Sivash - the lagoon between two seas

Edited by
Valeriy Siokhin, Vasiliy Kostyushyn

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V.Siokhin, I.Chernichko, V.Kostyushyn, N.Krylov, Yu.Andrushchenko, T.Andrienko, Ya.Didukh, V.Kolomijchuk, L.Parkhisenko, R.Chernichko, T.Kirikova

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This popular brochure on the Sivash - the largest wetland along the Ukrainian Azov-Black Sea coast - contains a wide range of information on the history of the area, landscape diversity, climate, mineral resources, biological diversity, nature conservation and threats to the wetland.

Chief editors - V. Siokhin, V. Kostyushyn
Editing of English text - T. Nash-Collins, I. Ivanenko
Layout - V. Melnychuk

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Introduction

The natural originality of the shallow gulf of the Azov Sea - known as the Sivash - attracts the attention of everybody who frequently travels by car or by train to the Crimea. Its nickname is "the Foul Sea". The view of the Sivash from the height of a bird's flight makes a real impression. A whimsically indented coastal strip, a lot of small and large islands, spits, clay red-brown precipices, reed-marshes and wetlands create an unforgettable mosaic of landscapes. The colour of the water itself is wonderful too: sometimes light pink, sometimes green or grey-violet. In translation from Turkish, Sivash means "a depression with salt dirt or foul sea or lagoon".

The length of coastal strip, depending on the level of water, is 2969-3184 km (for comparison: all the coastal strip of the Azov Sea is only 2686 km). The lagoon is divided into two, almost equal, parts by an administrative border between the Kherson region and the Autonomous Republic of Crimea. In 1978 the Sivash was among the first wetlands of the USSR to be entered into the Ramsar List of wetlands of international importance.

1. History of origin and development

The Sivash is a gulf of the Azov Sea separated by the Arabatska Strelka (spit). Fig. 1 The spit is a unique natural object 115 km long and 270 m to 7.5 km wide. It is a typical coastal bar that has been formed as a result of undulation transferring sand and the shells of sea molluscs (exclusively *cardium*) from the submerged coastal slope to the coast.

According to the calculations of V. Zenkevich (1958) the amount of shells in the bar is more than 300 million cubic m. Such a volume of sediments implies that shells have been gathered from the very wide strip at the bottom but not only from the drift zone. It allows V. Zenkevich to confirm that the formation of the Arabatskaya Strelka bar "*began at considerably low sea level and far from the modern coastline*". Therefore, it is possible to say that the Arabatska Strelka appeared at the beginning of the formation of the Azov Sea (about 7000-8000 years ago) and then step by step shifted to the west as the Sivash did. Over a period of thousands of years the Sivash reservoir was formed with an area of ca. 2640 sq. km, connected to the Azov Sea by a narrow strait near the town of Genichesk.

The fact of the existence of both the Arabatskaya Strelka and the Sivash in ancient times was witnessed by Strabon in his "The Geography". "*The width of the lake of Sapra (Sivash) is 40 stages. Despite the fact that the lake of Sapra has, as everybody says, 4000 stages, it is only in the Western part of Meotida and the wide mouth connecting it with Meotida. It is rather marshy and hardly navigable for the boats sewn from leather, as the winds easily drain the shallow places and soon after cover them with water again; therefore the wetlands are closed to big ships. There are three islands in the gulf, several shallow places along the coast and underwater stones*".

On the map issued according to the data of Claudius Ptolemeus (II AD), the Sivash is represented as a gulf of the Azov Sea and separated from it by the Arabatskaya Strelka (The Map of Sarmatia). I. Babkov (1954) examining the Genoa maps of XIV-XV centuries noted that on some of them the Arabatskaya Strelka is depicted as a number of separate islands and not as a solid strip of land as is the contemporary situation.

It was the Cimmerians that inhabited the Prisivash steppes in ancient times, characterised by a nomadic mode of life. In I BC tsar Scythings dislodged them, conducting the same order of life. The reign of nomadic cattle breeding in the Prisivash has been conserved for centuries, while one folk have been consecutively replaced by another: Sarmats, Goths, Huns, Hazars, Pechenegs, etc.

In XIII a new important stage in the development of the Prisivash region began. In 1223 the first detachments of Tatar-Mongols invaded the Crimean peninsula and in 1242 Tavria was converted into one of the administrative regions of the Golden Horde. After the defeat of the Golden Horde by Timur in 1385, the process creating the State of Crimea began. The fighting between feudal groups ended in 1443 with the victory of Khadzi-Girey who founded the independent Crimean Khanate. But in the second part of the XV century the Crimean Khanate was under the power of Istanbul.

Despite the mixed ethnic structure of the population of the Crimea, the majority were steppe (North Crimean) Tatars. Nogais conducting a nomadic mode of life occupied the Sivash banks. This is confirmed by "The Map Representing Crimea and Crimean Steppe" of 1777. According to Russian State Archive data of the Plans of General land-surveying (XIX) arable lands were situated even on the Sivash islands.

In the course of the next settling of the Prisivashye, considerable changes in the structure of the ethnic population took place. At the beginning of the 60-s of XIX practically all the Nogais of Northern Prisivashye, and a considerable number of North-Crimean Tatars, left the boundary of Russia and settled in Turkey. The people from the interior gubernias (regions) of the Russian Empire occupied the abandoned settlements. Cattle breeding and farming were typical of the economic structure in the early XX-s. Traditionally the extraction of table salt plays an important role in the economical activity of local people here.

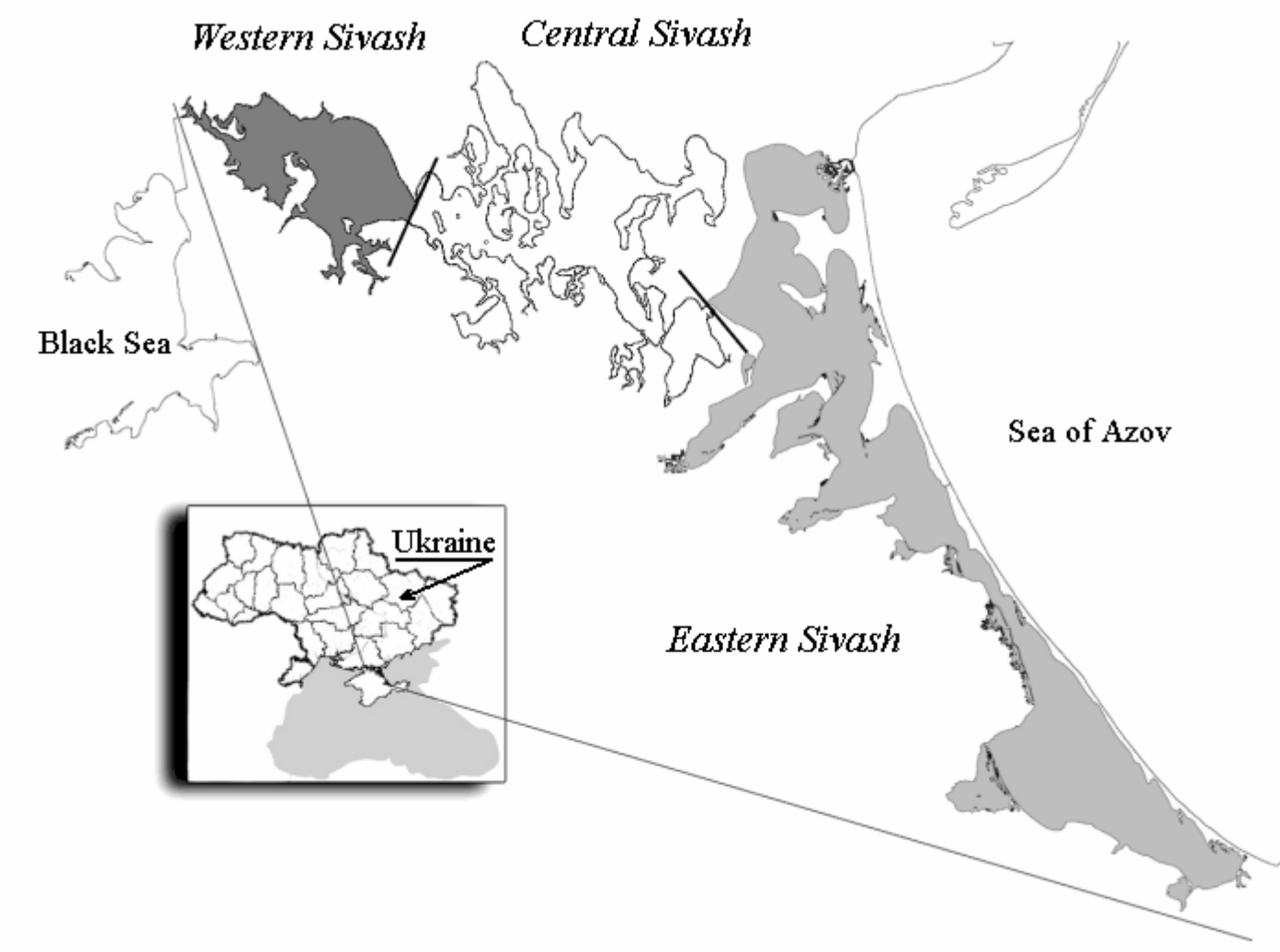

Figure 1. Map of the Sivash

2. Landscape diversity and climate

The Sivash is a natural museum of coastal shapes. A wonderfully jagged coastal strip and a wide diversity of coastal types inspire unforgettable picturesque views and give originality to the Sivash landscapes. Slopes and high landslides in the central and south-eastern parts of the Sivash provide refuges for rare birds and mammals. Plots of wormwood and wormwood-cereal steppe vegetation are located closely to precipitous coasts. Very large areas of feather-grass steppe reveal genuine beauty during the flowering period, shadowing the silver colour of the Sivash waters. Steppe plots wreathe in harmony with the design of the aquatic territories. 20 years of intensive irrigation has favoured the phenomenon of spreading fresh-water reed-marshes. Actually the area of reed-marshes in desalinated parts of the Sivash successfully competes with those in Dnipro and Dniester. Coastal salt marshes may be considered as a pearl of the Sivash. A bright palette of salt marshes, as one of the most picturesque and unique landscape elements of this region, is famous in August. A red-green carpet surrounds all salt lakes and gulfs. The riverbeds of some small rivers, which are typical for the Crimean peninsula, together with the Salgir-river - the biggest river of the territory - supplement landscape diversity.

