelago (Salo 1990 c). Another factor must have been the unimportance of the archipelago for the construction of Finnish national prehistory as well as the socioeconomic peripheralization of the archipelago in the 20th century: the archipelago was seen as a region of prehistorically little significance which had, besides, been under the sea water for several millenniums. The rather late launch of construction projects might be a third factor.

Extensive road construction projects during which archaeological remains are often unearthed, started in the archipelago as late as 1945 with the first building phase of the Skärgårdsvägen (”the Archipelagian Road”); previously the traffic communications were provided by steamships and ferryboats (Vikström 1994; Westerlund 2000). Thousands of summer cottages have been built in the archipelago since the 1960s (e.g. Andersson 1999) but they are mostly located close to the shores, and therefore these building projects have not affected archaeological remains to the same extent as on the mainland.

The second prop of the periphery hypothesis was the empirical generalization which had ensued as a consequence of the excavation projects on the coast: the cairns were an explicitly Bronze-Age form of burial rituals, which vanished gradually in Finland Proper to be substituted by other forms of graves or cemeteries in the Iron Age. The fact that the cairns are (so far) the only Metal-Age type of burial form found in the archipelago, would, according to this conception, demonstrate that no burials took place in the archipelago during the Iron Age. While several cairns were obviously from the Iron Age (see e.g. Cleve 1948), the investigators resorted willingly to regarding them as indications of alien people, as sporadic sailors' graves which had been left there by Vikings. This was a forced conceptual construction presented for lack of anything better because nothing suggests that the Iron-Age cairns should be alien or sporadic in this milieu; on the contrary, their morphology and choice of site indicate a continuity of the cairn tradition and a knowledge of local circumstances. The threat induced by Vikings in Åboland – irrespective of its imminence – does not account for the desolation of the archipelago, unlike the coast of the mainland, more than 1000 years before the Vikings, and its remaining desolate. On the other hand, there is no evidence of any Christian mortuary ritual without artefacts, if the excavated cairns with no artefact finds cannot be regarded as such.

In the light of the present-day evidence, it is not easy to find any ecological reasons for why the natural conditions in the archipelago should have been so harsh that – as suggested by Tallgren – Stone-Age and Bronze-Age fishermen, hunters or peasants could not have made their living in the archipelago (Tallgren 1931 a; Tallgren 1931 b). One of the main advantages of the archipelago is the geodiversity of the mosaic of land and sea. Olavi Granö and Markku Roto described in the 1980s the variation of the number of islands and the length of the shoreline in squares of 25 km² (5 x 5 km²) on the coast of Finland (Granö *et al*. 1986). According to their report the number of islands was more than 100, and the shoreline was longer than 75 km for every 25 square kms in many parts of the southwestern archipelago. The total length of the shoreline in the archipelago of Åboland is almost a third of the total length of the whole shoreline in Finland (Granö & Roto 1991). Due to land uplift the islands are no more the same as in the Bronze Age and the Iron Age, but a study of earlier land uplift phases (figures 61 and 62) demonstrates that the mosaic of land and sea in the archipelago was principally as kaleidoscopic in the prehistoric period as it is today. The great topographic diversity of the archipelago infers a number of islands of varying shapes and sizes, inlets, capes, straits, and stretches of open sea with varying animal and plant habitats within a relatively small area. The most specific traits of the archipelago include small vegetational patterns, conspicuous contrasts, and numerous ecotones:

The distance from the open shoreline to the dark interior of the woods is short, yet the wood is overshadowed in turn by a bare rock outcrop supporting windblown downy birch" (Lindgren 2000: 14).

Easily crossed waterways which, at least partly, were sheltered by the archipelago connected the land and the sea with each other. Consequently,the topographic diversity of nature must have provided good possibilities for fishing, hunting, seal hunting, fowling, and foraging. The Neolithic settlement of the archipelago of Åland was obviously based on maritime resources and their seasonal availability. The most essential natural resource that the Stone-Age population of the archipelago lacked, in comparison with the mainland residents, was the rapids abounding with salmon (Núñez 1986; Núñez 1991; Núñez 1994; Núñez 1996; Väkeväinen 1982).

The many small dales filled with fine-grained sediments and the meadows developing on gently sloping shores provided also potential soil for small-scale agriculture and cattle-breeding for the inhabitants of the archipelago. The clay in the archipelago belongs to the light Litorina clay-type in southwestern Finland, and tilling this soil was possible also with light implements (Orrman 1991 a: 200–201; Orrman 1991 b). The investigations conducted by Birgitta Roeck Hansen and Aino Nissinaho in Laitila, in South-West Finland demonstrate the small size of Iron-Age cultivations (Roeck Hansen & Nissinaho 1995). It is therefore difficult to vindicate the notion presented by Nikander suggesting that the tillable land areas on the island of Kimitoön should have been insufficient to Iron-Age peasants (Nikander 1942: 30–31).

9.2.4 Archaeological Evidence of Iron-Age Settlement

The archaeological material discussed above contains two aspects which are not easily compatible with the periphery hypothesis: on one hand the Iron-Age cemeteries and individual graves in the archipelago, and on the other hand the conservatism and the continuity which are characteristic of the morphology of the cairns, as well as of the location and the spatial references of the grave sites.

The graves on the islands of Stora Ängeskär and Långfuruholm in Dragsfjärd (060, 063) were, for a long time the only reported cairns in Åboland which had been assuredly constructed after the Bronze Age, the former in the Viking Age, and the latter in the Late Iron Age (or the Middle Ages?). Subsequently, a number of cairns have been discovered in their vicinity in the archipelago of Dragsfjärd; their small size and low-lying location resemble those of the graves at Stora Ängeskär and Långfuruholm, with which they seem to be of roughly the same age. The cemetery at Furunabb, Houtskär, consisting of 12 cairns, was dated back to the middle of the Iron Age in the investigations of the National Board of Antiquities. The graves at Sundbergen, Nagu must have been constructed in the Late Iron Age although their location on a high rock with a wide viewshed is very similar to the description presented in textbooks traditionally to the exalted sites of Bronze-Age "stoves of beasts". The distribution of the shore zone datings of grave sites (figure 57) indicates that 58 burial sites in Åboland are located so low that they were below sea level or in the shore zone during the Bronze Age. Consequently, 15 per cent of the graves in Åboland must logically date back to the Iron Age, and the burial sites at Sundbergen indicate that although some graves were constructed in a terrain which had emerged out of the sea in the Bronze Age, they are to be dated back to the Iron Age. The distribution of the shore zone datings did not reveal any such interruption or discontinuity which might be expected if the archipelago had remained for 15 centuries a desolate wilderness where only fishermen and hunters from the mainland coast moved very rarely during the hunting and fishing season.

Iron Age cairns are particularly abundant in the outer archipelago zone that still constituted a skerry zone for one or two millennia ago. It seems that all cairns in the so-called area of combined activities of the Southwestern Archipelago National Park date back to that period. The total area of the area of combined activities is 3000 km², the land covering 150 km² of the total area. The mean density of burial cairns is thus 0.25 cairns per square kilometer (for even higher figures see Tuovinen 1985: 34–45). Judging from the statistics given by Juha-Matti Vuorinen the mean density of burial cairns in the northern part of Finland Proper – one of the best known areas in Finland due to many field archaeological projects during the 20th century – is 0.19/km². Because Vuorinen's statistics include both Bronze Age and Iron Age cairns, the difference of densities must have been considerably greater than the difference implied by the statistics above. The greater density of Iron Age cairns in the outer archipelago zone is furthermore emphasized by the fact that the land uplift has increased considerably the total land area of the archipelago since the prehistoric period while the process has affected the mainland coast only in regions where there are seashores. The major original difference has been partly evened by the differential increase of land area. The gradient of burial cairns from the mainland coast to the outer archipelago is thus not only a stochastic time gradient, but it is probably also a gradient of density of cairns.

When tracing the characteristics of the graves in Group *P* and in Group *R* we paid attention to the morphological and spatial differences between the two groups but, simultaneously, it became evident that apart from the differences, there was an obvious continuity between them. The very appearance of the grave, a simple, externally structureless heap of stones was similar in the two groups. Although cairns have been categorized by archaeologists, and although their variation has been frequently described, the external substance of the cairn is, nevertheless, monotonously uniform, and accentuates, in its own way, the reiteration of the mortuary ritual. On an average, the graves in Group *P* are larger than those in Group *R* but it is not quite clear whether they were larger even at the time of their construction, or whether they have grown in size gradually due to later interments and subsequent addition of stones. Being older than the graves in Group *R*, they have had time to grow in size, too.

There are differences between the graves belonging to Group *P* and to Group *R* concerning the differences of height in the surroundings of the grave sites; the grave sites in Group *P* are located in a terrain with great differences of height. Great differences of elevation may naturally be considered to be results of a cultural choice but, at the same time, they are linked with land uplift. When the surface of the peneplane emerged out of the sea after the Ice Age, the highest tops of rocks turned into the first islands, and the dales and plains filled with fine-grained sediments were the last to dry up. The oldest areas of dry land are thus characterized by a sharp relief while the relief of the youngest areas is gently sloping. If graves of various ages are found in a landscape of land uplift, the oldest tend to be located in the areas with a sharp relief, and the youngest in those with a gently sloping relief. Consequently, the most significant differences characterizing the graves in Group *P* and in Group *R* have a context both to the prehistorical mortuary ritual and to the passing of time. The differences and the similarities are thus intertwined.

The similarity of the graves in Group *P* and in Group *R* is demonstrated by the fact that, on an average, there are no great differences in the ratio of the elevation of grave sites and the surrounding topography although local variation in one direction or the other is perceptible. In the Iron Age, the graves were constructed at elevated sites in the same way as in the Bronze Age. There are no conspicuous differences, either, in the location of the cairns in reference to the other cairns and cairn cemeteries in the vicinity. In the Iron Age, new graves were still constructed preferably beside old ones, as before, or at traditional sites resembling those of old graves, as demonstrated by the graves on the island of Nötö in Nagu and at Hyppeis in Houtskär. Frequently, for instance at Lillandet in Nagu and on the island of Kimitoön, the graves of the two groups are located within sight from each other, even closer. The memory of Bronze-Age graves, their significance for the constructors, seems to have been preserved until the Iron Age. Other traits, which the graves of the two groups have in common, are: the slope of the terrain at the grave site and the dissection of the landscape surrounding the grave site.

In the Iron Age, maritime sites were selected as grave sites, as it had been done in the Bronze Age. The viewsheds from these were, however, even more maritime than in the Bronze Age, contrary to what might be thought on account of land uplift. This is explained by the fact that in course of the gradual emergence of the archipelago out of the sea, cairns were constructed step by step further and further out in the archipelago with the rise of new islands and their growing size. The spatial references of the grave sites were systematic: the same regions were included in the viewsheds from several grave sites, or the viewsheds contained similar elements of landscape. The spatial references showed in certain cases great precision: the grave sites in the southwestern part of Houtskär, for instance, were selected so that the same water areas, two stretches of open sea, called the Hästö fjärden and the Svinö fjärden, were visible from several individual grave sites. According to my opinion, the systematism of spatial references derives from *local knowledge of nature* and from the traditional system of significances concerning natural places. Thus, the cairns and the grave sites in Åboland do not imply an interruption of the tradition but indicate continuity from the Bronze Age to the Iron Age and beyond.

Other investigations conducted in Åboland are in accord with this. The finds associated with the dwelling site and the trading place at Kyrksundet, Dragsfjärd, date mainly back to the 10^{th} and the 11^{th} centuries, and according to Torsten Edgren the site has at that time been inhabited all year round (Edgren 1995 a; Edgren 1995 b; Edgren 1996; Edgren 1997 b; Edgren 1999 b: 7–18). Other indicators of settlement are the dwelling sites on the island of Kimitoön from the Early Iron Age (Asplund 1997 a), and the hillfort on the island of Borgholm in Iniö, which has been possibly used in the Late Iron Age (Tuovinen *et al*. 1992).

