

**Underwater Survey at the Ruins of Nan Madol, Pohnpei State,
Federated States of Micronesia**

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Abstract

In this paper we demonstrate the results of underwater survey at Nan Madol, Federated States of Micronesia. Nan Madol are the ruins of a megalithic civilization composed of 95 small to large artificial islets made mostly of basalt, situated on a shallow water of Pohnpei Island. The site is now on the Tentative List of the UNESCO World Heritage Site submitted by Federated States of Micronesia. Protection of the site is comprised of both these basaltic islets and the water surrounding them. In addition, there is an oral tradition that a sunken city named Kahnihmweiso is located underwater near the site. The goal of our investigation is to make a map of underwater topography that is

expected to be utilized for the site documentation and the setting of core and buffer zones. The investigation was carried out by using multi-beam sonar and a remotely operated vehicle (ROV), as well as manual survey by scuba diving gears. Research has revealed that there is no clear evidence of artificial constructions under the water; however, a detailed map of underwater topography around the site was obtained. Our research also stresses the significance of the sea area as a resource of legends and a component of the intangible cultural heritage of Nan Madol.

Key words: Oceania; Federated States of Micronesia; Nan Madol; Multi-beam sonar; Remotely Operated Vehicle (ROV)

Background

Heritage Management and Underwater Cultural Heritage in Federated States of Micronesia

The Federated States of Micronesia (FSM) is a grouping of 607 small islands in the Western Pacific just north of the equator. They are spread over an area of 2,700 km². They consist of four States: Yap, Chuuk, Pohnpei and Kosrae (from west to east). Their land area is quite small, amounting to approximately 700 km². The capital is Palikir, and the largest city is Kolonia; both are located on the island of Pohnpei. All land area is the result of volcanic activity occurred millions of years ago resulting in islands and atolls of incredible variety. Each of the four States constitute one or more main high islands, and all but Kosrae include numerous outlying atolls. Each of them has its own culture and traditions, nevertheless, common cultural and economic bonds are centuries old. Together with the Republic of Palau, the FSM forms the group known as the Caroline Islands and in association with the Mariana Islands, the Marshall Islands and Kiribati they form the group today known as Micronesia. The maritime history of Micronesia spans nearly 4,000 years and is inextricably linked with the wider cultural region. Initial settlement of the area is approximated at 3,500 years based on linguistic, archaeological, and anthropological evidence (Rainbird, 2004). It suggests that the area was first inhabited by groups of Austronesian-speakers who arrived in ocean-going canoes. The inhabitants of each island group developed their own variations of watercraft based on their needs for procuring food and inter-island travel. The people of Micronesia are known to have been some of the most knowledgeable and skilled navigators of the Pacific, a tradition which continues today.

The people of the FSM have a strong bond with their land, sea and reefs. This is evident through the wealth of heritage sites that entail a spiritual association with the sea, which encompasses stories and the determined ownership of the land and water. Many sea and landscape features provide deep-seated connections to history, mythology and settlement of the islands, submerged heritage sites being a powerful and tangible part of society. The variety of submerged cultural heritage also reflects the broad range of activity which occurred in these island states. Shipwrecks from many time periods are known to lie in its waters, as do the remains of maritime infrastructure such as piers, wharves and landings. To date only a few submerged sites have been investigated historically and archaeologically such as the Yap fish weirs (*aech*) and the World War II relics of Chuuk Lagoon. Among the most exciting and culturally significant partially submerged sites are the indigenous ruins of Nan Madol in Pohnpei (Mckinnon, 2010: 37-42). The ruins of Nan Madol, which belong to a megalithic culture, are composed of 95 small to large artificial islets made of basalt and spread over a rectangular area approximately 1.5 km by 0.7 km. Its construction is said to have begun around 500 AD and continued to around 1600 AD, with royal palaces, temples, royal tombs, and residential districts integrally forming a city complex (Fig. 1). As the largest cultural heritage site in FSM, it is also a precious tourist resource. However, notwithstanding its extremely high significance in terms of academic value and as a tourism resource, no full-scale initiatives have been implemented to date to protect the ruins. Within the Pacific island countries (except New Zealand), there are only five UNESCO cultural heritage sites as of 2013. Even among the countries in the region, FSM is particularly eager to have Nan Madol inscribed on the World Heritage List, as it has no sites on the list at present.