More than 60 islands of continental and accumulative origin are located in Sivash waters. The biggest continental islands are Papanin, Kuyuk-Tiuk, Churiuk, Verbliudka, Kitay, Martinyachy and Russky. The island system of Koyanly, Chongar, Kairka, Salkovo and many other lesser islets represent accumulative (made of shells and clay) island systems. The two biggest depressions deserve special attention: the depression Shpindiyar and the depression system near the villages of Sivashskoye and Mikhailovka.

The Chongarsky peninsula, which juts deeply into the central part of the Sivash, naturally divides the gulf into separate reservoirs - Western and Central from the Eastern Sivash, they differ by hydrological and hydrochemical regimes. At the same time, for several decades artificial dams have separated Western, Central and Eastern Sivash from each other. Fig. 1

The Eastern Sivash is the biggest, occupying more than 60% of the total area. It incorporates the biggest accumulative island systems and spits including the Arabatskaya Strelka. The Eastern Sivash consist of 3 parts (Northern, Middle and Southern), bordered by the Genichesky and Chokrasky peninsulas from the east; and the Tiup-Tarkhansky, Tiup-Kazgansky and Dzhankoysky peninsulas and the Shakilinsky narrow spit - from the west. All the parts of the Eastern Sivash are joined together by a narrow strait system. Furthermore two straits in the east unite it with the Azov Sea. The shallow waters of the reservoir are planted with reeds.

The Central Sivash is separated from the other parts by regulated artificial dams equipped with sluices and pumps. In the southern part, close to the Sivash, there are 2 big isolated lakes: Aigulskoye and Karleutskoye. The Sergeevsky and Zelenovsky gulfs represent the northern part. Narrow straits unite these gulfs with the Sivash whilst from the other side artificial dams restrict them from the Sivash. Less shallow reservoirs in this part of the

Sivash have been transformed into fishponds. Jagged steep banks of the Central Sivash feature shallow waters with a depth of 0-10 cm (some quarter of the amount of the depth in open waters).

The Western Sivash is divided naturally from the Black Sea by the Perekopsky neck and, as already mentioned above, by a dam from the Central Sivash. The south-western part of the reservoir has been considerably altered by the functions of large industrial enterprises.

Most of the lakes here are separated from the main reservoir (Lakes Krasnoye, Kiyatskoye, Staroye, Krugloye). The Ad and Litovsky peninsulas divide the reservoir in two parts with the help of an artificial dam. Some of the lakes have been partially converted into industrial sinks and evaporators.

The following ecosystem characteristics determine the high value of the Sivash landscapes:

1. Large area (over 2640 km^2);
2. Highly indented and long coast line (about 3184 km);
3. High level of landscape diversity (shallows, freshened bays, flood lands, marshes, coastal precipices, islands of accumulative and mainland origin, virgin steppe areas, as well as artificial landscapes: rice fields, fish ponds, sedimentation tanks and cultivated lands);
4. Considerable areas of breeding habitats for waterbirds , among which islands of accumulative and mainland origin together with the reed beds and marshes make up to 50% of the total breeding area available;
5. Absence of both the tidal water level fluctuations and the influence of large riverine systems;
6. Rich biological diversity and sufficient feeding capacity for breeding and migratory birds;
7. Transcontinental significance of the territory for birds migrating between Eurasia and Africa as a moulting and wintering area (for some of them the only one);
8. The wetland is the main ecological corridor connecting coastal wetlands of the Black Sea and the Azov Sea;
9. Presence of non-freezing water areas on which the formation of wintering waterbird concentrations takes place.

The Sivash is located in a continental European region within the influence of a moderate zone. The climate here is very dry, with hot summers and mild winters. The continental air of temperate latitudes prevails here: it is cold in winter and warm in summer. The average daily temperatures pass the 5 degrees C mark at the end of March or beginning of April, and in autumn at the end of November. Evaporation prevails over precipitation. The annual average amount of precipitation is 403 mm. Most precipitation occurs in summer, commonly in the form of rainfall. As a result relatively little water is absorbed by the ground. During rainfall the penetration of moisture into the ground is no deeper than 5-8 cm. The amount of precipitation does not exceed 300 to 350 mm. In winter snow falls more often but in less amounts. Snow cover is around 22 cm in depth and lasts some

30 days. Fogs are observed all year round and have clear seasonal trends. The most severe fogs are in winter (23 days), the least severe (no more than 2 days) - in summer. Moderate mists prevail throughout the year.

The weather conditions in winter are determined by European and Asian cyclones, in summer - by the influence of high pressure located over the south of Europe. During the cold season the continental polar air dominates over the gulf. Arctic air masses are almost never observed here.

The atmospheric pressure has a correct annual lapse, the maximum is observed in winter, the minimum in summer. The average wind speed is 6.8-4.1 m/s, with a maximum of 24 m/s. The average duration of a freeze-free period in the north is 203 days and in the south - 222 days. The average summer temperature is +22 to +24 ^{o}C, the average temperature in January is 0 to +6 ^{o}C; although in some years strong frosts (-20 to -30 ^{o}C) have been recorded.

3. Biological diversity

Flora

There are three main features of the vegetation cover:

1. Large areas of true steppe, rich with different species of the genera *Stipa, Tulipa, Artemisia, Salvia,* and grasses (Poaceae=Gramineae), still remain here. These areas are located mainly on large islands in the Central Sivash: Churiuk, Kuiuk-Tuk, Russki, and Verbliudka, on small-upraised coastal plots or slopes. In the East Sivash such areas remain only on Papanin Island, Poligonny peninsula, and on small coastal plots.
2. South Ukraine's largest areas of halophytic vegetation are in the Sivash region. Species of *Salicornia, Halocnemum, Tripolium,* and *Plantago* predominate here. Almost all depressions on coastal and adjacent areas are overgrown with these plants.
3. Decreasing salinity in shallow and relatively deep bays has led to the formation of huge areas of reeds and other wetland vegetation. These plant communities are located mostly in the East Sivash, and they are now comparable in area to corresponding communities in the Dnieper estuary and the Danube Delta.

The Sivash region is situated in the zone of wormwood-fescue or wormwood-turfgrass Ukrainian steppes. Wormwood areas constitute a transitional belt between steppe and desert. Wormwood-grass steppes in southern Ukraine are located along the coasts of the Black Sea and the Azov Sea of as well as in the North and South (Crimean) Sivash regions. The main herbaceous plants of these steppes are such xerophytic species as *Artemisia taurica, Agropyron pectinatum, Festuca sp., Stipa lessingiana,* and *S. capillata*. The steppes in the Sivash region differ from the northern steppes by the presence of halophyte vegetation. Such halophyte-steppe species as *Artemisia santonica, Limonium caspium, Atriplex aucheri* are widely distributed here. The littoral vegetation of the Sivash region is denoted by the predominance of Mediterranean and Black Sea (Pontic) species, and the presence of many endemics, such as *Leymus sabulosus, Cakile euxina, Polygonum janatae, Asparagus pallasii, Achillea birjuczensis, Centaurea odessana, Limonium czurjukiense, Lepidium syvaschicum.* Species with disjunct ranges (*Limonium suffruticosum, Ofaiston monandrum, Tetradiclis tenella*), as well as species with mainly desert distribution (*Halocnemun strobilaceum, Suaeda prostrata*) are also very characteristic of the Sivash vegetation.

Some plant species listed in the Red Data Book of Ukraine were recorded in the North Sivash region: species of *Stipa, Tamarix gracilis, Allium scythicum, Astrodaucus littoralis, Asparagus pallasii, Tulipa schrenkii,* etc.

The vegetation of the Crimean Sivash is very interesting and typical for the Sivash. Natural vegetation has survived in areas unsuitable for the cultivation of crops (slopes, ravines, pods and salt marshes). It is comprised mainly of halophyte communities. Due to

the high salinity of the soils, the vegetation of the Crimean Sivash region is very specific, though not very diverse in respect of species and plant communities.

The most salty habitats are occupied by communities with a dominance of *Salicornia europaea* (the Arabatska Spit, and the banks of the Salgir river). Communities of *Suaeda prostrata* sometimes accompanied by *Petrosimonia brachiata, Salsola soda,* and *Salicornia europaea* are located somewhat higher up. Communities of *Bassia hirsuta, Salsola tragus,* and *S. iberica* occur comparatively rarely on the Arabatska Spit.

Communities of *Halimione pedunculata* are rather frequent along the Sivash coasts. They occupy areas with small amounts of salt and water in the soil. *Petrosimonia oppositifolia, Puccinellia fominii,* and *Limonium meyeri* grow on the upper parts of the landscape. Halophyte semishrubs are relatively well adapted to salt soils. They are represented by communities of *Halocnemun strobilaceum, Limonium suffruticosum, Halimione verrucifera,* and *Artemisia santonica,* which successively replace one another in a series of areas with decreasingly less soil salinity.

Areas with solonetz soil are inhabited by communities of *Camphorosma monspeliaca* (dry valleys, coastal zones, slopes), *Artemisia taurica* (old fallows, plain plateaus), and *Kochia prostrata* (slopes of the Sivash).

Psammophyte communities, with *Crambe pontica, Leymus sabulosus, Centaurea diffusa, C. odessana,* and *Carex colchica* represent the littoral vegetation of the Sivash.