9.2.5 Pollen Analyses

The vegetation period in the archipelago begins early in spring when the snow melts and the earth warms up. Severe frosts are virtually non-existent during the vegetation period. The frostless period is the longest in the country: it lasts about six months (Solantie 1987; Solantie 1990). Even if the numerical values of the climatic parameters during the early phases of agriculture – during the subboreal and the subatlantic chronozones (Mangerud *et al*. 1974) – had not been the same as today, the more favourable climate in the archipelago in comparison with that on the mainland, was probably a significant factor in prehistorical agriculture which had to accommodate to extreme northern circumstances (Zvelebil & Rowley-Conwy 1986). The pollen analyses conducted by Irmeli Vuorela revealed in Åboland *Cerealia* occurrences which belong to the oldest in the country (Vuorela 1991 b; Vuorela & Hicks 1995; Vuorela 1999). Magnus Fries discovered indications of Bronze-Age agriculture on Åland islands as early as the early 1960s (Fries 1961) but, at that time, they were apparently without any cause considered questionable (Irmeli Vuorela, pers.comm.).

The earliest indication of primitive agriculture in the present-day archipelago has been discovered in a sample obtained from the bog of Lalaxkärret in Nagu. The radiocarbon date of the absolute *Cerealia* limit of the sample is 3600 ± 90 uncal BP, calibrated (Stuiver & Reimer 1993) 2110 – (1960) – 1880 BC. In archaeological chronology the date refers to the Neolithic culture of Kiukais[110]; it is one of the oldest traces of agriculture in Finland. The pollen curve shows also possible indications of cultivation in about 2600 BP. Due to peat harvesting there is a gap of 2000 years in the history of the surface layer of the swamp, and therefore the pollen material could not be investigated continuously until the present day (Vuorela 1991 a; Vuorela 1991 b).

Vuorela has discovered almost equally old evidence of Stone-Age cultivation in the swamp of Isokärret in Kimito: the date of the absolute *Cerealia* limit is 3360 ± 100 uncal BP (cal 1770 – (1660) – 1540 BC). Agriculture stabilized in about 2400 BP (empiric *Cerealia* limit), and to judge from its indications, it was probably slash-and-burn-cultivation. The cultivation of rye started in the Viking Age in about 900 AD, which is shown by the sharp increase in the *Cerealia* pollen frequencies (rational *Cerealia* limit). At the same time, permanent field cultivation was introduced, and the sample bears also evidence of a simultaneous change in the flora as a result of pasturage (Asplund & Vuorela 1989; Vuorela 1990; Vuorela 1991 a).

At Mossdalen, Kimito, the earliest indications of woodland clearings in the pollen samples from the Bronze Age, ca 3000 BP (Vuorela 1991 b), suggest slash-and-burn-cultivation. Also the absolute *Cerealia* limit (2530 ± 110 uncal BP) dates back to the Bronze Age, approximately 780 BC (Asplund & Vuorela 1989).

The curves of pollen samples collected from the swamp of Mossen in Korpo reveal indications of woodland clearing more than 2000 years ago. The age of the absolute *Cerealia* limit is 1990 ± 90 BP, calibrated 110 BC – (4) – 100 AD. The Iron-Age cultivation in the surroundings of the swamp has apparently not been continuous, even if

110.At the Late Neolithic dwelling site of Kotirinne (Niuskala), Turku, a cereal grain was found in the 1980s (Vuorela & Lempiäinen 1988). Today the site is located on the mainland (thus outside the research area of the present study), but during the Kiukais culture it was surrounded by an inner archipelago landscape.

the pollen material suggests two more intense periods of cultivation during the Iron Age. In about 600 BP, i.e. about 1400 AD, effective agricultural activity was started in the surroundings of the bog, the deciduous trees were cut down, and the terrain was cleared for cultivation (Vuorela 1991 a; Vuorela 1991 b).

Thus, the pollen stratigraphy demonstrates that the sporadic phase of agriculture which is represented by slash-and-burn-cultivation from the Kiukais culture to the Pre-Roman Iron Age, is followed by increased area of cultivation and more intensive human impact on the flora in the Early Iron Age. Eventually the cultivation of rye gains ground in the Late Iron Age and the Middle Ages. The final transition to field cultivation takes place at the same time. The complete picture is, however, still rather inaccurate due to the small number of investigations. The inaccuracy is caused, among other things, by the sparse pollen production of the oldest crops, barley and wheat (Vuorela 1991 b: 130–131).

9.2.6 Onomastic studies

The mother tongue of the majority of the present-day population of Åboland is Swedish. The population descends from Central Sweden, and they carried out the colonization of the archipelago which according to most researchers took place in the 12th century. The place name material of the region consists of many ingredients which represent contacts between Swedish and Finnish. The recent investigations concerning place names in Åboland include an extensive mapping work and interpretations of place names, they determine the various name strata and their reciprocal age relationships. This allows a comparison of onomastic and archaeological results with each other although the temporally remote linguistic and material cultural ingredients are not entirely compatible.

The oldest stratum of the name material in Åboland is represented by the names of Finnish origin which have then been borrowed into Swedish, and simultaneously adopted a phonetic structure to suit the Swedish language. Approximately 1000 place names of the total of 40000 in the region are originally Finnish. Ritva Liisa Pitkänen divides the names into three age strata (Pitkänen 1990):

1. Half of the loan-names originate from the time of colonization and the preceding centuries. These names include e.g. *Kvivlax* < **Kuivalahti*, 'dry cove'.
2. A number of names originate from the beginning of the first millennium (e.g. *Lemlax* < **Lemmenlaksi* 'Lempi's cove' (called after a person named Lempi).
3. The oldest names were given during the last millennium BC (e.g. *Rosklax* < **Ruskonlaksi*).

The Finnish names are often associated with islands, coves or sea inlets, capes, or other natural places. When they were borrowed into Swedish, they often became names of settlement, for instance *Hyppeis* (< **Hypöinen*) and *Mossala* (< **Musta-salo*). The Finnish name material includes, apart from names of natural places, also names associated with fishing, cattle-raising, agriculture, villages, houses, rear buildings, smithies, mills, harbours, borders, means of communication, persons, as well as *pyhä*- and *hiisi*-names (Pitkänen 1985). During the Iron Age, *hiisi*-names originally denoted places marked off within inhabited areas. They were associated with positive religious meanings, but after the coming of Christianity they changed to designate beasts (Anttonen 1996: 116–123). Part of the names may descend from the Estonian language. The borrowing of names has, according to Pitkänen, required a permanent and organized co-operation, common interests, and agreements between populations with different mother tongues. An additional prerequisite must have been a bilinguality of a certain degree. Hostile contacts could not have resulted in Finnish names being borrowed into Swedish, the same applies to contacts between settlers from Sweden and Finnish seasonal fishermen (Pitkänen 1985 a: 352–353; Pitkänen 1985 b; Pitkänen 1992). On the other hand, the use of the borrowed names must have been continuous, otherwise they would not have been preserved to the present-day investigators of names (Pitkänen 1990; Zilliacus 1997). The Finnish material of loan-names is thus not in accordance with the notion that the archipelago of Åboland would have been only a usufructuary of travelling fishermen and slash-and-burn cultivators of the Iron Age.

Kurt Zilliacus derives the parish name *Houtskär* from the Finnish name of an island **Hauta-salo* in which the word *hauta* refers to old graves, maybe prehistoric cairns with significance to those who introduced the place name; the word salo refers to a large (wooded) island. According to him, the name reflects the respect shown toward the graves by the bygone generations (Zilliacus 1997). This interpretation opens the opportunity to try to understand the relationship between those who had given the name to the place and the graves, many of which could be very old when the name was given. It means that the graves still involved living significances and interpretations when the parish name *Houtskär* was introduced. Which graves, then, among those which have been preserved until our day, could have been objects of such respect? In the first place probably those which had been constructed at elevated and prominent sites with extensive viewsheds. Such graves are characterized by an elevated site but also by their relatively high position in reference to their adjacent surroundings. Kummelbergen at Björkö, Kummelbergen at Kittuis, Trollberg and Västerskogen at Medelby, Ekholm and Svinö Svälteskär at Hyppeis, and Resberg at Nåtö belong to these graves. The both registered grave sites called Kummelbergen in Houtskär belong thus to this group. Even this aspect, for its part, suggests that ancient graves were noted when giving names to various places.

The Swedish place names do not include name types deriving from the Primitive Germanic language spoken in Scandinavia in the prehistoric period. Therefore the old theory of onomastics, according to which a population speaking a Primitive Germanic language would have lived on the coast of Finland before the Christian era, has been abandoned (Naert 1995: 15–18; Häkkinen 1996: 169–170; Zilliacus 1997). According to the prevailing opinion, the Swedish place names date back to the 12^{th} century, at the earliest.

Also the Swedish material includes place names of various ages. The oldest village names are of the type -*by*, -*böle*, and -*boda* in Kimito, and -*by* in Korpo (Zilliacus 1994: 13–24; 41–46). In his recently published research work, Bertel Fortelius has, however, come to the conclusion that the village names Aspö, Björkö, Kälö, and Brånskär (Brunskär) in the outer archipelago of Korpo, which originally were natural names, are likely to date back to the Iron Age (Fortelius 1999: 437–455).

9.2.7 Summary

The notion that Åboland had been an uninhabited desolate wilderness for 1500 years compelled its advocates to assume specific circumstances and events, which have not been verified empirically. The periphery hypothesis has relied on implicit conceptions, which may have been formulated on somebody's writing desk, of the isolated and harsh natural conditions in the archipelago. This has resulted in indiscriminate interpretations, and the notion retained its vitality because no field investigations which would have thrown light on the hypothesis were started for decades. The problem has remained: was there a gap in the settlement or is there a gap in the field archaeological studies and evidence of the settlement? The morphological conservativity of the cairns, the relative locations of the graves, the local knowledge revealed by the spatial references of the grave sites, and the datings of the graves indicate, however, a continuity from the Bronze Age to the Iron Age and beyond. The results of other field archaeological investigations, of pollen analyses, and of the onomastic studies are in accordance with this. Of course, these arguments are not adequate to create a consistent and complete image of the Iron-Age settlement in Åboland, its character and sources of livelihood, but they do give sufficient evidence to justify the abandonment of the hypothesis concerning the peripheral nature of the archipelago.

9.3 Cairns: a Coastal Archaeology View

There are presumably approximately 10000 cairns on the coast of Finland (Salo *et al.* 1992: 6)[111]. Quite a few of those date from the Bronze Age, but in a large part of the coast the cairn remained the most common type of burial far in the Iron Age. According to C.F. Meinander, there are cairns in all coastal elevation zones in southern Ostrobothnia, which provides firm evidence of the continuity of settlement from the Bronze Age to the Pre-Roman Iron Age. In the Nordic countries cairns have been in the Early Iron Age more predominant in Ostrobothnia than anywhere else, which, according to Meinander, indicates an independent tradition in the region (Meinander 1977: 23).

The distributions of the grave site elevations in Middle Ostrobothnia, collected by Ari Siiriäinen, demonstrate that the Bronze-Age burial cairns are located higher up in the terrain than those from the Iron Age, and that there are graves which have been constructed after the Iron Age (Siiriäinen 1978).

Also on the coast of Satakunta the tradition of cairns continued until the Iron Age, at least until the Late Roman Iron Age but after that the finds are sparse (Salo 1970). So far, it has been possible to date only four graves in the Viking Age (Räty 1992).