Fig. 1 Artificial islets of Nan Madol. (T. Ishimura)

The UNESCO Office for the Pacific Region (Apia, Samoa), acknowledging that international support is needed to protect and inscribe the site on the World Heritage List, approached the Japan Consortium for International Cooperation in Cultural

Heritage (henceforth JCIC-Heritage) regarding the possibility of its cooperation in sending a Japanese survey team to assess the present state of the Nan Madol, as no surveys have so far been conducted regarding its condition and the framework required for its protection. In response to this request, JCIC-Heritage sent a survey team to Micronesia to conduct a survey of Nan Madol in 2011. The team of JCIC-Heritage carried out a survey to assess the present state of Nan Madol, including its preservation condition and the status of policy framework in February 2011 (Japan Consortium for International Cooperation in Cultural Heritage, 2012). Based on this survey, we have presented an overview of the present state of the Nan Madol ruins, and have discussed the framework of the FSM for preserving the site, as well as the results of interviews with relevant stakeholders. When considering the ruins as cultural heritage that is intimately associated with the history and traditional culture of the island of Pohnpei, it is extremely important to avoid development for the sake of tourism, but to promote measures for maintaining this heritage in a sustainable manner while respecting the living culture of the local residents.

At JCIC-Heritage, we have continued our cooperation in response to the request of FSM, based on proposals derived from the results of this survey. As a result, certain achievements have been made, and local initiatives for protection of Nan Madol have made steady progress. As a supplement, we introduce the cooperation we have extended based on the results of the 2011 survey. As proposed in light of the survey results, the formulation of a management plan based on a consensus of all local stakeholders is of foremost importance in the effort to protect Nan Madol. To help the stakeholders achieve consensus, a workshop was held in November, 2011 in Kolonia, Pohnpei (Japan Consortium for International Cooperation in Cultural Heritage, 2012: 41). It focused on three main objectives: (1) to gather all stakeholders; (2) to share information on the present state of protection of Nan Madol among all stakeholders, and (3) to provide an understanding of future efforts that need to be made by each stakeholder. In addition to JCIC-Heritage, a Japanese experts team (funded by the Japan Foundation), the FSM HPO and UNESCO (UNESCO/Japan Funds-in-Trust) co-sponsored the workshop and fulfilled their respective tasks. The workshop was extremely meaningful in the sense that by bringing together all stakeholders, it allowed

everyone to share information, gain proper understanding of proposals put forth by experts from in and outside FSM as well as tasks needed in future activities, and to mutually verify their concurrent commitment to move forward their initiatives for protection of Nan Madol. However, now that a consensus has been achieved, activities for protection of the ruins and inscription of the site on the World Heritage List are expected to advance steadily. Subsequently, the State Party of FSM submitted a Tentative List including the ruins of Nan Madol to the World Heritage Centre in February 2012, and launched its nomination process for its inscription on the List of UNESCO World Heritage.

Through the survey and workshop above, it has been stressed that the establishment of zoning (core/buffer zones) based upon an accurate site map is needed in order to protect the site and implement site management. Following this recommendation, the Japanese team organized a technical consultation workshop for capacity building on site documentation of Nan Madol in Kolonia, Pohnpei in September, 2012, funded by the Japan Foundation (Ishimura, 2013). In this consultation meeting, it has been pointed out that the sea area around the site of Nan Madol should be protected properly and the potential of neglected underwater cultural heritage existence must be scientifically confirmed. Since the artificial islets of Nan Madol were constructed in the inter-tidal

zone of a reef flat along the shores of Temwen Island located in the southeastern part of Pohnpei, the gradually submerging monuments, the sea and its landscape are essential components to the sites' protected heritage. In addition, there is a legend of an underwater city named Kahnihmweiso, sunken in the harbor of Nahkapw, a deep area approximately 50m in depth in the northeast of Nan Madol (Fig. 2).