Fauna

More than 30 mammal species inhabit the Sivash coast. The most valuable of these are Wild Boar, Muskrat, Coypu, Common Fox, Reccoon Dog, Badger, Polecat and Earth Hare. The latter three species are worth paying special attention to, because their habitats have significantly declined in the region today. The Sivash is the last stronghold of their populations, where relatively continuous distribution of such habitats ensures reproduction, which is so important for the individuals and families of these animals. As for the Earth Hare, there is no other place within the whole Ukraine more significant than the Sivash. An Earth Hare caught in the headlights of a car hurriedly running along a country road could easily be taken as a symbol of the *placor* areas of the Sivash.

The Sivash is inhabited by 4 amphibian and 6 reptilian species. Three of the latter are listed in the Red Data Book of the Ukraine. The Entomofauna of this area has been inadequately studied, but specialists expect it to constitute no less than 500-700 species of insects.

As a result of water freshening, the hydrofauna of the Sivash underwent notable changes in many areas. On some occasions its richness decreased locally, whereas an opposite trend is apparent at many other localities. Because of this, hardly any exact estimates are currently available. About 30-45 species of fish are supposed to inhabit the waters of the

wetland, whilst the hydrofaunstic list would be extended by 800-900 species of the phyto- and zooplankton, phyto- and zoobenthos if these are taken into account.

Birds

Two hundred and fifty five species of birds, representing 17 orders, are recorded in the Sivash area. The breeding ones make up about half of them (115 species), 216 species are migratory or vagrant, and 68 more stay over winter. Out of 67 bird species listed in the Red Data Book of the Ukraine, 37 are recorded in the Sivash. Twenty-three of them are breeding there. If one looks at the numbers and distribution of Squacco Heron, Glossy Ibis, Stone Curlew, Kentish Plover, Black-winged Stilt, Oystercatcher, Caspian Tern and Great Black-headed Gull along the whole of the Azov-Black Sea coast, one would easily come to the conclusion that they are mainly concentrated in the Sivash. It is worth to noting that such breeding birds as the Little Cormorant, Lesser Kestrel and Bustard have a high conservation status on a European level as well.The birds are discontinuously distributed over the wetland. Depending on their ecology and status they use various habitats, of which the most principal are as follows; water areas, salt marshes, islands and spits of accumulative origin, reed beds, coastal precipices, and man-made habitats (pastures, agricultural fields, forest belts and various buildings.)

Breeding

The highest numbers of breeding birds are found in the Eastern Sivash, whereas the western part of the waterbody is characterised by the lowest breeding density. The Central Sivash takes the intermediate position in this respect. The majority (55,200 pairs) of non-passerine birds breed on the islands of accumulative and mainland origin, that makes 68.8% out of their total numbers in the Sivash. Gulls, terns, waders and Cormorants predominate by numbers. 10,064 pairs (12.5%) inhabit the reed bed complexes, whereas other habitats hold 7.7-10.9% out of the total breeding numbers (1998 data). The islands also take the leading position by the number of breeding colonies, (40), of which 22 are located in the Eastern Sivash. Many of the colonies are also found in the saltmarsh depressions. The areas of the Eastern Sivash are the most valuable breeding territories, holding most of the colonies with high numbers of birds.

In the area as a whole, for southern Ukraine, waterbird colonies in the Sivash are the principal location for 4 species of grebes (they constitute 56% of their regional population), 3 species of birds of prey (38.5%), ten species of *Ciconiiformes* (18.7%), and Cormorants (50%). Up to 19.9% of the regional populations of gulls and terns also breed in this wetland. Breeding bird numbers found in the Sivash constitute about 50-80% of the regional population estimates for Herring Gull, Great Black-headed Gull, Caspian Tern, Gull-billed Tern, Great White Egret, Glossy Ibis, Common Tern, Black-winged Stilt, and Kentish Plover, whilst the breeding settlements of 4 larks, comprising 90% of their regional numbers, are merely unique.

For a number of species breeding in the Mediterranean, the Sivash population comprises a significant proportion of their overall totals. Thus, among them are: Kentish Plover

(20%); Little Ringed Plover (10%); Great Black-headed Gull (60%); Common Tern (10%); and Roller (8%).

Migrations

Spring migration starts at the end of February. In April-May migration takes place together with the intensive breeding of local populations. The last spring migrants (Sanderlings and Turnstones) leave the Sivash in early June, when many local birds already have chicks. By mid-July the first waders, having lost their clutches in the tundras, have already arrived in the Sivash (Curlew Sandpipers, Dunlins, Ruffs). The period of autumn migration lasts from this moment until early November, while by the end of December the formation of the wintering bird communities is complete.

The Sivash is rightfully considered to be the most significant concentration area for birds in the Northern Mediterranean (Fig. 2). This was recently confirmed by the expedition organised and financially supported by Wetlands International - AEME. For 10 days in August 1998 the joint research team of the Foundation Working Group for International Waterbird and Wetland Research (WIWO) and the Azov-Black Sea Ornithological Station managed to synchronously survey waterbirds in the whole area of this wetland. The results revealed that more than 1.4 million non-passerine waterbirds were using this waterbody at the time of the counts.

The analysis of bird distribution in August 1998 indicated that the habitats of the Eastern Sivash attract many more birds (914,000 individuals) due to the predominance of the freshened water areas and related vegetation. The maximum species diversity was also recorded in the Eastern Sivash (27.1 - the average number of species per counting unit). Among others herons, Glossy Ibises, Coots, *Anseriformes* and Cormorants predominated.

The total number of birds in the Central Sivash came to 443,000 individuals. Only waders were represented in numbers comparable with those in the Eastern Sivash, while other taxonomic groups were less numerous. Shelducks and Ruffs, related to the hypergalinic areas of the Sivash were the only exceptions, as the percentage of these birds in the Central Sivash was 90% and 70% respectively compared to the other two parts. An explanation of the high concentration of Ruffs in this area is discussed separately. The average number of species per location amounted to 21.7.

The Western Sivash, subjected to significant transformation of the water area and coastline, appeared to be the least suitable territory for birds. Only 73,000 individuals were counted there, most of which had been restricted to the adjacent bays and other habitats with rich food and good protective qualities. The lowest average number of species per location (17.9) was also found in the Western Sivash.

Given the relatively high turnover rate of most gulls, terns and waders, the actual estimate is likely to be very high. Approximate calculations show that the numbers of, for example, waders, passing the region may run up to 1.5-2.0 million individuals. Similar estimates for herons give a figure of 30,000, for ducks - more than 500,000, and for Common Cranes - up to 45,000 - 60,000 individuals. Numbers of many rare or

disappearing migratory species are as high as hundreds or even thousands of individuals. In August 1998, the numbers of some species listed in the Red Data Book of the Ukraine amounted to: 2,934 - for Glossy Ibis, 4654 - for Black-winged Stilt, 2180 - for Collared Pratincole, and 1371 - for the Caspian Tern.

The territory has transcontinental significance for birds migrating from Eurasia to Africa as a stopover etc. Interestingly enough for one of the Scandinavian waders - the Broad Billed Sandpiper (*Limicola falcinellus*) - the Sivash is the main staging area on the way from Norway to the Arabian peninsula and back.

Figure 2. Map showing the range of recoveries of birds ringed in the Sivash

Wintering

Mild and almost snowless winters together with non-freezing saltwater areas provide stable conditions for wintering birds. The adjacent agricultural lands also provide additional food for ducks, geese and swans. The numbers of ducks can reach 320,000 or more.

Some years up to 200,000 - 250,000 White-fronted Geese, 4,000 - 8,000 swans and 20,000 - 30,000 Shelducks winter in the Sivash. Besides them, in winter such rare and scarce birds as the Peregrine, White-tailed Eagle etc. can also be found.

To stress the international importance of the area for waterbirds, we can list the countries where the birds (mostly waterbirds) ringed by the Azov-Black Sea Ornithological Station were recovered. More than 1200 ringing recoveries from: Norway, Sweden, Finland, Germany, Denmark, the Netherlands, Belgium, England, France, Poland, the Czech Republic, Hungary, Austria, Romania, Bulgaria, Italy, Spain, Portugal, Greece, Turkey, Israel, Morocco, Tunisia, Egypt, Senegal, Nigeria, Somali, Chad, Ethiopia, RSA, Iran, United Arab Emirates, Malta and others, show the geography of waterbird migrations.

The Ukraine is located on the major bird flyways of Southern Europe. The conservation of migratory species of animals is outlined by the contents of the Bonn Convention and the special Afro-Eurasian international agreement (AEWA) which regulates the actions of individual countries. It will be easy for the Ukraine, which has signed only the latter agreement, to join the international co-operation, because wetlands such as the Sivash are known all over the world. The study and protection of the bird flyways significantly contribute to the co-operation of different countries in the conservation of the genetic fund of disappearing populations and species.

4. Mineral resources

The mineral resources of the Sivash have drawn the attention of scientists since the Crimea region became a part of Russia. In 1834 Prof. Gabel carried out an analysis of the brine of the Sivash and Perekopsky lakes. Further investigations of the Sivash were fulfilled exclusively in order to learn the peculiarities of the chemical composition of its water solutions. In the 1920-s Prof. E. Burkser carried out hydro-chemical investigations of the water and bottom sediments of the Sivash for balneological purposes.

In 1934 the Crimean scientific-research station at the Academy of Sciences of the USSR undertook a careful hydro-chemical analysis of all Sivash waters. In 1935 investigations of the bottom sediments of Western Sivash were carried out by the All-Union Institute of Galurgy together with the Institute of Geology of Academy of Sciences of the USSR. In the 20-s a study of the irrigation of natural complexes of Prisivashye was begun. Investigations were carried out on key coastal plots and Sivash islands within the boundaries of the Melitopol region. The practical realisation of scientific findings concerning the wide use of mineral resources of the Sivash took place after the Great Patriotic War.