In the coastal regions of South-West Finland, more than 1000 cairns have been reported, and less than 100 of these have been excavated (Salo *et al.* 1992). In the valley of the River Aura which has been scrutinized in the most minute detail, the cairns indicate

111.This figure does not include the cairns in Åland nor the cairns in the Finnish inland, the so-called Lappish cairns. According to Jussi-Pekka Taavitsainen such cairns indicate the settlement of inland regions in the Bronze Age and the Iron Age (Taavitsainen 1994).

a continuity of settlement from the Bronze Age until the Pre-Roman Iron Age, and there are some registered cairns from the Migration Period. Reliable datings are, however, rather sparse. Juha-Matti Vuorinen has observed that there is a size gradient for the cairns from the inland towards the coast so that the inland graves in Laitila, for instance, are, on an average, larger than those in Kalanti which is closer to the coast; correspondingly the graves in Mynämäki are, on an average, larger than those in Mietoinen (Vuorinen 2000 c: 181). This is a distinct suggestion of the fact that the construction of graves has kept along the receding shoreline (due to land uplift), and that the inland graves are thus, on an average, older than those on the coast. The direction of the age gradient is thus logical, and in accordance with that in the archipelago.

During the Iron Age new grave and cemetery types were established in South-West Finland, such as the cemetery types of Kärsämäki and Untamala, *tarand* graves, cremation cemeteries under level ground, and inhumation cemeteries (eg. Salo 1995). During the Iron Age the great frequency of graves and cemeteries becomes a prominent feature of the agrarian regions on the mainland coast of South-West Finland in reference to the other provinces of the Finnish mainland; other characteristic features include the diversity of grave types, and the long-term usage of the cemeteries (Seger 1982 b; Seger 1984). According to Kaisa Lehtonen, there is a tendency in the river Aurajoki valley towards a more uniform burial practice in the Late Iron Age, but otherwise her results support the general notion concerning the frequency and period of use of the cemeteries (Lehtonen 2000).

The many cairns on the mainland of Åland date back to the Bronze Age and the Early Iron Age. There is, however, no clear-cut line between a burial cairn and a burial mound from the Late Iron Age on Åland (e.g. Kivikoski 1963); at frequent sites the two grave types seem, at least partly, to have coexisted in the Late Iron Age. It is not very probable, either, that the difference between the grave types should imply a discontinuity of settlement (Edgren 1983; Edgren 1984).

In the archipelago of Åland cairns are relatively sparse (Karlsson 1990). Thorough studies by Kenneth Gustavsson have demonstrated that the settlement at Otterböte in Kökar dates back to the Bronze Age (approximately 1000 BC), and served as a winter dwelling site where seal hunters from the southern coast of the Baltic, today's Poland, spent some months waiting for the beginning of the hunting season. It is worth noting that so far only one cairn has been discovered in Kökar although the investigations in the region have been fairly thorough. The grave dates back to the Late Iron Age (Gustavsson 1997).

On the western coast of Finland the tradition of the Bronze-Age grave type seems to have continued with unabated strength even in the Iron Age. In South-West Finland the tradition receded in an early phase, the ancient grave type was substituted by various diversified and partly successive grave and cemetery types. In the archipelago of Åboland the tradition of cairns continued with little change in the Iron Age. On the mainland of Åland the burial ritual changed from the old cairn structure into a mound, often with various internal structures. Further north on the coasts of Satakunta and Southern Ostrobothnia the cairns became rare in the Iron Age, and apparently they were not substituted by other grave types to the same extent as in South-West Finland. Thus the tradition of cairns changed or was substituted principally in South-West Finland and on the mainland of Åland; the expansion of agrarian economy in the Iron-Age is another common feature with the two regions. This again raises the question whether the continuity of the cairn tradition from the Bronze age to the Iron Age was associated with the subsistence strategies of the coastal population. Is it possible to associate cairns with maritime settlement?

In Finland, shore displacement was the most rapid on the western coast. The grave sites have risen high above the present-day sea level but along the coast the occurrence of cairns follows mainly, however, the elevation zones of the shores in the Early Metal Age (Okkonen 1998; Siiriäinen 1978; Meinander 1977; Meinander 1954 a; Salo 1981 b; Salo *et al*. 1992). In Ostrobothnia and Satakunta where the peneplane is flat, and where there are few islands off the coast, the occurrence of the cairns follows the coast like a string of pearls. In the regions with an archipelago, as in Åboland, the occurrence of cairns dissolves into a zone covering the width of the archipelago. The inland location of several cairns is only seeming: the cairns in Perniö in South-West Finland seem to have been built in the inland but in the Bronze Age the sea reached the valleys of the River Perniönjoki and the River Asteljoki as deep fjords, and most of the cairns were located on their banks (Kallberg 1991: map 2).

With the land uplift new islands emerged out of the sea outer and outer in the archipelago. The islands grew in size, and new graves were built on them. This is how the stochastic age gradient of the graves developed into what it is in the present-day landscape from the mainland coast to the outer archipelago: the Bronze-Age graves (Group *P*) are located in the inner and the middle zone, while the Iron-Age graves (Group *R*) are in the middle and the outer zone, occasionally close to the skerry zone. Figure 76 displays on a map all the ”classical” Iron-Age graves and cemeteries in South-West Finland[112]: mounds and mound cemeteries (89), intermediate forms between cairns and mounds (273), inhumations and inhumation cemeteries (41), cremation cemeteries (142), stone constructions above the ground other than cairns (*tarand* graves, graves indicated with an upright stone (29), miscellaneous, indeterminable graves (49), totalling 623 cemeteries and individual graves. A comparison with the distribution of cairns in South-West Finland (figure 77) seems to reveal a two-way process in burial rituals: (1) in the Bronze Age the graves were constructed mostly on the mainland coast or the large mainland-like islands close to the coast, and (2) in the Iron Age the cairns were built in different parts of the archipelago, but most typically in the middle and the outer zones, and at the same time the classical grave and cemetery types of the Iron Age began to be established on the mainland and in mainland-like regions at some distance from the shore.

112.This information is based on the data base TYARKTIKA (Salo *et al*. 1992; Vuorinen 2000 a).

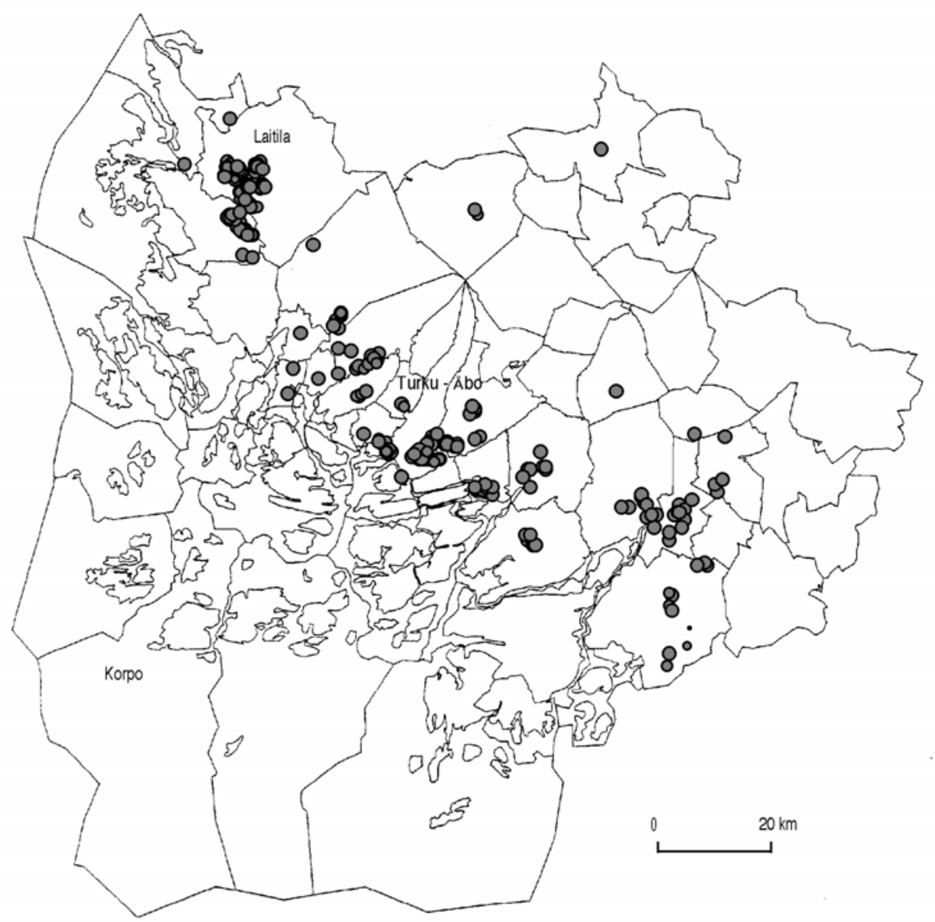

Fig. 75. The Iron-Age graves and cemeteries of classical types in Finland Proper (SW Finland) (*n* = 623).

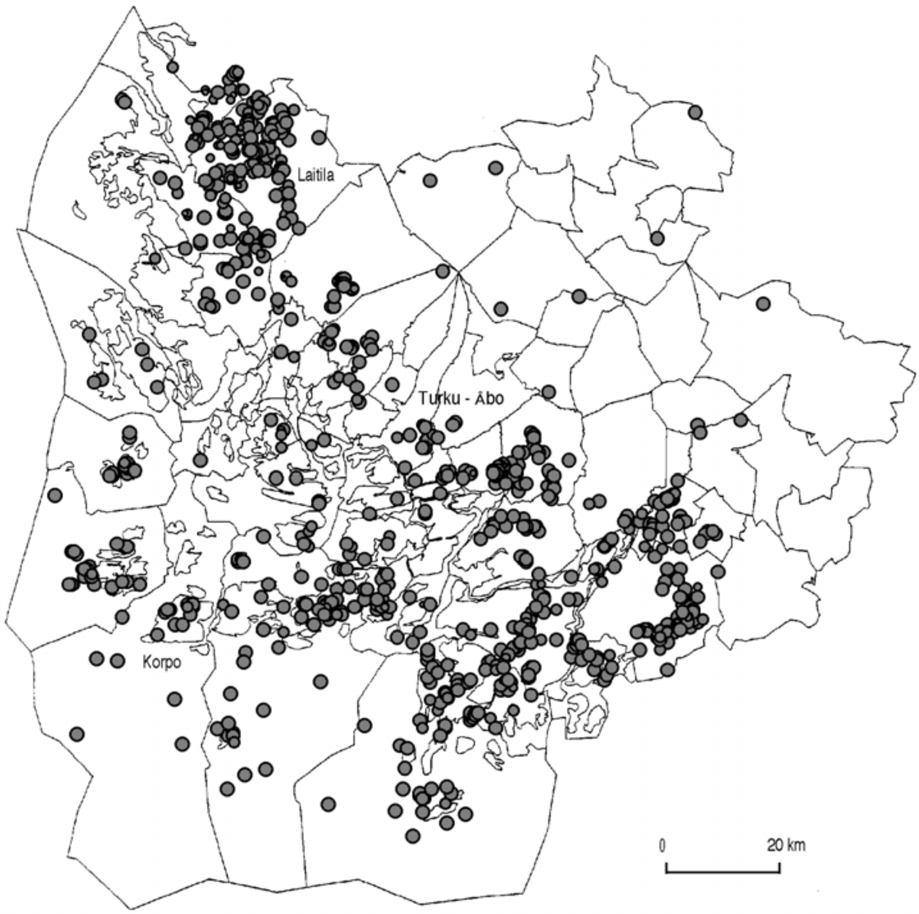

Fig. 76. The cairns in Finland Proper (SW Finland) (*n* = 1627).