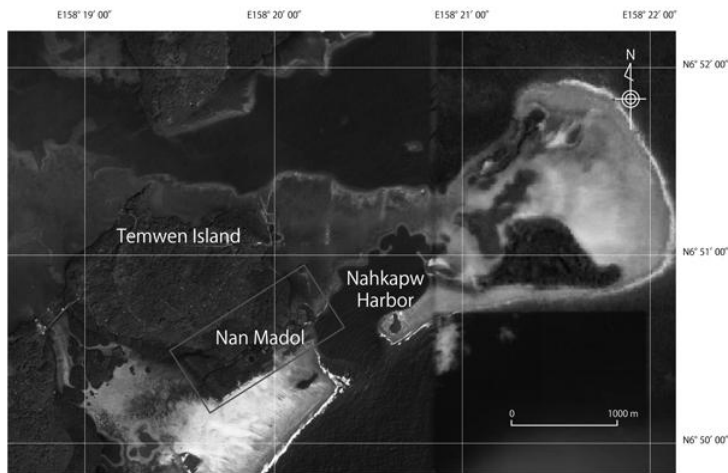


Fig. 2 Aerial photo of Nan Madol and surrounding area. (T. Ishimura, based on the images from GoogleEarth).

Legendary Underwater City in Nan Madol

According to the local legend, below Nahkapw Harbor there is the secret "City of the Gods" built before the people of Pohnpei arrived. Nan Madol, the city above water, is actually quite recent, built by two legendary brothers that came from across the sea from the southeast region. One day, "the brothers climbed the mountain to get a view of the country to find a suitable site for their capital city. When they looked into Madolenihmw Bay, they saw the ancient city of the gods, Kahnihmweiso. Here was an important sign to the two brothers." The brothers then decided to build the city nearest to the one below the harbor in order to be nearer to the gods. Ancient Pohnpeian legend says the builders of Nan Madol selected the site because they saw the submerged ruins of Kahnihmweiso from a high cliff above Madolenihmw Bay, which is between Temwen Island and Nakapw Island. To the east of Nahkapw Island, in about 60m of water, are the ruins of the castle of KahnihmwNankhet, well known to the natives of Pohnpei, but none of the submerged ruins are talked about for fear of spirits who would punish them. For decades divers have reported submerged megalithic ruins of the legendary cities Kahnihmweiso and KahnihmwNankhet, such as some of the megalithic columns and pillars which still stand erect, rising up to 9 m above the sloping sea floor.

The possibility of underwater construction at Nahkapw Harbor was first explored by the team of Dr. Arthur Saxe in 1978 (Saxe et al., 1980). Conducting a series of diving surveys, they reported that there were a number of tall stone pillars covered in coral growth which stand some 6 m tall, 0.9-1.2 m wide, at depths of over 25 m and one that even supposedly stood on a "pedestal." The presence of stone pillars is a style of construction which only appears below water surrounding the city in the harbor, and not within any part of the city above. Saxe also wrote about the many legends on the island of two sacred underwater cities believed to exist in the harbor, one called Kahnihmweiso, and the other KahnihmwNamkhet which exists somewhere further east of the reef (Saxe et al., 1980: 47-55). In this report Saxe also explained the mechanism why the city of Kahnihmweiso had been sunken in the sea, referring to the "Blue Hole" hypothesis (Saxe et al., 1980: 126-129). A "Blue Hole" is basically a limestone cavern whose roof has fallen in. The name comes from the fact that deep tropical waters