In 1950 the decision was adopted to build the Kakhovskaya hydroelectric power station and hydro-technical irrigation complex. The main goal of the complex was to provide the population and economies of the south - eastern part of Ukraine with a reliable water supply. As a result the Kakhovskaya and Severokrimskaya irrigation systems, respectively in Northern and Southern Prisivashye, were created.

Detailed investigations of the mineral resources of the Sivash stipulated considerable changes in the economic development of the region. During the post-war period chemical industries, textile industries, food industries and machine building were developed here.

Mineral ores from the Sivash and Perelopsky lakes are used by enterprises of chemical industries located in the towns of Krasnoperekopsk and Armiansk. Crimean soda and Perekopsky bromine plants are located in Krasnoperekopsk. The Crimean soda plant is the biggest manufacturer of sodium alkali in the Ukraine. The Perekopsky bromine plant specialises in the production of a variety of bromine compounds. The Crimean enterprise "Titan" specialises in the production of titanium dioxide, dyestuffs and sulphuric acid.

The Sivash industrial area is the biggest source of industrial raw materials in the Ukraine. In the former USSR it provided 20% of All-Union production of sodium alkali, 40% of bromine and 60% of magnesia. Resources of raw materials for the production of table salt are practically inexhaustible. Static resources calculated for January 1, 1983 (the date of the last geological survey) consist of: brine - 2144 mln. cub m; sodium chloride - 102802 thousand tons; bromine - 227 thousand tons; magnesium - 5357 thousand tons. Dynamic resources: brine - 950 mln. cub m; sodium chloride - 10000 thousand tons; bromine - 25 thousand tons; magnesium - 710 thousand tons. (Static resources - contained in Sivash reservoirs; Dynamic resources - come from the Azov Sea). Strontium (15-20 mg/l),

lithium (0.63-2.9 mg/l), boron oxide (8-25 mg/l), rubidium (up to 0.88 mg/l) are found in Sivash brine in non-industrial concentrations.

The Sivash possesses large resources of curable mud. Resources of iodine-bromine underground waters with an industrial content of bromine and iodine have been found in north-west Sivash in the boundaries of the Sivash depression and are suggested to be of use for balneology. Silt curable mud from the lake of Salkovo, the Yaroshinsky estuary, Western, Middle Sivash and the southern part of the Eastern Sivash has practical significance for the pharmaceutical industry.

5. Threats to the biological and landscape diversity of the Sivash

The main changes in the Sivash and its adjoining territories are connected with the changing of the natural hydrological regime, the discharging of polluted waters, and the destruction of native coastal ecosystems.

Changes in the Hydrological Regime

Changes in the natural hydrological regime are caused by a number of factors, of which the impact of the Northern Crimean Canal is the most important. In spite of the fact that this canal is one of the biggest canals in Europe and it is very important for human life and economic activity, its waters brought not only goods, but serious problems too. Solution of these problems will require great effort and significant expenditure.

The length of the main canal and the dense net of small canals of irrigation systems in the Sivash region is 3,200 kilometres. Because of mistakes during project design, its construction and exploitation, the significant part of receiving water is filtered through soils and leads to the flooding of settlements, swamping, secondary salinisation etc. To avoid these impacts, a special drainage net of holes, wells, and canals was established. It discharges surplus waters into the Sivash and salt lakes near the Sivash. Practically all channels of small rivers, gorges, and swamp systems are used for this purpose.

Large volumes of fresh water are discharged into the Sivash from rice fields, other agricultural lands, and fish-breeding ponds. In previous years, when the payment for water was scanty, sizeable volumes of water, used for irrigation, ran as transit flow into the Sivash through irrigation canals.

The total volume of discharging waters is more than the total volume of natural flow. Therefore, the salinity of Sivash was decreased almost 10 times. In spite of some reduction in discharges in recent years, the level of salinity in the Sivash has not been restored. The Eastern Sivash suffers more than other parts of the Sivash from the discharging of fresh waters and its consequences. The salinity of the Eastern Sivash does not exceed 20 parts/1,000. The salinity of the Central Sivash does not exceed 40 parts/1,000. The Western Sivash does not suffer from the desalinisation of water. It was transformed into a reservoir and used as a source of raw materials for industry. Enterprises from the cities of Krasnoperekopsk and Armyansk use minerals and raw materials from the Western Sivash. The total volume of Sivash water, used for the needs of enterprises in the Perekopsk Experimental Economic Zone, is about 0.044 cubic kilometres per year.

The changing of water salinity and some other factors, in particular the eutrophication of a reservoir, described below, led to a whole series of changes in the Sivash ecosystem. Desalinisation changed the specific composition and numbers of hydrobionts - organisms, living in the water. First of all, it concerns fisheries. Glossa is a striking

example. In the first stages of Eastern Sivash desalinisation, when salinity was decreased to the level of 25-30 parts/1,000, spawning and fattening areas of this species were increased considerably. Species numbers were increased correspondingly. At the beginning of the 1990s, under the further decreasing of water salinity, there were almost no places left suitable for spawning. In 1987, the catch of glossa was 919 tons, in 1994 - 54 tons, in 1997 - 28 tons. Another striking example is the Far Eastern grey mullet. The introduction of this species into the Azov Sea was begun in 1975. A marketable population was formed in 1992. As a result of water desalinisation to the level of 18-20 parts/1,000, Eastern Sivash became one of the main spawning places of this species. Particular fresh water species like crucian, carp and others, appeared at places of intensive fresh water discharge.

The appearance of vast reeds that seize new areas of shallow waters is another consequence of Sivash desalination and carrying-out a lot of biogenic elements from it. There are namely those shallow waters that have values for recreation and for the feeding of billions of migratory sandpipers. At the first stages of reed development, the combination of reed beds with open stretches makes them attractive for many ducks and other bird species. Such reeds give birds an opportunity to shelter from predators and humans. Furthermore, a large amount of fresh water plants and invertebrates appear here. They are used as food for birds. However, as the reeds develop, the feeding base becomes steadily worse. Together with these changes, the majority of birds disappear. The reeds then become suitable only for habitation of small numbers of bird species.

Reeds reduce fattening areas for glossa. If the decreasing salinity reduced the opportunities of this species for spawning, the overgrowth of areas of shallow waters by reeds reduced opportunities to feed normally. To some extent, it is even possible to call reeds at the last stage of their development a desert. By now, areas of Sivash reeds are quite comparable with areas of reeds in the Dnieper and Dniester deltas and may even exceed them. Unfortunately, the overgrowth of shallow water areas is continuing at a high rate.

The construction of dams, dividing the Sivash into three separate parts, practically transformed an integral ecological system from a common reservoir into three separate reservoirs: Western, Central, and Eastern Sivash. As noted above, Western Sivash has been practically transformed into an industrial reservoir.

Discharge of polluted waters

The consequences of water pollution can be diverse as much as the pollutants are diverse. Quite often, insignificant amounts of some substances lead to serious and even tragic consequences. There are many examples in other areas of our planet. The pollution of the Sivash waters takes place mainly as a result of pesticides and chemicals used in agriculture, especially during rice cultivation, as well as household and industrial sewage. The annual water discharge into the Sivash is 0.29 cubic kilometres, including 0.20 cubic kilometres of collection and drainage waters, discharges from rice fields and 0.09 cubic

kilometres of sewage. Sewage adds 1,050 tons of organic substances, 36 tons of sulphates, 4,085 tons of chlorides, 103 tons of ammonium nitrogen etc. into the reservoir.

Industrial water pollution is typical of Western Sivash. Here, especially in the system of salt lakes adjoined to the Sivash (for example, the Krasnoje Lake), industrial wastes, including toxic ones, have accumulated. The level of industrial contamination in some territories of the Western Near-Sivash region is catastrophic. Pollution has filtered into the exploited basins of underground waters. In particular, high levels of lead, cadmium, manganese, and zinc have been registered.

Territories have been contaminated which could otherwise be used for treatments (medicinal dirt) and human recreation. The leaking of toxic substances, into underground water basins used for drinking, has reduced the quality of drinking water, making it of little use and even unsuitable for use. The discharge of polluted waters leads to the accumulation of toxic substances in fish, used as food by local people. The accumulation of toxic substances in hydrobionts leads to their accumulation in higher links of the trophic chain, for instance, in birds that eat water animals and plants. In the case of birds, toxicants are accumulated in the yolk of the egg. This considerably reduces the success of bird reproduction. Besides toxicants, the microbial contamination of surface and underground waters is dangerous. It leads to the threat of gastric, intestinal and other diseases.

The introduction of considerable amounts of biogenic elements into the Sivash ecosystem influences it significantly. Biogenic elements are actively included in biological processes and promote an increase in the total productivity of organic substances. Such a phenomenon is called the eutrophication of reservoirs and, in the end, leads to the acceleration of the rate at which they are turned into marshland.

Transformation of land ecosystems

Intensive ploughing of the virgin land took place 20-30 years ago. For example, in a Crimean part of the Near-Sivash region more than 70% of the land has been ploughed up. Most parts of this land are not cultivated at present but are used for livestock pasture.

This is connected with a total decrease in agricultural production. Nevertheless, in many places the restoration of natural grass complexes did not take place. Secondary weeds occupy most of the territory. Unfortunately, restoration processes are taking place too slowly. Quite often overgrazing and, as a result, desertification of separate territories takes place. The destruction of the land's ecosystem is also connected with the establishment of rice fields and fish-breeding ponds, wrong irrigation, flooding by underground waters, and the secondary salinisation of soils.

Flooding and the secondary salinisation of soils intensifies the problem of overgrazing, because it reduces areas suitable for grazing and leads to the overloading of preserved pastures. It is necessary to note that the establishment of rice fields and fish-breeding ponds, whilst destroying initial land ecosystems, has created favourable conditions for the

nesting and feeding of some species of near water and waterfowl birds, particularly storks, sea-gulls, and sandpipers.