Naturally, the procedure of shaping the spreading process involves also a source of error: the cognizance of the chronology of the cairns on the mainland coast, and, as a consequence, also of their location in reference to the ancient phases of the sea shore is defective. In this phase of research, the interpretation which seems the most recommendable to me, is the following: the burial cairns represent the Bronze-Age population who based their subsistence mainly on the versatile natural resources of the archipelago (including arable land), and the Iron-Age population who pursued the Bronze-Age strategies of subsistence. The classical grave and cemetery types of the Iron Age represent a population whose way of living was associated with the mainland rather than the archipelago, and whose subsistence was based on the options provided by specialized cattle-raising and agriculture.

The Bronze-Age graves were, in my opinion, built by a population who pursued the slash-and-burn type of agriculture adopted during the culture of Kiukais, and for whom fishing, seal hunting, fowling, and other maritime sources of livelihood were of great significance. The islanders of the Bronze Age exploited the opportunities provided by their topographically versatile and small-featured environment in their subsistence strategies. In their religious thinking the earth possessed significances which made them construct the graves at maritime sites from where one could see extensive areas of land. This might have something to do with a symbolically presented and desired yield of land and cattle rather than with an actual success within a source of livelihood which had barely been initiated in the circumstances of the northern Baltic and involved great risks of failure of crops. The stone and wooden tools of the Bronze Age made small-scale agriculture, presumably slash-and-burn-cultivation, feasible, but it was impossible to resort to agriculture alone. The sea was of great importance, firstly, since it offered several sources of livelihood giving thus security, and secondly, because of the maritime climate which provided the best possible prerequisites for agriculture. The Bronze-Age islanders of the south-western archipelago of Finland observed thus, in their own way, the same strategy of low productivity and minimized risks as the Bronze-Age populations in many other parts of northeastern Europe (Zvelebil 1985).

The Iron-Age islanders of the archipelago pursued the burial ritual initiated in the Bronze Age; the graves were, however, not as large as before – or there were fewer reinterments than previously –, and the grave sites were selected in the landscape so that the viewsheds from them were turned towards the sea. During the Iron Age the constructors of the graves found their way also to the outer isles and skerries, which naturally evokes an image of the great significance of fishing, seal hunting, and fowling. The pollen analyses refer, however, to the stabilization of agriculture towards the end of the Iron Age, at least in the inner and the middle archipelago zones. The multifaceted economy of the Bronze Age seems thus to have continued in the archipelago which offered good natural conditions to that activity. The continuity of the burial ritual was associated with the continuity of subsistence strategies. There was no need to change either of those. The Metal-Age subsistence strategy in the archipelago may thus have resembled, to some extent, the annual rotational cycle of the islanders which is well-known from ethnographies; this cycle comprised a seasonal exploitation of natural resources, the rotational interlock of agriculture, cattle raising, fishing of different fish species, seal hunting, fowling, egg collecting, and the use of other natural products. If one of these resources failed, the loss could be compensated for by strengthening the use of other resources (see Storå 1982; Storå 1985).

Further light on the development of the settlement and the economy on the mainland coast in South-West Finland can be thrown if one makes an effort to see these aspects from a coastal archaeology view. The response of the Bronze-Age economy to the risks of agriculture at the extreme climatic limits of the possibilities of cultivation was the multifaceted economy and the avoidance of risks; new and better prerequisites of more extensive cultivation and of getting the best possible profit from it, were opened when the iron tools were introduced in tilling the soil. The use of iron scythes facilitated the gathering of forage on the meadows. The development of mainland settlement and the expansion of agriculture (e.g. Meinander 1980) was a socio-economic change which apparently led also to changes and diversity in burials.

According to Marek Zvelebil the real Neolithic form of economy did not develop in northeastern Europe until the Iron Age on account of the risks involved in agriculture. The agrarian economy was compelled to aim, if possible, at safeguarding productivity in case of possible collapses, and this adaptation included orientations towards cattle raising, slash-and-burn-cultivation, and versatile mixed economy. The trend was, however, distinct: from the earlier unspecialized, local cultivation which aimed at providing indispensable products towards specialized agricultural production and social complexity. The realization of these two things required overproduction and a regional network of goods exchange (Zvelebil 1985). It is quite possible that South-West Finland developed a barter system between the archipelago and the coast to reduce the risks involved in agriculture: the natural products of the archipelago and what was produced by the islanders themselves could be exchanged for the products of the mainland regions which were specialized in agriculture. In this way the agrarian economy of the mainland might have proceeded towards a further specialization in agricultural products and a more effective production of food. The latter aspects can be considered to be the basis of the stabilized settlement (Salo 1995) and the great frequency of cemeteries (Seger 1982 b; Lehtonen 2000) in South-West Finland. This idea might be illustrated by a historical example, the extensive network of contacts between the peasants of the parishes in the archipelago of Åboland and those of the mainland. The islanders transported fish, meat, butter, eggs and firewood to Stockholm, the towns in the region of the lake Mälaren, the coastal parishes of southern Finland, Tallinn, and St Petersburg to be exchanged for grain, salt, hemp, and iron. The fishermen-peasants of the archipelago were dependent on the trade in the centres of population on account of their own petty grain production; on the other hand, the centres of population were equally dependent on the products of the archipelago (Villstrand 1993; Orrman 1991: 262–264; Kerkkonen 1978; Papp 1986; cf. Modéer 1945).

Actually we might have some evidence of a system of exchanging goods between the archipelago and the coast: the dwelling site of Kyrksundet in Dragsfjärd. The finds from this community which was used chiefly from the 9th to the 11th century, consist of artefacts which suggest contacts with the Finnish mainland. There is, for instance, a key-formed pendant with an equivalent at Rapola, Valkeakoski in Häme (a province in Finland). Most of the artefacts, some of which are Oriental or European coins, indicate, however, contacts with Sweden, Åland or Estonia. Some twenty weights among the finds are obvious indications of trading activity at the site. Torsten Edgren suggests that the trading site at Kyrksundet was established by peasants from Halikko and Perniö who first stayed at the site only seasonally but from the 10th century all the year round. They carried on trade with the Vikings who sailed past the coast (Edgren 1995 a; Edgren 1995 b). There is, however, no need to imagine that participation in the Baltic goods exchange should have excluded the bartering contacts with the mainland, actually the result was just the opposite. If the settlers of Kyrksundet came from Halikko and Perniö, the barter trade with their original home region would seem as natural as the cooperation with the Vikings.

The archipelagean zone of the Finnish coast is the widest in Åboland and Åland. It comprises extensive sheltered areas where the fishing boats need not be as big and heavy as on the open coasts. On the other hand, it was relatively difficult to move in the archipelago due to the numerous underwater shallows, which hampered the exploitation of and the competition for the natural resources by outsiders. Due to land uplift new shoals continued to emerge out of the deep water – naturally at a fairly slow pace. When the commission of goods and products for foreign exchange of goods was being organized in the region around Turku (Pihlman 1985 b), the transportation of the merchandise required the establishment of a local knowledge of navigational circumstances. Although pilots on the Finnish waters were first mentioned in the Middle Ages (Lähteenoja 1947; Öhman 1996), it is quite evident, e.g. according to Henrik Cederlöf; that pilotage had been organized earlier than what is related in written sources (Cederlöf 1989: 15). There is a possible early juncture in the 8th century when new changes developed in the Baltic market. Prior to the 8th century the imported goods consisted of luxury articles and other products, and their price was determined by supply and demand, but also by the mutual social relationships between those who participated in the exchange of goods. From the 8th century onwards, trading became a market-based long-distance commercial activity, and it was no more necessary for the participants in the exchange to have any specific social relationships with each other (Pihlman 1985 b; Näsman 1984: 121–128; Näsman 1991). This century was also a period when the scope of the exchange enlargened to the area of Volga and Kama in Russia (Salo 1982: 11–18). The local knowledge of the islanders has surely been the nearest available solution when solving the problems of pilotage in the archipelago.

9.4 Cairns in Historical Sources?

9.4.1 Långholm

In Finland, cairns dating back to the historical period have been reported from Ostrobothnia and the archipelago of Uusimaa (Siiriäinen 1978; Europaeus 1922). Cairns form the historical period have been registered also on the eastern coast of Sweden, occasionally associated with *tomtning*-remains (Larsson 1984; Hermodsson 1987; Norman 1991; Norman 1993: 93, 158). In the archipelago of Åboland, the shore zone datings for some cairns in the outer archipelago suggest that the grave might date back to the Middle Ages. This is the case concerning, for example the grave at Djupklevudden, Kälö, Korpo (364). It has been constructed on a shore cliff, which today is at the height of 6.4 m above sea level, which corresponds to the shore zone dating 940 ± 160 AD but there is no certainty of medieval origin for any of the graves.

There are, however, two historical sources which may be relevant. One is the great inquiry into the ancient monuments in 1666–1693 which was launched in Sweden-Finland with a royal statute (Baudou & Moen 1995; Cleve 1967; Laakso 1987; Edgren 1995 c). In 1674, the Vicar of the parish of Taivassalo, Petrus A. Bergius dispatched to the King a report on the information he had acquired concerning the ancient remains in his parish. In order to collect that information he convened the peasants of his parish, which at that time comprised also the subordinate parish of Iniö. The letter written by Bergius was published in 1859 by Karl August Bomansson in the following form:

> Men fans intet, som wärdigt är skrifwas; Vthan bönderna wid wårt capell, och Juimo byy, berättade, at på en högh backawägh som Callas borgh holmen, hafwer fordom warit en skanss temligh stoor och wijdh, hwilcken Konungens Krigzfolck i den giordt hafwer, och sedan aff Landzens inbyggiare i siälskap och på en annan holme haart när, i twå jord och sand här begrafne *)
>
> Petrus A. Bergius
>
> Past. et Præp. toefsalensis
>
> *) Meningen häraf är svår att fatta. Utg. anm.

As stated by Bomansson in his footnote, the contents of the text are rather obscure. In the following a suggestion for an English interpretation[113]:

> But there was nothing worth writing about; apart from what the peasants from the village of Jumo in our chapel parish [of Iniö] told: on a high hill, called Borgholmen, there was in ancient times a fairly large and wide earthwork built by the King's warriors, and furthermore, two of the islanders were buried here and on another island nearby, together in earth and sand.

The *borgh holmen* mentioned by Bergius can be recognized as the island of Borgholm in the village of Jumo in Iniö. The shores of the island are walled in by a rampart in nine separate sections. The total length of the sections, which in all probability are the remains of the earthwork mentioned by Bergius, is approximately 450 metres. The lowest point of the rampart is at the height of 8.1 m indicating that the fortified island was not in use before the Viking Age (Tuovinen *et al*. 1992). The rampart which had been constructed in ancient times, as mentioned in the letter written by Bergius, was a dry-stone wall like those of the Iron-Age hillforts, which suggests a dating to the Late Iron Age; building the wall too far from the shore would not have been prudent since that would have given the invaders the opportunity to perform a landing on the shore zone. What is actually more interesting than the age of the hillfort, is the statement that two islanders had been buried together on a nearby island in earth and sand. This description suits best the island of Långholm which is separated from Borgholm by a narrow strait. This island is more sandy and more gravelly than most of the adjacent islands. In the middle of Långholm there is a cairn (102), which has been constructed, very exceptionally, in a terrain of gravel and pebbles.

9.4.2 Långfuruholm

In the cairn of Långfuruholm at Högsåra, Dragsfjärd one could still see in the early 20th century well-preserved parts of a human skeleton between the boulders. This grave, discovered by Volter Högman in 1886, and the apparently late remains of a human skeleton inspired Svante Dahlström to write an animated essay in 1940 (Dahlström 1940). In this essay he deals with a statute in the provincial code of Uppland in Sweden from the

113.My thanks are due to Ulrika Wolf-Knuts and Kurt Zilliacus for the help in interpreting the text. Any possible mistakes are mine.

year 1296. It decreed the procedure to be observed if a member of the crew on a vessel belonging to the Swedish marine military organization, called *ledung*, should be taken ill. If the disease lasted long and was serious, the vessel had to be sailed to a harbour, and the crew should be forbearing, watch and observe the state of the patient. The suspense went on until all the members of the crew agreed about the death of the patient. The deceased had to be taken then to an uninhabited island and buried between stones and turf – *mællum stens ok torfwo*. Only after this did the vessel sail off. The passage of the statute concludes with the statement that if the sailor after all survived, was rescued, and was able to name the vessel and its crew, he was entitled to receive a remuneration of 140 marks as a compensation for being buried. The final clause should be interpreted as a determination of the liability for remuneration, which made the crew consider very carefully the resolution concerning the death of the patient.