Wide scale use of chemicals (pesticides) and fertilisers influenced, and partly continues to have a considerable negative impact on, the flora and fauna of the land's ecosystems. In previous decades, scientists repeatedly registered mass poisonings of birds and mammals in the Sivash and Near-Sivash region. Under the influence of chemicals, a reduction in the numbers of many useful species of invertebrates, including the Red Data Book of the Ukraine species, has taken place. Although it is necessary to note that in recent years the amounts of fertilisers and pesticides used have been considerably reduced in connection with the worsening economic situation. As a result of human activity, natural steppe ecosystems have been practically destroyed around the Sivash. The existence of steppe biota is threatened.

Other human impacts

Among those human impacts not mentioned above, hunting and the disturbance factor are the most important. Hunting is a factor with direct impact on biota. First of all, it concerns mammals and birds. A number of different organisations are responsible for the management of the hunting economy. They are the Ukrainian Society of Hunters, the Dzhankoj forest hunter club and the Crimean Military Society of hunters and fishermen. Twenty species of mammals and about 50 species of birds are potentially hunting species in the region. However, the real numbers of species are less, because some of them are protected. They have been included in the Red Data Book of the Ukraine. Unfortunately, this often does not save them from being killed by hunters. There are some reasons for this. Firstly, it is due to a low level of discipline and the violation of hunting rules. Quite often, it is due to hunting in a drunken state as well as the hunters' poor knowledge of birds. The latter factor is especially important for some threatened bird species. Shooting in conditions of bad visibility, in the twilight or at night, leads to the deaths of even distinctive species. Unfortunately, clear data about the impacts of these considered factors is unavailable. Nevertheless, on the basis of research conducted in other regions, as well as separate observations by ornithological scientists, it is possible to consider the negative impacts of these factors as being very important.

The direct pressure from local people on birds is expressed not only in legal hunting and fisheries, but also in different forms of poaching. According to data from ornithological scientists, in the Chongar Islands, for example, local people store up bird eggs in large amounts. Mediterranean Gulls and Slender-billed Gull have suffered from this.

It is especially necessary to stress the disturbance factor. Human presence, independent from that of people having any economic activity, or simply recreating in nature near nesting colonies, feeding, recreating, migrating or hibernating crowds of birds, often leads to negative consequences for these birds. Thus, even temporary human visits to bird colonies can lead to the deaths of up to 80-90% of eggs and nestlings from young generations. Multiple disturbances do not give feeding and recreating birds the opportunity to feed and recreate normally. As a result, this leads to birds weakening and

to increasing numbers of deaths. The especially strong influence of this factor becomes apparent close to settlements and places of people's mass recreation, for example, at the Arabatskaja Strelka.

6. Conservation of the nature complexes of the Sivash

Protected Areas

The Azov-Sivash National Nature Park (NNP), established on the basis of a hunting reserve at the end of 1994 (Kherson Oblast, an area of more than 40,000 hectares) is the biggest protected area located in the Sivash region. The park's cordons are situated on the Kuyuktuk and Tchuryuk islands. Besides this there is the Arabatskiy Botanical Zakaznik of national importance (1974, Lenin Rayon, Autonomous Republic of Crimea, 600 hectares), the Prisivashskiy Botanical Zakaznik of local importance (1979, Nizhnegorsk Rayon, 998 hectares), and the "Aqua Complex of Arabatskaya Strelka" Hydrological Monument (Lenin Rayon, 150 hectares).

In the future it is expected that the existing Azov-Sivash National Nature Park will be expanded to form the Kalinovskiy regional Landscape Park, and the Sivash National Nature Park. The latter will include 8 reserved ornithological zakazniks (sanctuaries) with a total area of more than 12,000 hectares: Tchongarskiy (150 hectares), Mysovoj (1,060 hectares), Dzhankoj Bay (2,000 hectares), Zmeinyje Islands (700 hectares), Plavni (2,500 hectares), Octyabr'skiy (3,500 hectares), Arabatskiy 1 and Arabatskiy 2 (2,100 hectares).

The main problem lies with the fact that the natural complexes of the Sivash function as a single whole. A bird's movements within a twenty-four-hour period, from one bay to another that may be located in an almost opposite direction, demonstrates this especially clearly. The provisional absence of co-ordination between administrations in the defining of a regime of protection, and of the structure of protected areas, in conjunction with a difficult economic situation in the region, has hindered the achievement of the necessary level of protection of the unique natural complexes of the Sivash and their sustainable use.

Conservation Projects

Currently, integrated scientific programmes to study the Sivash do not exist. In the 1970s separate investigations were carried out by researchers from the Institute of Zoology of the National Academy of Science of the Ukraine and the Melitopol Pedagogical Institute.

From the 1980s, the Azov-Black Sea Ornithological Station has paid special attention to the Sivash. However, these research projects have had mainly ornithological orientations. The Ornithological Station developed the "Tetis" Project, including the "MAP-Ukraine" Scientific Programme for wetland study. The scientific programme "Monitoring and Maintenance of Biodiversity in Wetlands of the Ukraine" was developed jointly with leading Ukrainian scientific institutions.

Since 1991, the Central Department of Science of the Ministry of Education of the Ukraine has financed the scientific theme of the investigation of biodiversity in the Sivash wetlands and other reservoirs of international importance. Also in 1991, MEPNS of the Ukraine jointly with the State Committee for Environment Protection of

Autonomous Republic of Crimea provided funds for the substantiation of protected areas in the Sivash region.

Foreign projects were implemented by the Dutch organisation WIWO. Jointly with the Ornithological Station, 3 projects in the Sivash region were implemented (WIWO-90/91; Azov-92/93 and WIWO-93/94). In 1998, a fourth project was finished. Joint research in the Sivash region was implemented in accordance with scientific agreements with the Netherlands (Ministry of Agriculture, Nature Management and Fisheries), Germany (Institute of Ornithology Vogelvarte), Poland (Ornithology Station of Polish Academy of Sciences) and Italy (National Institute of Wild Fauna).

Scientific projects carried out over the last few years are the most prospective and significant. According to the 1997-2002 Ramsar Strategic Plan and Black Sea Wetlands Action Plan, an inventory of those wetlands having national and international importance along the Ukrainian coast of the Azov and Black Seas will be provided.

The project "Support to the Conservation of Wetlands and Wetlands Species in the Azov-Black Seas Region of Ukraine" has been carried out in accordance with the three-year project of Wetlands International (1997-2000) and under the support of the Netherlands government and MEPNS of Ukraine. Special attention in this project is being paid to biodiversity evaluation and the management needs of the Sivash region.

The GEF/World Bank project "Biodiversity Conservation in the Azov-Black Sea Ecological Corridor", which is currently being prepared, is the key project for the Sivash today. The international and global importance of the biodiversity of the Azov-Black Sea coast is discussed in the project. The Sivash is the most important territory of the Azov-Black Sea coast. A distinctive feature of this project is that it is not only planning scientific research, but also the provision of concrete actions for the studying, restoration and conservation of the natural environment.

Management of the Area

The main directions and purposes of Sivash management are under preparation. A full management plan of the Sivash will probably make up a series of ten thick volumes. For their preparation, a large amount of work will be required for the gathering and analyses of data as well as the use of a wide circle of specialists and local people. Proceeding from the environmental problems of the Sivash and the regional and national priorities of environment protection, as well as the international commitments of the Ukraine in the field of the environment, we see the main purposes of management as follows:

Strategic goal

To develop and implement an integrated system of administrative, legal and economic measures, which: secure the protection of the wetlands and its natural resources; minimise or prohibit activities that damage the Sivash ecosystems; promote the development of the economy in the region according to the principles of sustainable

development; and enable the active participation of local people in environmental decision-making.

Objectives

A. To establish and realise a detailed plan for biodiversity conservation.

Main directions of activity:

- the establishment of a network of protected areas (including the remainder of the steppe ecosystems as well as areas of shallow waters, islands, and other biotopes which are important for breeding, migrating and wintering birds);
- develop and implement an integrated management plan for the entire Sivash and detailed management plans for all protected areas;
- the restoration of degraded territories;
- the protection of rare and threatened animal species;
- reed management to maintain maximum biodiversity;
- the support and restoration of original fish stocks;
- the regulation of hunting and the disturbance factor;
- the establishment of a system of monitoring for the state of biological objects (in first instance birds) as part of a total system of environmental monitoring;

B. To develop and implement concrete action plans for different branches of economic activity in the region as well as for separate enterprises, directed at reducing the negative impacts on the Sivash ecosystem and, in the first instance, at the transition to environmentally friendly and resource saving technologies.

Main directions of activity:

- development of an integrated land-use plan for the entire Sivash region (including the areas with a hydrological link with the Sivash as well as the economic zones);
- decrease the total volume of fresh water discharges into the Sivash;
- decrease the disposal of sewage (domestic, industrial, agricultural);
- solve environmental problems caused by rice growing;
- reduce the areas of arable lands and promote renaturalisation of these areas;
- regulate grazing;

C. To raise awareness and environmental consciousness of people, encouraging them to actively participate in the solution of regional environmental problems.

Main directions of activity:

- the permanent elucidation of the international importance of the Sivash wetlands and biodiversity as well as its threats and environmental problems, via for instance local mass-media;

- the inclusion of information in the school system about the international importance of the Sivash wetlands and biodiversity as well as its threats and environmental problems, particularly at the level of secondary specialised and higher education;
- the publishing of environmental information and education materials (leaflets, booklets, posters etc.), to elucidate the international importance of the Sivash wetlands as wells as its threats and local problems;
- promotion to establish and activate public environmental organisations;
- the establishment of a mechanism for free public access to environmental information (for example, by the establishment of public committees under local authorities and the main nature protection services)

D. To establish an environmental monitoring system as well as systems for obtaining information rapidly and responding to environmentally dangerous emergencies.

E. To conduct additional complex researches for the gathering and specification of data, which characterises the present state of the Sivash and it's adjoining territories.

Annex

Sivash Birds from the Red Data Book of the Ukraine

Shag - *Phalacrocorax aristotellus*. A rare species that is likely to be present during the autumn, in the concentrations of Cormorants at some places, along the Azov Sea coast in the Kirovski district of the Crimean Republic. The closest breeding areas are Kazantip and the coast of the Tarkhankut peninsula in Crimea.

Little Cormorant - *Phalacrocorax pygmaeus*. A rare species which breeds in the reed beds of the Eastern Sivash in mixed colonies together with Glossy Ibises, Great White Egret and Little White Egret. It occupies the periphery of the colony and builds nests in the intermediate stratum. The numbers are decreasing and currently do not exceed 10 breeding pairs. The closest colonies are situated in the Makarovsko-Chabanski *pod* (a depression with saltmarsh vegetation) on the border of the Western Sivash in the Kherson region. There are no stable colonies in the Sivash, as the birds annually move, together with other *Ciconiiformes*, over the reed beds of the Eastern Sivash.

White Pelican - *Pelecanus onocrotalus*. Rare species recorded in the last three years (1996-1998) during the post-breeding movements. All birds (8) were seen in the Eastern Sivash keeping to the open water areas in the bays with reeds. Seven birds were recorded in the Sovetski district in 1998. The closest breeding areas known are in the Danube Delta and in the Primorsko-Akhtarskie *plavni* (vegetated downstream parts of rivers) in Russia.

Squacco Heron - *Ardeola ralloides*. A common species breeding in the reed beds with adjacent open water areas and short reeds. It mixes with other *Ciconiiformes* colonies. The heron builds nests in the lower stratum close to Glossy Ibises and Night Herons. It apparently avoids the neighbourhood of the Great White Egret and Little White Egret. The main breeding colonies are found in the Dzhankoiski and Sovetski districts of the Crimean Republic. They annually move to new places within the bays. Numbers fluctuate from 60 to 100 breeding pairs. The closest breeding areas are in the Karkinitski bay of the Black Sea (Lebiazhi Islands) and in the Chernomorski Biosphere Reserve (Volyzhin Forest).

Spoonbill - *Platalea leucorodia*. It is this species in which numbers are increasing in the Sivash. Two colonies are known in the Eastern Sivash. They are usually located far from the coast and far in the bays. Birds visit the feeding habitats, located as far as 10 km from the colony, irregularly. Instead of them, the open and semi-open shallows, irrigation canals or rice fields are used for foraging.
Water pollution, the degrading of reed beds, and the decreases in the feeding capacity of the wetlands are the main factors limiting distribution of the species.
Spoonbills arrive at the breeding areas in March, and in some years in early April. They do not breed in mono-species colonies, while the ones mixed with other herons are fairly common for southern Ukraine. The nests are located on reeds next to small straits or open

water areas in the lower stratum (0.6-0.8 m above the water).
The numbers in the region fluctuates. On the one hand, it is decreasing in the old colonies (the Danube Delta), but on the other hand, new colonies with growing numbers are appearing in the Sivash. None of the existing colonies can ensure the stability of the population. In general, the numbers are close to a dangerous limit.
The pollution of shallows, coming from the rivers and reed beds, the decline of the prey species, and disturbance by man are the main threats to the species.

Glossy Ibis - *Plegadis falcinellus*. This species has occupied new habitats and is slowly increasing in numbers. There are 4 colonies of Glossy Ibis in the Sivash, totalling about 400-500 pairs. The birds choose dense reed beds in the brackish or freshwater bays for breeding. Feeding habitats are similar to the breeding ones and also include rice fields. The birds return from their winter quarters at the end of March - April. Intensive egg laying takes place from 20 April to 26 May. Terms of breeding are highly variable between seasons as well as between the sub-colonies during one season. The nests are located in separate groups in those colonies mixed with other herons. They are usually found in the lower stratum (up to 0.4 m above water), but this can vary. Breeding density is high. After fledging the young migrate east and west from the native colony, although in some years they can stay there until late September. Glossy Ibises leave the breeding area in October.
The numbers strongly fluctuate each year. The oldest and the most stable colonies are found in the Danube and Dniestr deltas, in the Karkinitski bay and in the Eastern Sivash. Some insignificant increases only are observed in the Sivash.
Disturbance by man, the degrading of reed beds, the draining of the deltaic areas and the pollution of shallows and bays are the main threats to the breeding population.

Bewick's Swan - *Cygnus bewickii*. This is a very rare vagrant of the Sivash. The birds can be recorded at the end of November - December. They leave for the breeding grounds in March. Numbers are very low.

Red-breasted Goose - *Branta ruficollis*. This goose is recorded all over the Sivash during migration and in winter. Depending on the weather several thousands of birds pass through, and about one thousand of them winter in the Sivash. A general increase in numbers is apparent, but annual fluctuations are nevertheless high. The Sivash has great significance for the species because the main migratory route comes across it, from the Caspian Sea to the north-western areas of the Black Sea region.

Ruddy Shelduck - *Tadorna ferruginea*. Single breeding pairs occur mainly on the coast of the Central and northern part of the Eastern Sivash. Besides that, single vagrant birds and small groups happen to stay in spring, summer and winter. Some hundreds of birds concentrate in autumn only in the southern part of the Eastern Sivash. They probably originate from the Kerch peninsula. From mid-July the ducks unite in small groups and move to their moulting sites in the south of the Eastern Sivash and the Kerch peninsula. The Sivash has great significance for the species as a potential territory for further breeding expansion.

Ferruginous Duck - *Aythya nyroca*. Single pairs can breed in the reed beds on the ponds, freshened bays and saltmarsh depressions. Migratory and wintering birds are also scarce, but occur practically throughout the Sivash territory. The numbers are stable and low, although the Sivash has great significance for the restoration of the species population.

Red-breasted Merganser - *Mergus serrator*. Single pairs breed mainly in the Eastern Sivash. The species migrates and winters in small numbers. The numbers are stable and low, although the Sivash has great significance for the restoration of the species population.

Osprey - *Pandion haliaetus*. This is a scarce migrant. The bird is recorded in the Eastern Sivash much more frequently, where the fish stock is higher.

Hen Herrier - *Circus cyaneus*. The species commonly migrates and winters in the Sivash. Females predominate in winter. Thin and irregular snow cover in the area allows for the successful hunting of small rodents. Winter-time records show even distribution over the whole area of the wetland.

Pallid Herrier - *Circus macrourus*. Extremely rare migratory species, which has been known to breed. Single males and females have been recorded during the breeding season, but no confirmation is available up to now. The vagrant herriers most frequently occur in summer.

Long-legged Buzzard - *Buteo rufinus*. In the last 3-4 years this has become a regular vagrant species. Single adults and immature birds are recorded from April to October throughout the Sivash coast. The birds hunt small rodents, as the herriers do.

Steppe Eagle - *Aquila nipalensis*. At the beginning of the century it bred on the coast of the Sivash. It disappeared from the whole territory of the Southern Ukraine, but single vagrant birds occur in the steppes of Crimea close to the southern coast of the Sivash.

Spotted Eagle - *Aquila clanga*. This is a rare migratory bird. Most records (apparently of juveniles) were made during late summer or autumn. As well as the other eagles the species does not show any preference of a particular habitat in the Sivash.

Imperial Eagle - *Aquila heliaca*. This eagle is a rare migrant recorded mainly in the autumn.

Golden Eagle - *Aquila chrysaetos*. Only single records of the migratory birds are known. In warm winters it stays on the coast of the Sivash. Juvenile Imperial and Golden Eagles, which have run into the electric power lines along the Sivash coast, are sometimes found by field workers, fishermen or hunters. It is known that these large birds of prey are sometimes killed by mistake too.

White-tailed Eagle - *Haliaeetus albicilla*. This is a common wintering eagle of open areas. It usually keeps close to the large concentrations of Mallards, Mute Swans, White-

fronted Geese and Coots, preying upon weak or looking for dead individuals. During the ice free period they also fish, taking dead or weak fish as well as live, healthy fish.

Saker - *Falco cherrug*. This is one of the largest breeding falcons of the Ukrainian fauna. Nests are made on the high clay precipices of the Sivash. The total population does not exceed 5-6 pairs. Its breeding is often unsuccessful because of the intensive erosion and slumping of the coast. The falcon preys upon sousliks, and less frequently upon other rodents or birds.

Peregrine - *Falco peregrinus*. This species regularly migrates and winters, but it is rare everywhere. During migration its diet consists of waders, gulls and ducks, while in winter this falcon preys upon starlings, doves, thrushes and larks.

Lesser Kestrel - *Falco naumanni*. This bird is a rare breeder of the Central Sivash, preferring precipices. It had been breeding on the islands of Kuiuk-Tuk and Churiuk, but no reliable information on breeding is available now. The species requires immediate protection.

Demoiselle Crane - *Anthropoides virgo*. Single pairs breed on the islands and remote peninsulas far from villages in the Central and northern part of the Eastern Sivash. Besides that, some pairs probably breed along the coast of the Western Sivash. Large summering and premigratory gatherings, which by the end of the summer number up to 1,000 birds, take place in the Crimean part of the Central Sivash. The numbers are relatively stable. The Sivash has great significance as a breeding area for a considerable part of the Ukrainian bird population, as well as being the premigratory concentration area for almost all birds originating from this country.

Common Crane - *Grus grus*. Spring migration of this species takes place at the end of February - beginning of March. In May-June summering birds concentrate in the Western and Central Sivash. Autumn migration lingers from September until the beginning of October. It seems that more than 70,000 birds pass the Sivash during migration, whereas about 5,000 stay over the summer. The numbers are high and stable. The Sivash is a very important staging area for a considerable part of the East European population of the species, apart from being a moulting site for many of them.