But *mællum stens ok torfwo*; Dahlström interpreted this expression as a cairn. The association between the old law text and the cairns is naturally liable to discussion: it might be arbitrary to build a bridge between a medieval provincial code and the grave at Långfuruholm. On the other hand it might be thinkable that the simply and unsophisticatedly described procedure in which the decision concerning death is made in the community around the patient, derives from a prehistorical common tradition in the country. The possibility of the survival of the patient brings forth the unsought reminiscence of the tradition described by cultural anthropologists of treating the patient as deceased and of initiating the mortuary ritual before the biological moment of death; I refer here, for example, to Lauri Honko's description of the burial tradition in Melanesia with the patient as a participant (Honko 1960: 49–50; see also Honko 1981 b: 161–162; Nenola 1985: 185–187). If the death of a sick Skolt was delayed and turned into a difficult process, the death was sometimes hastened by setting a copper pot beside the patient the wrong side up; this upside-down position reflected the principle of inversion in the realm of Death (Storå 1971: 207). It is thus a matter of cultures where the biological moment of death is not regarded as the decisive point of transition from the living to the realm of Death. Bringing the dying member of the community into the category of the deceased is rather a cultural procedure attended to by the community, and the biological death is only one momentary phase in this procedure, though of great importance, to be sure. Maybe this example will remind us of the fact that archaeology provides only a limited means of comprehending the mortuary ritual behind the cairns.

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Appendices

Appendix 1

Sundbergen 1, Nagu. An example of the rebound measurements of boulders lying on the surface of a cairn. The number of the sample (cf. fig.34), the type of rock, the weight of the boulder (m), the statistics for the values of the upper and lower surfaces, the differences d_R of the mean values and the t statistics, the degrees of freedom and the significance levels. The boulders with the greatest rebound value difference where the upper surface values are smaller than the lower surface ones come first, and the boulders with the greatest opposite difference come last. Twenty-nine boulders were measured, the total number of readings, n = 465.

N:o	Rock	m	Upper surface			d_R	Lower surface			t	df	α
			$\bar{x}$	s	n		$\bar{x}$	s	n			
159	Granite	61.5	39.5	11.8	12	-29.6	69.1	2.6	9	-8.41	12.4	0.000
77	Granite	69.0	33.5	6.7	10	-26.6	60.1	7.4	11	-8.61	19.0	0.000
344	Granite	48.0	47.4	5.0	6	-26.1	73.4	4.0	5	-9.68	9.0	0.000
19	Granite	37.5	30.5	4.8	8	-25.8	56.3	5.8	7	-9.38	11.7	0.000
762	Granite	15.0	49.2	5.2	8	-18.2	67.4	4.5	9	-7.73	14.0	0.000
3	Uralite porphyrite	38.0	45.7	6.2	8	-18.1	63.8	3.8	6	-6.74	11.6	0.000
352	Granite	61.0	39.7	4.7	6	-16.9	56.6	9.7	6	-3.84	10	0.003
76	Granite	48.5	46.9	4.7	8	-16.7	63.6	9.6	11	-5.00	15.2	0.000
2	Migmatite	30.5	37.3	5.2	10	-11.2	48.5	10.1	7	-2.68	8.2	0.028
37	Granodiorite	49.5	39.5	5.7	7	-10.0	49.5	14.0	10	-2.03	12.7	0.065
113	Migmatite	45.0	52.6	1.5	7	-9.7	62.3	2.8	6	-7.69	7.4	0.000
131	Granite	58.0	36.2	6.0	8	-8.0	44.2	10.4	9	-1.96	13.0	0.072
4	Granodiorite	21.5	34.1	2.4	6	-7.7	41.8	4.1	6	-4.00	10	0.003
32	Granodiorite	25.0	40.6	6.7	9	-7.3	47.9	3.8	10	-2.89	12.3	0.013
377	Granite	45.0	57.0	8.7	12	-6.5	63.5	5.8	11	-2.13	19.3	0.047
41	Migmatite	20.0	33.8	5.7	8	-6.0	39.8	4.0	9	-2.49	12.4	0.029
18	Migmatite	53.0	37.0	4.5	7	-4.6	41.6	4.9	9	-1.96	13.5	0.071
7	Migmatite	14.5	36.7	3.1	6	-4.1	40.8	0.9	4	-3.08	6.3	0.022
918	Granite	27.0	65.6	5.6	9	-3.8	69.4	4.9	10	-1.58	16.0	0.134
13	Mica gneiss	68.5	48.1	3.3	7	-1.3	49.4	3.0	7	-0.76	12	0.462
17	Migmatite	31.0	58.3	9.9	9	1.0	57.3	8.8	8	0.22	15.0	0.831
1	Granodiorite	64.0	46.4	7.7	8	1.6	44.8	5.5	6	0.45	12.0	0.659
371	Granodiorite	55.5	37.8	5.4	6	3.4	34.4	4.5	6	1.19	10	0.261
8	Granite	27.0	70.7	7.3	6	4.2	66.5	2.4	6	1.35	10	0.208
58	Mica gneiss	36.0	51.0	2.2	8	5.6	45.4	4.7	8	3.04	14	0.009
355	Amphibolite	93.0	49.1	7.6	10	6.2	42.9	6.6	8	1.85	15.8	0.085
40	Mica gneiss	63.5	55.1	4.1	10	15.8	39.3	4.7	12	8.33	19.9	0.000
327	Granite	41.5	68.9	1.4	6	18.6	50.3	7.9	10	7.22	9.9	0.000
33	Granodiorite	29.0	61.4	3.3	7	21.4	40.0	5.0	7	9.37	12	0.000

Appendix 2

Summary of the known interments in Åboland

Burial	Architectural constructions	Burnt human bone MNI	Unburnt human bone MNI	Faunal remains	Artefacts	Excavation by
Labbnäsåsen, Dragsfjärd (012)	Concentric chains(?)	–	–	–	–	Högman 1886
Jordbro, Dragsfjärd (036)	–	–	–	Seal (stratigraphically earlier?)	Pottery(?)	Högman 1886
Långnäsudden, Dragsfjärd (041)	Chain	–	–	Bivalve shell (?)	Dagger	Högman 1886
Rövik, Dragsfjärd	–	–	–	–	–	Högman 1886
Hammarsboda 108, Dragsfjärd (045)	Chain, stone cist?	–	?	–	–	Högman 1886
Nämanön, Dragsfjärd (061)	–	–	–	–	–	Högman 1886
Tjuda, Kimito (129)	Concentric chains	1	–	–	–	Högman 1886
Tjuda, Kimito (130)	Peripheral chain and stone cist	1	–	–	–	Högman 1886
Jättekastberget, Kimito (149)	Chain built as dry-stone wall	–	–	–	–	Högman 1886
Söderviken, Västanfjärd (326)	Four-sided stone frame	–	–	–	–	Högman 1886
Lillskogen, Västanfjärd (328)	–	?	–	–	–	Högman 1886
Lillskogen, Västanfjärd (329)	Concentric chains	–	?	–	–	Högman 1886
Söderby, Dragsfjärd (037)	Peripheral chain	1	–	–	–	Kivikoski 1935
Trollberg, Houtskär (087)	Concentric chains	1	–	–	Quartz scrape and -debris	Erä-Esko 1978
Furunabb, Houtskär (088)	Centrally located boulder	–	–	?	–	Seger 1986
Furunabb Houtskär (091)	Chain?	.	.	.	–	Pykälä-Aho 1981
Furunabb Houtskär (092)	–	–	–	–	Ferrule of iron	Höysniemi 1979
Furunabb Houtskär (093)	Chain, two centrally located boulders	.	.	.	–	Pykälä-Aho 1981
Furunabb Houtskär (094)	–	–	–	–	–	Pykälä-Aho 1981
Furunabb Houtskär (095)	–	.	.	.	–	Pykälä-Aho 1981
Furunabb Houtskär (096)	–	–	–	–	–	Pykälä-Aho 1981
Furunabb Houtskär (097)	–	–	–	–	–	Pykälä-Aho 1981
Jordbro, Dragsfjärd	–	1	–	–	–	–
Rosendal, Dragsfjärd	–	1	–	–	–	–
Långfuruholm, Dragsfjärd (060)	Stone cist	–	1	–	–	–
Stora Ängeskär, Dragsfjärd (063)	–	–	–	–	Grinder pendant	–
Sundbergen 1, Nagu (258)	–	1	–	Bird, rodent, roe deer/deer, fish	Comb of antler	Tuovinen 1988
Sundbergen 2, Nagu (259)	–	–	1	Cattle, pig, goat/sheep, bird, cat, rodent, fish	Iron rivets and nails	Tuovinen 1988
Lila Kuusis, Nagu (245)	–	–	–	–	–	Tuovinen 1988
Östergård, Dragsfjärd (054)	–	–	–	–	–	Tuovinen 1990
Ängesnäs bergen, Nagu (217)	–	–	–	–	–	Tuovinen 1993

Appendix 3

The numbers of the carns, the municipalities, the names of the burial sites, the locations of the burial cairns (Basic Map numbers, coordinates in the Finnish National Grid Coordinate System kkj (see Niemelä 1984), and WGS-84 coordinates), the groupings in the discriminant analysis, and the posterior probabilities p for belonging to group R (the posterior probability for belonging to group P is 1-p).