Great Bustard - *Otis tarda*. Single pairs can breed on the remote islands and peninsulas far from villages. Winter numbers are low. Autumn migration is observed on the Arabat Spit, which is also the place where birds are found in winter. Breeding numbers are low and stable. The Sivash has some significance as a breeding and staging area for these birds.

Little Bustard - *Tetrax tetrax*. Single birds are recorded during autumn migration and in winter in the Central Sivash. Recently the birds have become more frequent in the Sivash and adjacent areas of the Azov-Black Sea coast. The Sivash is a potential area for the further westward distribution of the species.

Stone Curlew - *Burhinus oedicnemus*. This is a common breeder and migratory species in the Sivash. The birds prefer salinas, areas with poor steppe vegetation, but also breed on the pastures and agricultural fields. Numbers are stable. The Sivash is an important stronghold for a large part of the Ukrainian population.

Kentish Plover - *Charadrius alexandrinus*. The Sivash is one of the few places in the south of the Ukraine where the breeding population of this small wader species does not show the rapid decline observed within the last decade. The plover breeds in the salinas and sand beaches along the coast. The breeding population totals 800-1,000 pairs

Black-winged Stilt - *Himantopus himantopus*. This was a very rare species in the past, but progressive freshening of the Sivash has favoured the wide distribution of this wader. The population totals 2,000 pairs, while its state can be considered as safe and satisfactory.

Oystercatcher - *Haematopus ostralegus*. This wader is scarcely breeding in the open sandy (sometimes muddy) areas of coasts, beaches and islands. The availability of breeding habitats is limited by the development of coastal vegetation. The breeding population in the Sivash is estimated at 200-250 pairs.

Marsh Sandpiper - *Tringa stagnatilis*. The unfavourable situation of this species in the continental Ukraine was the main reason to include it in the national Red Data Book. In the Sivash these birds occur during the spring and autumn migrations. They reach quite high numbers, because the migration route of March Sandpipers originating from Kazakhstan and Southern Russia comes through the Sivash. Due to this, in the autumn as many as 5,000-7,000 individuals can be recorded.

Slender-billed Curlew - *Numenius tenuirostris*. Only three reliable records (in the 60s-70s) from the Sivash are known.

Curlew - *Numenius arquata*. This is a very rare breeding species (3-5 pairs) and a common migratory and wintering species. In autumn flocks can number up to 50-100 individuals.

Whimbrel - *Numenius phaeopus*. This bird commonly migrates in spring (April) and autumn (September). Numbers are higher in spring and may reach several hundreds of individuals.

Collared Pratincole - *Glareola pratincola*. This is a rarely breeding bird. The Sivash population of the pratincole, totalling 400-500 breeding pairs, seems to be the largest and the most important for the species survival in the whole Ukraine. Colonies are located on dry salinas or sometimes on the agricultural lands.

Black-winged Pratincole - *Glareola nordmanni*. This species is gradually disappearing from the coast of the Sivash. This is related to the transformation of habitats (it prefers dry areas, which are declining), and probably to some population dynamics.

Great Black-headed Gull - *Larus ichthyaetus*. The numbers of the species are not very high, but stable. It is occupying new habitats. There are three breeding colonies: the Chongarskie Islands (5-20 pairs), Kitai Island (180-360 pairs) and the islands near the Ad peninsula (80-100 pairs). Compared to the other areas of the Azov-Black Sea coast, colonies in the Sivash hold the major portion of the population. They are found only on the islands of accumulative or mainland origin surrounded by the fresh or brackish water. These gulls prefer open or partly vegetated areas. They do not avoid the neighbourhoods of other colonially breeding species and show high breeding site fidelity.
In spring the birds arrive at the colonies, at the end of March - beginning of April. Eight to ten days later they start breeding, whereas by 10-12 April the formation of colony is over. Chicks and adults leave the territory of the colony in mid-June and spend most of their time close to the coast. The adult gulls leave the breeding grounds as soon as the young are able to fly (the end of July - beginning of August). They depart to the winter quarters in September - October. Some years they make small wintering concentrations in the Sivash and southern coast of the Crimea. Inter-species relations can sometimes influence the breeding success of these birds.
The numbers significantly fluctuate around a dangerous level. Only two out of 4 known breeding colonies have existed for a long time. In the last few years a decline in numbers and attempts by single pairs to breed near colonies of other birds have been recorded. Disturbance by man and habitat loss are the main threats to the Sivash population of this species.

Caspian Tern - *Sterna caspia*. This tern is rare, but its numbers are relatively stable. Of the two known earlier colonies only one now remains (on the Chongarskie Islands). The numbers fluctuate within the range of 240-250 breeding pairs. Their breeding habitats are mainly islands of accumulative origin among the brackish shallows of the bays and lagoons. It clearly avoids vegetation, preferring open territories covered with shells. Feeding habitats are brackish and freshwater shallows.
Caspian terns arrive in early April. Intensive egg laying takes place in late April - beginning of May, but a case is known when a new colony appeared only in the last ten days of May. Terns breed in dense colonies separately from other species. The breeding success is high under the favorable conditions. The diet contains excessive amounts of marine and freshwater fish, which is looked for by flying over the shallows. In the search for food, some birds get as far as 20 km from the colony. The species quickly responds to the appearance of available and abundant food.
The main threats are disturbance by man and weather conditions resulting in the flooding of colonies.

Rose-coloured Starling - *Pastor roseus*. In the years of breeding expansion this bird is common for the Sivash. It breeds almost everywhere in buildings and their remains, stones etc. The numbers sharply fluctuate, sometimes starlings totally disappear for many years. The Sivash has a great significance as a potential breeding area in the years of expansion.

Annex

Short overview of avi-fauna

Order *Gaviformes*. The Black-throated Diver is regularly recorded during migration and in the wintering period, whereas the Red-throated Diver is a rare visitor at the time of autumn movements.

Order *Podicipediformes*. All 5 species of grebes known in the Ukraine occur in the Sivash. The Slavonian Grebe is extremely rare and found mainly in the rivers and freshened bays. Little, Red-necked, and Black-necked Grebes are relatively common during the autumn migration. Their spring numbers are considerably lower. The Great Crested Grebe is the most numerous species throughout the year. It also winters in small numbers in the Eastern Sivash. The Black-necked Grebe winters less frequently.

Order *Procelariiformes*. This order is represented by only one species - the Manx Shearwater. Small flocks of these birds are recorded as a rule in the late summer - early autumn during migrations.

Order *Pelecaniformes*. Four species, of which 2 are pelicans and 2 cormorants. The Dalmatian Pelican was relatively common at the beginning of the century, but since then is only rarely seen. In the last few decades flocks of White Pelican of up to 10-30 birds became more frequent in the areas of the Sivash which are rich in fish. The Cormorant is a mass species that already requires some control of the population, whereas on the contrary to this the Pygmy Cormorant is one of the rarest species of the family in Europe. The Sivash is not an exception as it is seldom recorded here from April to September.

Order *Ciconiiformes*. This is one of the most numerous taxonomic groups, but the numbers of each of the 14 species differ. Species such as the Black and White Stork, Spoonbill and Bittern are very rare. Cattle Egret and Flamingo are only occasional vagrants. Purple Heron, Squacco Heron, Little Bittern and Night Heron are more common. The most numerous herons are the Grey Heron, Great White Egret, and Little Egret. Numbers of the latter reach 8,000 - 10,000.

Order *Anseriformes*. Birds of this order take second place by the number of species, which comes to 26-28. The difference in the totals is due to the fact that both Velvet and Common Scoters were not recorded exactly within the ranges of the Sivash, but were found instead on the coast of the Azov Sea and the Karkinitski bay of the Black Sea, very close to its borders. The Mute Swan is a numerous summering and wintering species. During winter, although in much smaller numbers, the Whooper Swan is found in the Sivash. Among geese, the White-fronted Goose requires special attention. In spring, autumn and winter concentrations numbering many thousands of birds decorate the coastal landscape of the Sivash. Birds come here from the breeding grounds in the Eurasian tundras, located between the mouths of the Pechora and Lena rivers (mostly from the eastern part of this area). The Lesser White-fronted Goose is a rare autumn

migrant, whereas the migratory route of the Red-breasted Goose (a globally threatened species) goes completely through the Sivash. About 2,000-3,000 Red-breasted Geese stay here over the winter. Most of the ducks are very common and make up large concentrations: Shelduck, Wigeon, Pintail, Teal, Garganey, Shoveler, Scaup, Tufted Duck and others Some of the ducks, like Mallard and Porchard, are extremely numerous. White-headed Duck, Ruddy Shelduck, Ferruginous Duck, Gadwall, Red-crested Pochard, both mergansers, Goldeneye and Smew should be listed as rare and scarce duck species.

Order *Falconiformes*. In spite of the total number of species recorded, (26), birds of prey are always and everywhere scarce. The Sivash is no exception to this rule, except for the higher winter numbers of Hen Herrier compared to adjacent areas. Many birds of prey are attracted by the concentrations of waterbirds which ensures successful hunting. Thus, some of them migrate together with their potential prey. For example, Sparrowhawk moves with the small passerines, and the Peregrine follows the ducks and waders.

Order *Gruiformes*. With the exception of some of the *Rallidae* species (like Coot and Moorhen), birds of this order are generally scarce or rare migratory birds of the Sivash. The significance of the Sivash in the protection of the Common Crane population (the Red Data Book species), both on a national and European level, is outstanding. Birds from the European and partly West Siberian breeding grounds make up unusually high concentrations here. A gradual increase in the numbers of breeding, as well as migratory *Rallidae* species, has been observed in the last few decades. This apparently reflects the ongoing freshening of the wetland and the expansion of reeds and other fresh water vegetation.

Order *Charadriiformes*. This order takes the lead position in terms of the number of individuals, while in terms of species diversity (60) it is second behind the passerines (see table). The total number of birds regularly migrating through, or moulting, staging and wintering in the Sivash easily runs to over several million individuals. Forty species of waders, among which are many rare Ukrainian and European birds, have been recorded in the wetland. During 12 years of ringing about 40,000 shorebirds were marked to study the role of the Sivash in their transcontinental flyway systems (figure 2). That also helped in the understanding of the migration strategies of single populations of some species. For example Dunlin, as it was shown by re-traps and recoveries, uses quite a complicated route. In autumn some of the waders migrate along the Baltic coast, then across the whole of continental Europe to the Western Mediterranean. Only in spring do these birds stop over in the Sivash as they head to the breeding grounds. Other populations, having stopped reproduction, regularly turn to the Sivash from the northern coast of Eurasia to moult and then move further south-west to their winter quarters in the Central Mediterranean. These birds visit the Sivash twice, as they repeat the same migratory route in spring too. Besides these two, there are populations which return to the wintering grounds along the previous route, but in spring they take a more easterly way (apparently reaching the Caspian region). They then get to their breeding grounds in the Taimyr Peninsula and the Lena River avoiding not only the Sivash, but also Eastern Europe. But the Dunlin is not an exception, and many waders are likely to demonstrate such a complicated and variable migratory strategy between populations. Once again this

stresses the significance of the Sivash in the conservation of flyway populations of different breeding and wintering origins.
In spite of the relatively small number of gull and tern species, most of them are very numerous. The Black-headed Gull, Herring Gull, Little Gull, Common and Sandwich Terns are the most numerous. Some terns, which are rare for the Ukraine, are represented by populations numbering several thousands of individuals (Gull-billed Tern, Little Tern, Caspian Tern).

Other orders of non-passerine birds are represented in the Sivash (as well as all over the whole Azov-Black Sea coast) by a few species. Their numbers, except for Bee-eaters and Rollers, are also low.
The species composition of the order *Passeriformes* is still under consideration. Those 80-85 species listed in the table are unlikely to adequately describe the species diversity of the spring, and especially autumn, migrants, using the reed beds, steppe areas and forest belts of the wetland and adjacent areas.

	Designations for the table
o	rare breeding bird species
oo	common breeding bird species
ooo	numerous breeding bird species
•	rare migratory bird species
••	common migratory bird species
•••	numerous migratory bird species

Table. List of bird species occurring in the Sivash

Species	**Status and abundance**
Gavia stellata	**o**
Gavia arctica	**ooo**
Podiceps ruficollis	•
Podiceps auritus	•
Podiceps nigricollis	••
Podiceps griseigena	••
Podiceps cristatus	•••
Pelecanus onocrotalus	**ooo**
Pelecanus crispus	**ooo**
Phalacrocorax carbo	**ooo**

Phalacrocorax pygmeus	**ooo**
Botaurus stellaris	••
Ixobrychus minutus	•••
Nycticorax nycticorax	•••
Ardeola ralloides	••
Egretta alba	•••
Egretta garzetta	•••
Ardea cinerea	••
Ardea purpurea	••
Platalea leucorodia	••
Plegadis falcinellus	•••
Ciconia ciconia	•
Ciconia nigra	**o**
Phoenicopterus roseus	**o**
Cygnus olor	••
Cygnus cygnus	**oo**
Anser anser	••
Anser albifrons	**ooo**
Anser erythropus	**oo**
Anser fabalis	**o**
Branta ruficollis	**ooo**
Tadorna ferruginea	•
Tadorna tadorna	•••
Oxyura leucocephala	**o**
Anas plathyrhynchos	••
Anas crecca	**ooo**
Anas strepera	••
Anas penelope	**ooo**
Anas acuta	•
Anas querquedula	•
Anas clypeata	••
Somateria mollissima	**o**
Netta rufina	••
Aythya ferina	•••
Aythya nyroca	•

Aythya fuligula	**oo**
Aythya marila	**ooo**
Melanita fusca	**o**
Malanita nigra	**o**
Bucephala clangula	**oo**
Mergus albellus	**oo**
Mergus serrator	••
Mergus merganser	**oo**
Pandion haliaetus	**oo**
Pernis apivorus	**oo**
Milvus milvus	**o**
Milvus migrans	**o**
Circus cyaneus	**ooo**
Circus macrourus	**oo**
Cyrcus pygargus	**ooo**
Circus aeruginosus	**ooo**
Accipiter gentilis	**oo**
Accipiter nisus	**oo**
Accipiter brevipes	**o**
Buteo lagopus	**ooo**
Buteo rufinus	**oo**
Buteo buteo	**oo**
Circaetus gallicus	**o**
Haliaeetus albicilla	**oo**
Aquila nipalensis	**o**
Aquila clanga	**o**
Aquila pomarina	**oo**
Aquila heliaca	**o**
Aquila chrysaetus	**o**
Falco tinnunculus	•••
Falco columbarius	**oo**
Falco vespertinus	•••
Falco subbuteo	•••
Falco cherrug	•
Falco peregrinus	**oo**

Perdix perdix	••
Coturnix coturnix	••
Phasianus colchicus	•
Crex crex	**oo**
Porzana porzana	••
Porzana parva	••
Rallus aquaticus	•••
Gallinula chloropus	•••
Fulica atra	•••
Grus grus	**oo**
Anthropoides virgo	•
Otis tarda	•
Tetrax tetrax	**o**
Burhinus oedicnemus	••
Squatarola squatarola	**ooo**
Pluvialis dominica	**oo**
Pluvialis atricarius	**oo**
Charadrius hiaticula	**oo**
Charadrius dubius	••
Charadrius alexandrinus	••
Eudromias morinellus	**oo**
Chetussia leucura	•
Vanellus vanellus	••
Himantopus himantopus	•••
Recurvirostra avosetta	•••
Haematopus ostralegus	••
Tringa ochropus	**oo**
Tringa glareola	**oo**
Tringa nebularia	**oo**
Tringa totanus	••
Tringa erythropus	**oo**
Tringa stagnatilis	**ooo**
Actitis hypoleucos	**oo**
Xenus cinereus	**o**
Phalaropus lobatus	**ooo**

Arenaria interpres	**oo**
Philomachus pugnax	**ooo**
Calidris minutus	**ooo**
Calidris temminckii	**oo**
Calidris ferruginea	**ooo**
Calidris alpina	**ooo**
Calidris alba	**oo**
Calidris canutus	**oo**
Limicola falcinellus	**ooo**
Tringites subruficollis	**o**
Gallinago media	**o**
Gallinago gallinago	**oo**
Scolopax rusticola	**o**
Numenius tenuirostris	**o**
Numenius arquata	**oo**
Numenius phaeopus	**oo**
Limosa limosa	**oo**
Limosa lapponica	**oo**
Glareola pratincola	••
Glareola nordmanni	•
Stercorarius pomarinus	**oo**
Stercorarius parasiticus	**o**
Larus canus	**ooo**
Larus cachinnans	•••
Larus ichthyaetus	••
Larus ridibundus	**ooo**
Larus melanocephalus	•••
Larus genei	••
Larus minutus	**ooo**
Chlidonias hybrida	••
Chlidonias leucoptera	••
Chlidonias nigra	•
Gelochelidon nilotica	••
Sterna hirundo	•••
Sterna albifrons	••

Thalasseus sandvisensis	•••
Hydroprogne caspia	••
Columba oenas	**oo**
Columba palumbus	••
Streptopelia turtur	••
Streptopelia decaocto	••
Cuculus canorus	••
Athene noctua	••
Asio otus	••
Asio flammeus	•
Caprimulgus europaeus	•
Apus apus	••
Alcedo atthis	•
Merops apiaster	•••
Coracias garrulus	•••
Upupa epops	•••
Jynx torquilla	**oo**
Dendrocopus syriacus	••
Melanocorypha calandra	•••
Calandrella cinerea	••
Calandrella rufescens	••
Galerida cristata	••
Lullula arborea	**oo**
Alauda arvensis	•••
Eremophila alpestris	**oo**
Riparia riparia	••
Hirundo rustica	••
Delichon urbica	••
Motacilla flava	**ooo**
Motacilla feldegg	••
Motacilla citreola	**o**
Motacilla alba	••
Anthus campestris	••
Anthus trivialis	**oo**
Anthus pratensis	**o**

Anthus cervinus	**ooo**
Lanius collurio	••
Lanius minor	•••
Lanius excubitor	**o**
Troglodytes troglodytes	**oo**
Prunella modularis	**oo**
Erithacus rubecula	**oo**
Luscinia luscinia	••
Luscinia megarhynchos	**oo**
Luscinia svecica	**oo**
Phoenicurus ochruros	••
Phoenicurus phoenicurus	**oo**
Saxicola rubetra	•
Saxicola torquata	**oo**
Oenanthe isabellina	••
Oenanthe oenanthe	••
Oenanthe pleschanka	•
Turdus merula	**oo**
Turdus pilaris	**ooo**
Turdus iliacus	**o**
Turdus philomelos	**oo**
Turdus viscivorus	**o**
Emberiza calandra	••
Emberiza citrinella	**ooo**
Emberiza hortulana	••
Emberiza aureola	**o**
Emberiza melanocephala	•
Emberiza schoeniclus	•••
Fringilla coelebs	••
Fringilla montifringilla	**oo**
Chloris chloris	••
Spinus spinus	**oo**
Carduelus carduelis	••
Carduelus flammea	**oo**
Carduelus cannabina	••

C. coccothraustes	•
Passer domesticus	••
Passer montanus	••
Sturnus roseus	•••
Sturnus vulgaris	•••
Oriolus oriolus	•
Garrulus glandarius	**o**
Pica pica	••
Corvus monedula	••
Corvus frugilegus	••
Corvus cornix	••
Corvus corax	••

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