Groups:
N = Non-dated
P = Group *P*
R = Group *R*

No.	Municipality	Place-name	Map	kkj x	kkj y	WGS84 *x*	WGS84 *y*	Group	p
001	Dragsfjärd	Genböle	103414	6664740	1583460	6664591	1583274	N	0.08
002	Dragsfjärd	Kosackkullan	103413	6658940	1580320	6658791	1580134	N	0.10
003	Dragsfjärd	Kosackkullan	103413	6658910	1580330	6658761	1580144	N	.
004	Dragsfjärd	Stora Ängeskär	103312	6642920	1579520	6642771	1579334	N	1.00
005	Dragsfjärd	Stora Ängeskär	103312	6643010	1579500	6642861	1579314	R	0.73
006	Dragsfjärd	Nämanön	103410	6652090	1575560	6651941	1575374	N	0.92
007	Dragsfjärd	Falkön	103411	6669530	1577210	6669381	1577024	N	0.36
008	Dragsfjärd	Västersjälsmalmen	103411	6663940	1578150	6663791	1577964	N	0.99
009	Dragsfjärd	Långnäs	103414	6661540	1581990	6661391	1581804	N	0.34
010	Dragsfjärd	Storö	103411	6667800	1577440	6667651	1577254	N	0.90
011	Dragsfjärd	Malmisberget	103414	6663820	1583190	6663671	1583004	N	0.36
012	Dragsfjärd	Labbnäsåsen	201214	6662930	2416560	6662785	1583421	N	0.00
013	Dragsfjärd	Rosendal	201202	6668300	2421780	6668159	2421603	N	0.01
014	Dragsfjärd	Rosendal	201202	6668600	2421970	6668459	2421793	N	0.69
015	Dragsfjärd	Rosendal	201202	6668720	2422110	6668579	2421933	N	0.59
016	Dragsfjärd	Genböle	201214	6664720	2418140	6664579	2417963	N	.
017	Dragsfjärd	Västersjälsmalmen	103411	6663880	1578150	6663731	1577964	N	0.94
018	Dragsfjärd	Falkön	103411	6669620	1577450	6669471	1577264	N	0.88
019	Dragsfjärd	Hemlandet	103312	6648220	1575330	6648071	1575144	N	0.90
020	Dragsfjärd	Hertsböle	201213	6658140	2418750	6658000	2418573	N	0.06
021	Dragsfjärd	Hertsböle	201213	6657930	2418740	6657790	2418563	N	0.84
022	Dragsfjärd	Hertsböle	201213	6658580	2418780	6658440	2418603	N	0.06
023	Dragsfjärd	Hertsböle	201213	6658280	2418830	6658140	2418653	N	0.05
024	Dragsfjärd	Hertsböle	201213	6658230	2418900	6658090	2418723	N	0.02
025	Dragsfjärd	Hertsböle	201213	6658130	2419520	6657990	2419343	N	0.00
026	Dragsfjärd	Hertsböle	201213	6658960	2418930	6658820	2418753	N	0.38
027	Dragsfjärd	Hertsböle	201213	6658680	2419390	6658540	2419213	N	0.03
028	Dragsfjärd	Hertsböle	201213	6658690	2419390	6658550	2419213	N	0.11
029	Dragsfjärd	Hertsböle	201213	6659310	2419800	6659170	2419623	N	0.80
030	Dragsfjärd	Hertsböle	201213	6658900	2419890	6658760	2419713	N	0.11
031	Dragsfjärd	Hertsböle	201201	6659200	2420050	6659060	2419873	N	0.02
032	Dragsfjärd	Kaldoholmen	103312	6643460	1578200	6643311	1578014	N	0.99
033	Dragsfjärd	Kaldoholmen	103312	6643690	1578350	6643541	1578164	N	0.96
034	Dragsfjärd	Björkboda	201214	6665010	2418700	6664869	2418523	N	0.37
035	Dragsfjärd	Nordanå	103414	6667560	1581360	6667411	1581174	N	0.00
036	Dragsfjärd	Jordbro	103414	6662390	1581040	6662241	1580854	N	0.52
037	Dragsfjärd	Söderby	103414	6662290	1581020	6662141	1580834	N	0.99
038	Dragsfjärd	Söderby	103414	6662250	1581030	6662101	1580844	N	.
039	Dragsfjärd	Söderby	103414	6662260	1581030	6662111	1580844	N	.
040	Dragsfjärd	Långnäsudden	103414	6661780	1581940	6661631	1581754	P	0.00

041	Dragsfjärd	Långnäsudden	103414	6661780	1581960	6661631	1581774	P	0.00
042	Dragsfjärd	Rövik	103413	6656140	1581650	6655991	1581464	N	0.05
043	Dragsfjärd	Hammarsboda	103411	6661210	1578670	6661061	1578484	P	0.00
044	Dragsfjärd	Hammarsboda	103411	6661240	1578710	6661091	1578524	P	0.01
045	Dragsfjärd	Hammarsboda	103411	6661210	1578690	6661061	1578504	P	0.08
046	Dragsfjärd	Hammarsboda	103411	6661220	1578600	6661071	1578414	P	0.11
047	Dragsfjärd	Kammarbergen	103411	6666760	1578550	6666611	1578364	N	1.00
048	Dragsfjärd	Söljeholmen	103413	6654450	1581010	6654301	1580824	N	0.82
049	Dragsfjärd	Östergård 1	103410	6657060	1577560	6656911	1577374	N	0.62
050	Dragsfjärd	Östergård 1	103410	6657020	1577530	6656871	1577344	N	0.06
051	Dragsfjärd	Hamnholmssundet	103410	6657050	1577150	6656901	1576964	N	0.96
052	Dragsfjärd	Östergård 2	103410	6656580	1577500	6656431	1577314	N	1.00
053	Dragsfjärd	Östergård 2	103410	6656580	1577500	6656431	1577314	N	1.00
054	Dragsfjärd	Östergård 2	103410	6656580	1577500	6656431	1577314	N	1.00
055	Dragsfjärd	Östergård 2	103410	6656590	1577500	6656441	1577314	N	1.00
056	Dragsfjärd	Östergård 2	103410	6656590	1577510	6656441	1577324	N	1.00
057	Dragsfjärd	Östergård 2	103410	6656580	1577510	6656431	1577324	N	1.00
058	Dragsfjärd	Östergård 2	103410	6656600	1577500	6656451	1577314	N	1.00
059	Dragsfjärd	Krogarudden	103410	6655510	1577860	6655361	1577674	N	1.00
060	Dragsfjärd	Långfuruholm	103410	6652210	1573840	6652061	1573654	R	0.96
061	Dragsfjärd	Nämanön	103410	6652060	1575550	6651911	1575364	N	1.00
062	Dragsfjärd	Bötskäret	201115	6640250	2418300	6640110	2418123	N	0.97
063	Dragsfjärd	Stora Ängeskär	103312	6642850	1578800	6642701	1578614	R	1.00
064	Houtskär	Kummelbergen	104107	6683200	1521610	6683051	1521424	N	1.00
065	Houtskär	Kalnäs	103206	6678760	1514410	6678611	1514224	N	1.00
066	Houtskär	Sälgnäs	103206	6677120	1514990	6676971	1514804	N	0.92
067	Houtskär	Vårdberget	103206	6678810	1514740	6678661	1514554	N	0.99
068	Houtskär	Edjärdan	103206	6678400	1515760	6678251	1515574	N	0.75
069	Houtskär	Ekholm	103206	6679180	1515770	6679031	1515584	N	0.95
070	Houtskär	Flakbergen	103206	6678530	1515380	6678381	1515194	N	1.00
071	Houtskär	Svälteskär	104104	6681660	1512060	6681511	1511874	N	0.99
072	Houtskär	Hästkilsbergen	103206	6675990	1513160	6675841	1512974	N	1.00
073	Houtskär	Hästkil	103206	6675850	1512660	6675701	1512474	N	1.00
074	Houtskär	Timmerholm	103206	6676140	1516820	6675991	1516634	N	0.93
075	Houtskär	Järvis	103206	6677490	1516190	6677341	1516004	N	1.00
076	Houtskär	Västerskogen	103206	6678060	1516050	6677911	1515864	N	0.99
077	Houtskär	Kummelbergen	103209	6676740	1525060	6676591	1524874	N	0.07
078	Houtskär	Västerskogen	103206	6675400	1519900	6675251	1519714	N	1.00
079	Houtskär	Västerskogen	103206	6675680	1519970	6675531	1519784	N	1.00
080	Houtskär	Västerskogen	103206	6676040	1519990	6675891	1519804	N	1.00
081	Houtskär	Sunsveden	103209	6677080	1522580	6676931	1522394	N	0.41
082	Houtskär	Norrnäs	104104	6681470	1513100	6681321	1512914	N	1.00
083	Houtskär	Surnon	104107	6683540	1521080	6683391	1520894	N	0.65
084	Houtskär	Reisberg	104102	6692750	1508320	6692601	1508134	N	0.84
085	Houtskär	Reisberg	104102	6692720	1508330	6692571	1508144	N	1.00
086	Houtskär	Hästkil	103206	6675900	1512520	6675751	1512334	N	1.00
087	Houtskär	Trollberg	103209	6677040	1521630	6676891	1521444	P	0.03
088	Houtskär	Furunabb	103206	6678570	1514740	6678421	1514554	R	0.93
089	Houtskär	Furunabb	103206	6678550	1514740	6678401	1514554	R	0.99
090	Houtskär	Furunabb	103206	6678560	1514740	6678411	1514554	R	1.00
091	Houtskär	Furunabb	103206	6678570	1514750	6678421	1514564	R	0.99
092	Houtskär	Furunabb	103206	6678580	1514740	6678431	1514554	R	1.00
093	Houtskär	Furunabb	103206	6678580	1514730	6678431	1514544	R	1.00
094	Houtskär	Furunabb	103206	6678580	1514750	6678431	1514564	R	0.99
095	Houtskär	Furunabb	103206	6678580	1514750	6678431	1514564	R	0.98

096	Houtskär	Furunabb	103206	6678590	1514750	6678441	1514564	R	1.00
097	Houtskär	Furunabb	103206	6678590	1514750	6678441	1514564	R	1.00
098	Houtskär	Furunabb	103206	6678600	1514750	6678451	1514564	R	1.00
099	Houtskär	Furunabb	103206	6678600	1514740	6678451	1514554	R	1.00
100	Houtskär	Svinö Högberget	104104	6681500	1512700	6681351	1512514	N	0.99
101	Iniö	Äspholm	104109	6702730	1520540	6702581	1520354	N	0.45
102	Iniö	Långholm	104109	6703630	1520790	6703481	1520604	N	1.00
103	Iniö	Keistiö	104105	6696050	1518260	6695901	1518074	N	0.98
104	Iniö	Keistiö	104105	6696080	1518260	6695931	1518074	N	1.00
105	Iniö	Märrarygg	104108	6696660	1520920	6696511	1520734	N	.
106	Iniö	Dalen	104108	6697260	1520990	6697111	1520804	N	0.96
107	Iniö	Norrby	104108	6697580	1521320	6697431	1521134	N	1.00
108	Iniö	Norrby	104108	6698300	1520650	6698151	1520464	N	0.99
109	Iniö	Norrby	104108	6698050	1520320	6697901	1520134	N	0.91
110	Iniö	Söderby	104108	6696920	1521970	6696771	1521784	N	1.00
111	Iniö	Norrby	104108	6698120	1520480	6697971	1520294	N	0.99
112	Iniö	Norrby	104108	6698120	1520490	6697971	1520304	N	1.00
113	Kimito	Smisskullen	201206	6678340	2433510	6678200	2433333	N	0.97
114	Kimito	Smisskullen	201206	6678340	2433460	6678200	2433283	N	0.82
115	Kimito	Viksgård	202104	6681170	2430670	6681029	2430493	N	0.02
116	Kimito	Viksgård	202104	6681200	2430610	6681059	2430433	N	0.01
117	Kimito	Österängsberget	201206	6678420	2430760	6678280	2430583	N	0.09
118	Kimito	Österängsberget	201206	6678450	2430760	6678310	2430583	N	0.17
119	Kimito	Skrinnanberget	201203	6677740	2429260	6677599	2429083	N	0.02
120	Kimito	Skrinnanberget	201203	6677740	2429250	6677599	2429073	N	0.06
121	Kimito	Gästerby	201203	6677380	2428820	6677239	2428643	N	0.95
122	Kimito	Smisskullen	201203	6678700	2429680	6678559	2429503	N	0.00
123	Kimito	Trotby	201206	6677660	2431260	6677520	2431083	N	.
124	Kimito	Telegrafberget	202104	6681030	2430240	6680889	2430063	N	0.11
125	Kimito	Storhomman	103415	6673960	1583170	6673811	1582984	N	0.99
126	Kimito	Verkholm	201215	6673300	2418170	6673159	2417993	N	0.00
127	Kimito	Verkholm	201215	6673290	2418150	6673149	2417973	N	0.00
128	Kimito	Tjuda	201203	6677480	2428950	6677339	2428773	N	0.45
129	Kimito	Tjuda	201203	6677550	2428890	6677409	2428713	N	0.08
130	Kimito	Tjuda	201203	6677540	2428870	6677399	2428693	N	0.29
131	Kimito	Klobben	201203	6676440	2429070	6676300	2428893	N	0.15
132	Kimito	Tjuda	201203	6676690	2428010	6676549	2427833	N	0.01
133	Kimito	Tjuda	201203	6676680	2428010	6676539	2427833	N	0.50
134	Kimito	Spångmalm	201203	6675210	2428390	6675070	2428213	N	0.97
135	Kimito	Spångmalm	201203	6675230	2428340	6675090	2428163	N	0.99
136	Kimito	Spångmalm	201203	6675200	2428350	6675060	2428173	N	.
137	Kimito	Spångmalm	201203	6675180	2427930	6675039	2427753	N	0.03
138	Kimito	Makila	201203	6674290	2427220	6674149	2427043	N	0.09
139	Kimito	Båtkullaberget	201206	6672830	2433490	6672690	2433313	N	0.00
140	Kimito	Kummelberget	201206	6671790	2436660	6671650	2436483	N	0.01
141	Kimito	Kummelberget	201206	6671770	2436660	6671630	2436483	N	0.37
142	Kimito	Sjölax	201206	6671450	2436910	6671310	2436733	N	0.03
143	Kimito	Sjölax	201206	6671450	2436900	6671310	2436723	N	0.02
144	Kimito	Sjölax	201206	6671460	2436880	6671320	2436703	N	0.00
145	Kimito	Björnholmen	201206	6671380	2437480	6671240	2437303	N	0.38
146	Kimito	Länsmansberget	201206	6672770	2431050	6672630	2430873	N	0.00
147	Kimito	Länsmansberget	201206	6672780	2431040	6672640	2430863	N	0.00
148	Kimito	Jättekastberget	201203	6671970	2427850	6671830	2427673	N	0.82
149	Kimito	Jättekastberget	201203	6671940	2427860	6671800	2427683	N	0.89
150	Kimito	Jättekastberget	201203	6671920	2427870	6671780	2427693	N	0.99

151	Kimito	Linnarnäs	201205	6669840	2436500	6669700	2436323	N	0.00
152	Kimito	Rågholm	201205	6669680	2438370	6669540	2438193	N	0.01
153	Kimito	Storhagan	201203	6670730	2423630	6670589	2423453	N	0.00
154	Kimito	Makila	201203	6674450	2428490	6674310	2428313	R	0.01
155	Kimito	Svartträsket	201206	6679710	2430980	6679569	2430803	N	0.02
156	Kimito	Svartträsket	201206	6679670	2430990	6679529	2430813	N	.
157	Kimito	Svartträsket	201206	6679630	2431010	6679489	2430833	N	0.13
158	Kimito	Sjölax	201206	6671560	2436800	6671420	2436623	N	0.04
159	Kimito	Östermark	201202	6667650	2429580	6667510	2429403	N	0.86
160	Kimito	Östermark	201202	6667420	2429300	6667280	2429123	N	0.97
161	Kimito	Östermark	201202	6667290	2429120	6667150	2428943	N	0.95
162	Kimito	Östermark	201202	6667540	2429660	6667400	2429483	N	0.88
163	Kimito	Östermark	201202	6665790	2428840	6665650	2428663	N	0.94
164	Kimito	Ackokullan	201203	6670710	2426720	6670570	2426543	N	0.00
165	Kimito	Påvalsby	201203	6671730	2426690	6671590	2426513	N	0.02
166	Kimito	Påvalsby	201203	6671740	2426690	6671600	2426513	N	0.01
167	Kimito	Påvalsby	201203	6671700	2426720	6671560	2426543	N	0.02
168	Kimito	Påvalsby	201203	6671370	2426360	6671230	2426183	N	0.00
169	Kimito	Påvalsby	201203	6671290	2426110	6671150	2425933	N	0.03
170	Kimito	Storhagan	201203	6670710	2423620	6670569	2423443	N	0.00
171	Kimito	Mattkärrmalm	201202	6669650	2425070	6669510	2424893	N	0.20
172	Kimito	Mattkärr	201202	6669580	2424910	6669440	2424733	N	0.99
173	Kimito	Mattkärr	201202	6669580	2424890	6669440	2424713	N	0.48
174	Kimito	Kåddbölebrinken	201202	6667870	2423180	6667730	2423003	N	0.28
175	Kimito	Kåddbölebrinken	201202	6667870	2423170	6667730	2422993	N	0.83
176	Kimito	Kåddböle	201202	6667340	2424190	6667200	2424013	N	0.03
177	Kimito	Kummelberget	201206	6671980	2436660	6671840	2436483	N	0.00
178	Kimito	Kummelberget	201206	6671950	2436670	6671810	2436493	N	0.00
179	Kimito	Kummelberget	201206	6671970	2436670	6671830	2436493	N	0.00
180	Kimito	Kummelberget	201206	6672320	2437110	6672180	2436933	N	0.00
181	Kimito	Viksgård	202104	6680050	2431150	6679909	2430973	N	0.01
182	Kimito	Mörkdalsberget	201203	6671830	2426820	6671690	2426643	N	0.00
183	Kimito	Mörkdalsberget	201203	6671930	2426920	6671790	2426743	N	0.00
184	Kimito	Mörkdalsberget	201203	6671930	2426930	6671790	2426753	N	0.01
185	Kimito	Vreta	201203	6672140	2427040	6672000	2426863	N	.
186	Kimito	Vreta	201203	6672150	2427080	6672010	2426903	N	0.31
187	Kimito	Vreta	201203	6672220	2427520	6672080	2427343	N	.
188	Kimito	Brudbergen	201203	6672110	2428920	6671970	2428743	N	0.85
189	Kimito	Bollberget	201203	6674780	2427110	6674639	2426933	N	0.53
190	Kimito	Engelsby	201203	6674180	2428470	6674040	2428293	N	0.24
191	Kimito	Tavastrona	202104	6680510	2435660	6680370	2435483	N	0.92
192	Kimito	Vestlax	201202	6662950	2429780	6662810	2429603	N	0.99
193	Korpo	Prostberg	103212	6672180	1530030	6672031	1529844	N	1.00
194	Korpo	Söderskogen	103212	6673860	1533920	6673711	1533734	N	0.99
195	Korpo	Storskogen	103212	6673870	1534680	6673721	1534494	N	0.92
196	Korpo	Storskogen	103212	6673890	1534580	6673741	1534394	N	0.92
197	Korpo	Ekdalarna	103212	6672490	1534540	6672341	1534354	N	0.94
198	Korpo	Söderskogen	103212	6673530	1533790	6673381	1533604	N	0.98
199	Korpo	Söderskogen	103212	6673520	1533790	6673371	1533604	N	1.00
200	Korpo	Hväsby	103212	6670400	1531810	6670251	1531624	N	0.76
201	Korpo	Hummelskär	103209	6670770	1522450	6670621	1522264	N	1.00
202	Korpo	Bendby	103212	6670330	1533460	6670181	1533274	N	0.81
203	Korpo	Hagaudd	103208	6668120	1528880	6667971	1528694	N	0.36
204	Nagu	Taslot	103403	6678820	1548110	6678671	1547924	N	0.52
205	Nagu	Hangslax	103406	6675120	1558240	6674971	1558054	N	0.11

206	Nagu	Ådholm	103406	6679810	1557530	6679661	1557344	N	0.05
207	Nagu	Innamo	104301	6682940	1541970	6682791	1541784	N	0.99
208	Nagu	Jälankort	104301	6683040	1542420	6682891	1542234	N	1.00
209	Nagu	Jälankort	104301	6683050	1542410	6682901	1542224	R	0.99
210	Nagu	Käldinge	103406	6673800	1559220	6673651	1559034	N	0.98
211	Nagu	Käldinge	103406	6674970	1558450	6674821	1558264	N	0.30
212	Nagu	Brännskär	103406	6670830	1551570	6670681	1551384	N	0.39
213	Nagu	Piparby	103406	6673460	1554470	6673311	1554284	N	0.66
214	Nagu	Kalvberget	103409	6679220	1560300	6679071	1560114	N	0.79
215	Nagu	Öijen	103409	6674800	1561310	6674651	1561124	N	0.02
216	Nagu	Öijen	103409	6674770	1561310	6674621	1561124	N	0.16
217	Nagu	Ängesnäs bergen	104304	6680970	1553860	6680821	1553674	R	0.96
218	Nagu	Vikom	103406	6675960	1554690	6675811	1554504	N	0.99
219	Nagu	Lillskogen	103406	6676320	1558930	6676171	1558744	N	0.52
220	Nagu	Prostvik	103406	6675850	1559570	6675701	1559384	N	0.91
221	Nagu	Prostvik	103406	6675920	1559520	6675771	1559334	N	0.99
222	Nagu	Kiuasvuori	103406	6676690	1558050	6676541	1557864	N	0.00
223	Nagu	Simonby	103406	6676150	1558690	6676001	1558504	N	0.94
224	Nagu	Simonby	103406	6675830	1558150	6675681	1557964	N	0.01
225	Nagu	Hangslax	103406	6675270	1557810	6675121	1557624	N	0.93
226	Nagu	Hangslax	103406	6675290	1557820	6675141	1557634	N	0.46
227	Nagu	Hangslax	103406	6675290	1557790	6675141	1557604	N	0.98
228	Nagu	Hangslax	103406	6675270	1557780	6675121	1557594	N	0.56
229	Nagu	Hangslax	103406	6675260	1557810	6675111	1557624	N	0.92
230	Nagu	Ernholmsberget	103406	6675350	1551110	6675201	1550924	N	0.75
231	Nagu	Dalkarby	103406	6672660	1556770	6672511	1556584	N	0.04
232	Nagu	Öijen	103409	6675010	1561520	6674861	1561334	N	0.14
233	Nagu	Sandö	103409	6674620	1561660	6674471	1561474	N	0.01
234	Nagu	Österudden	103409	6676370	1563840	6676221	1563654	N	0.13
235	Nagu	Österudden	103409	6676360	1563610	6676211	1563424	N	0.99
236	Nagu	Sellmo	103403	6676450	1546580	6676301	1546394	N	0.98
237	Nagu	Näsberget	103403	6673860	1541900	6673711	1541714	N	0.82
238	Nagu	Näsberget	103403	6673870	1541990	6673721	1541804	N	0.99
239	Nagu	Näsberget	103403	6673870	1542150	6673721	1541964	N	0.98
240	Nagu	Norrskogsbergen	103403	6674480	1540330	6674331	1540144	N	0.92
241	Nagu	Norrskogsbergen	103403	6674400	1540330	6674251	1540144	N	0.97
242	Nagu	Taslot	103403	6678760	1548080	6678611	1547894	N	0.84
243	Nagu	Käldinge	103406	6674570	1558950	6674421	1558764	N	0.42
244	Nagu	Ytterholm	103405	6667720	1550880	6667571	1550694	N	0.99
245	Nagu	Lilla Kuusis	104301	6687460	1546100	6687311	1545914	N	0.96
246	Nagu	Vikom	103406	6675900	1554490	6675751	1554304	N	0.38
247	Nagu	Vikom	103406	6675740	1554780	6675591	1554594	N	.
248	Nagu	Vikom	103406	6675750	1554760	6675601	1554574	N	0.05
249	Nagu	Vikom	103406	6675740	1554980	6675591	1554794	N	0.07
250	Nagu	Sundbergen 3	103401	6651180	1543450	6651031	1543264	R	0.97
251	Nagu	Sundbergen 4	103401	6651010	1543520	6650861	1543334	N	1.00
252	Nagu	Sundbergen 5	103401	6651020	1543400	6650871	1543214	N	1.00
253	Nagu	Mjoö 1	103401	6651690	1543920	6651541	1543734	N	1.00
254	Nagu	Mjoö 2	103401	6651460	1543890	6651311	1543704	N	1.00
255	Nagu	Påkmo	103402	6666340	1545170	6666191	1544984	N	0.88
256	Nagu	Innamo	104301	6682520	1542850	6682371	1542664	N	1.00
257	Nagu	Haverö	104307	6682600	1560240	6682451	1560054	N	0.00
258	Nagu	Sundbergen 1	103401	6651110	1543460	6650961	1543274	R	0.99
259	Nagu	Sundbergen 2	103401	6651150	1543440	6651001	1543254	R	1.00
260	Pargas	Boda	103412	6677840	1575810	6677691	1575624	N	0.29

261	Pargas	Boda	103412	6677760	1575640	6677611	1575454	N	0.37
262	Pargas	Boda	103412	6677760	1575650	6677611	1575464	N	0.75
263	Pargas	Boda	103412	6677760	1575660	6677611	1575474	N	0.05
264	Pargas	Björkholm	103409	6675460	1569550	6675311	1569364	N	0.16
265	Pargas	Österudden	103412	6670950	1574410	6670801	1574224	N	0.21
266	Pargas	Ön	103409	6677890	1565250	6677741	1565064	N	0.87
267	Pargas	Labbholmen	103412	6672660	1575830	6672511	1575644	N	0.82
268	Pargas	Klofsudden	104307	6682940	1561360	6682791	1561174	N	0.54
269	Pargas	Mielisholm	103412	6678810	1573240	6678661	1573054	N	0.94
270	Pargas	Mågby	103409	6678210	1568550	6678061	1568364	N	0.99
271	Pargas	Mågby	103409	6676690	1569040	6676541	1568854	N	0.39
272	Pargas	Mågby	103409	6676650	1569140	6676501	1568954	N	0.74
273	Pargas	Mågby	103409	6676950	1569910	6676801	1569724	N	1.00
274	Pargas	Mågby	104307	6685660	1561680	6685511	1561494	N	0.97
275	Pargas	Klofsan	104307	6683090	1561570	6682941	1561384	N	0.92
276	Pargas	Skärmola	104307	6685190	1564600	6685041	1564414	N	0.81
277	Pargas	Mielisholm	103412	6678820	1573230	6678671	1573044	N	0.24
278	Pargas	Portnäset	103412	6671680	1571960	6671531	1571774	N	0.29
279	Pargas	Sandholm	103409	6679900	1562450	6679751	1562264	N	0.06
280	Pargas	Jättekasten	104307	6689560	1568650	6689411	1568464	N	0.32
281	Pargas	Jättekasten	104307	6689560	1568590	6689411	1568404	N	0.02
282	Pargas	Vallis	104307	6688020	1568340	6687871	1568154	N	0.06
283	Pargas	Lofsdal	104307	6682460	1568530	6682311	1568344	N	0.33
284	Pargas	Lofsdal	104307	6681700	1568190	6681551	1568004	N	0.11
285	Pargas	Kummelberget	104307	6680930	1569400	6680781	1569214	N	0.15
286	Pargas	Kummelberget	104307	6680930	1569430	6680781	1569244	N	0.90
287	Pargas	Sildala	103409	6679970	1568950	6679821	1568764	N	0.72
288	Pargas	Sattmark	104307	6682700	1568720	6682551	1568534	N	0.24
289	Pargas	Lilltervo	103409	6679700	1565280	6679551	1565094	N	0.08
290	Pargas	Lilltervo	103409	6679870	1565490	6679721	1565304	N	0.65
291	Pargas	Mågby	103409	6676590	1568640	6676441	1568454	N	.
292	Pargas	Mågby	103409	6676770	1568540	6676621	1568354	N	0.01
293	Pargas	Mågbyklobben	103409	6676040	1567640	6675891	1567454	N	0.59
294	Pargas	Långstrandsberget	103409	6677030	1567460	6676881	1567274	N	0.95
295	Pargas	Lofsdal	104307	6682780	1569040	6682631	1568854	N	0.46
296	Pargas	Bredviksbacken	104311	6694340	1574660	6694191	1574474	N	0.14
297	Pargas	Koupo	104307	6687080	1562180	6686931	1561994	N	0.43
298	Pargas	Koupo	104307	6687040	1562200	6686891	1562014	N	0.92
299	Pargas	Strandby	104307	6687580	1561230	6687431	1561044	N	0.86
300	Pargas	Mågby	103409	6676580	1568640	6676431	1568454	N	0.21
301	Pargas	Sandvik	103409	6676600	1568840	6676451	1568654	N	0.11
302	Pargas	Sandvik	103409	6676640	1568900	6676491	1568714	N	0.81
303	Pargas	Sandvik	103409	6676800	1569000	6676651	1568814	N	0.97
304	Pargas	Lilltervo	103409	6679850	1565420	6679701	1565234	N	0.08
305	Rymättylä	Nuikonvuori	104305	6698400	1551060	6698251	1550874	N	0.89
306	Rymättylä	Miinamäki	104305	6694840	1555590	6694691	1555404	N	0.64
307	Rymättylä	Äijälä	104305	6694330	1555520	6694181	1555334	N	0.66
308	Rymättylä	Isoluoto	104304	6687990	1553200	6687841	1553014	N	0.45
309	Rymättylä	Isoluoto	104304	6688000	1553010	6687851	1552824	N	.
310	Rymättylä	Hanka	104304	6686860	1553720	6686711	1553534	N	0.00
311	Rymättylä	Hanka	104304	6686990	1553800	6686841	1553614	N	0.00
312	Rymättylä	Hanka	104304	6686960	1553790	6686811	1553604	N	0.01
313	Rymättylä	Ojainen	104304	6689880	1554590	6689731	1554404	N	.
314	Rymättylä	Härmistönniemi	104304	6689020	1554200	6688871	1554014	N	0.02
315	Rymättylä	Härmistönniemi	104304	6689020	1554210	6688871	1554024	N	0.05

316	Rymättylä	Ojainen	104304	6689840	1554720	6689691	1554534	N	0.87
317	Rymättylä	Ojainen	104304	6689880	1554690	6689731	1554504	N	0.92
318	Rymättylä	Prustinvuori	104302	6698050	1547700	6697901	1547514	N	0.19
319	Rymättylä	Kramppi	104304	6686490	1554520	6686341	1554334	N	0.95
320	Rymättylä	Kramppi	104304	6686500	1554520	6686351	1554334	N	0.96
321	Rymättylä	Hanka	104304	6686820	1553700	6686671	1553514	N	0.02
322	Turku	Nunnavuori	104308	6696520	1569620	6696371	1569434	N	0.00
323	Turku	Kettukallio	104308	6693080	1564940	6692931	1564754	N	0.98
324	Velkua	Martinmaa	104112	6700220	1533810	6700071	1533624	N	0.95
325	Västanfjärd	Lyckeberget	201202	6663970	2425240	6663830	2425063	N	0.90
326	Västanfjärd	Söderviken	201201	6658310	2422650	6658170	2422473	R	0.98
327	Västanfjärd	Söderviken	201201	6658300	2422670	6658160	2422493	R	0.82
328	Västanfjärd	Lillskogen	201202	6660040	2426540	6659900	2426363	N	0.88
329	Västanfjärd	Lillskogen	201202	6660030	2426570	6659890	2426393	N	0.57
330	Västanfjärd	Södergårdskvarn	201202	6663260	2424160	6663120	2423983	N	0.10
331	Västanfjärd	Nivelax	201202	6665220	2424290	6665080	2424113	N	0.48
332	Västanfjärd	Nivelax	201202	6665230	2424280	6665090	2424103	N	0.95
333	Västanfjärd	Nivelax	201202	6665230	2424300	6665090	2424123	N	0.58
334	Västanfjärd	Norra Mågsholmen	201201	6656450	2423470	6656310	2423293	N	0.20
335	Dragsfjärd	Hammarsboda 10	103411	6660700	1578500	6660551	1578314	N	0.82
336	Dragsfjärd	Hammarsboda 11	103411	6660830	1578820	6660681	1578634	N	0.73
337	Dragsfjärd	Kalvholms fladan 1	103315	6642240	1583370	6642091	1583184	N	0.96
338	Dragsfjärd	Kalvholms fladan 2	103315	6642450	1583240	6642301	1583054	N	0.89
339	Dragsfjärd	Kalvholms fladan 3	103315	6642450	1583260	6642301	1583074	N	1.00
340	Dragsfjärd	Kyrkön	103315	6641740	1583620	6641591	1583434	N	0.97
341	Dragsfjärd	Västra Granholmen	103314	6638460	1582350	6638311	1582164	N	1.00
342	Dragsfjärd	Snåldö	103311	6639370	1574570	6639221	1574384	N	1.00
343	Dragsfjärd	Norrglo	103311	6639300	1577960	6639151	1577774	N	0.99
344	Dragsfjärd	Rosala Hamnholmen	103312	6641450	1577710	6641301	1577524	N	0.97
345	Dragsfjärd	Holma Hamnholmen	103312	6641760	1577580	6641611	1577394	N	0.77
346	Dragsfjärd	Ängeskär	103407	6655040	1567340	6654891	1567154	N	1.00
347	Dragsfjärd	Härön	103308	6637900	1563050	6637751	1562864	N	1.00
348	Korpo	Norrkumlet	103205	6662780	1518500	6662631	1518314	N	0.99
349	Korpo	Bussö	103210	6658520	1532600	6658371	1532414	N	0.99
350	Korpo	Kistskär	103204	6650240	1517460	6650091	1517275	N	0.76
351	Korpo	Västerö	103112	6649000	1533590	6648851	1533404	N	1.00
352	Nagu	Simonby 45	103406	6675910	1558540	6675761	1558354	N	0.03
353	Nagu	Simonby 46	103406	6675900	1558540	6675751	1558354	N	0.35
354	Nagu	Simonby 47	103406	6675880	1558680	6675731	1558494	N	0.28
355	Nagu	Hangslax 48	103406	6675120	1557580	6674971	1557394	N	1.00
356	Nagu	Käldinge 49	103406	6674310	1558240	6674161	1558054	N	0.35
357	Nagu	Öbergen 50	103409	6674600	1560740	6674451	1560554	N	0.99
358	Nagu	Öbergen 51	103409	6674570	1560740	6674421	1560554	N	0.00
359	Nagu	Högsar	103403	6670850	1547710	6670701	1547524	N	1.00
360	Nagu	Hummelholm	103402	6665230	1544830	6665081	1544644	N	0.69
361	Nagu	Hummelholm	103402	6665230	1544790	6665081	1544604	N	0.99
362	Dragsfjärd	Kalholm	103312	6643850	1576050	6643701	1575864	N	0.86
363	Dragsfjärd	Bötsön	103311	6635280	1577350	6635131	1577164	N	0.97
364	Korpo	Djupklevudden	103208	6662930	1520780	6662781	1520594	N	0.90
365	Nagu	Boskär	103401	6658410	1543180	6658261	1542994	N	0.99
366	Nagu	Ådön	103401	6655480	1548810	6655331	1548624	R	0.95
367	Nagu	Ön	103405	6661620	1558900	6661471	1558714	N	0.99
368	Nagu	Granholm	103401	6651640	1542220	6651491	1542034	N	0.98
369	Nagu	Mjoö 3	103401	6650310	1544050	6650161	1543864	N	0.90
370	Nagu	Gånganberget	103303	6641290	1543190	6641141	1543004	N	1.00

371	Nagu	Sandholm	103303	6643730	1545640	6643581	1545454	N	1.00
372	Nagu	Revberget	103303	6644470	1549570	6644321	1549384	N	0.97
373	Nagu	Käldinge 1	103406	6674040	1558320	6673891	1558134	N	0.99
374	Nagu	Käldinge 2	103406	6674060	1558250	6673911	1558064	N	0.46
375	Nagu	Käldinge 3	103406	6674110	1558340	6673961	1558154	N	0.86
376	Nagu	Käldinge 5	103406	6674420	1558330	6674271	1558144	N	.
377	Nagu	Käldinge 7	103406	6674500	1558400	6674351	1558214	N	0.15
378	Nagu	Käldinge 9	103406	6674120	1558010	6673971	1557824	N	0.80
379	Nagu	Käldinge 10	103406	6674100	1558030	6673951	1557844	N	0.76
380	Korpo	Västerretais	103212	6673530	1533750	6673381	1533564	N	0.99