appear as a darker blue than the shallower waters. In the Atlantic, where they have been studied, such as in the coral reef off Belize, the processes which result in their formation are as follows: A coral reef forms along a shore. During a glacial advance the sea levels drop due to the great amount of fresh water locked up in glaciers. The coral reef, now above sea level, becomes subject to the same processes of erosion and re-deposition by fresh water that any land deposit of calcium carbonate is subject to. Rain, falling on the surface, runs underground and gradually dissolves away pockets of calcium carbonate, which is soluble in water. If this goes on long enough, huge limestone caverns can be formed. Water dripping from the roof of the cavern, containing the lime in solution, evaporates forming stalactites. The same water falling to the floor of the cavern evaporates forming stalagmites. Sometimes these meet forming continuous columns from floor to roof, sometimes not. If the process continues long enough, the roof of the cavern may collapse because of inadequate support or the deposition of added weight above the roof of the cavern. This collapse may occur before or after the sea levels rise at the end of the glacial maximum. In any case, once the sea levels are once more above the level of the coral reef, the collapsed limestone cavern appears as a "Blue Hole" from the surface. Blue holes are also characterized by numerous passages or tunnels which tended to link the various "rooms" of the cave when it was a cave. These, when re-submerged, can be subjected to strong current flows when tides are going in or out. Saxe (1980) pointed out the possibility that an earlier Nan Madol Central was built on the reef on what is now Nahkapw Harbor and that its weight caused the cavern roof to collapse. This explanation allows for both a blue hole and underwater columns. It suggests the "first city" as perhaps being Kahnimweiso.

In 1988 and 1989, the team of the University of Oregon conducted underwater investigations around Nan Madol (Ayres, 1993). They carried out an underwater survey at the location in front of Nan Mwuluhsei, a massive wall approximately 275 m long, 8 m wide and 4 to 6 m high that forms an L-shaped configuration south and east of Nan Douwas tomb. They observed that a number of basalt columns were located seaward of the standing portion of the wall. It is likely that these are lost, discarded or fallen building materials, now underwater, of the artificial islets. They also examined underwater pillars reported by Saxe. While no complex features were discovered during this survey, two

clusters of columns were located. They reported that directly east of Nan Mwuluhsei the reef drops off twice, the first at approximately 2 m below the surface and the second at 7 to 10 m below the surface. After the second shelf the bottom falls away rapidly to the depths of Nahkapw Harbor which reach as much as 50 m. The first level of the reef is generally covered with columnar basalt and coral; however, this is replaced on the deeper shelf by a sandier bottom with a much sparser growth of coral. It is on this second shelf that the first of the upright columnar objects was encountered, at approximately 19 m from the north side of Nan Mwuluhsei. This object is roughly rectangular, stands 2.2 m high, and its sides 1.5 m by 0.8 m. Two other columns were located nearby. These appear to be solid coral and lie between six and nine meters below the surface. The second column, 0.9 m high with sides 0.2 m by 0.75 m, was 3.7 m from the first. The third column, 2.3 m high with sides 1 m by 1 m, was 20.3 m from the first. None of the objects had any obvious prismatic shape as would be expected from the basalt building materials of Nan Madol; however, it was possible that this feature was hidden by extensive coral growth. They used a steel bar to drill into the first and second columns in hopes of going through any coral encrustation covering stone. A penetration, approximately 20 cm deep, was made in both without striking stone. Finally, it was decided to raise the small column to the surface for detail inspection. The object was entirely of coral and therefore was not a purposefully positioned stone column. They implied that coral growth and submerged columnar basalt building material may have been interpreted and incorporated into Pohnpeian mythology, and these may have been perceived by the Pohnpeians as evidence for the presence of underwater structures inhabited by spirits. However, the surveyed areas by the team of University of Oregon were limited and their results have not fully refuted the hypothesis of "Blue Hole" proposed by Saxe. Since the legendary underwater city of Kahnimweiso is believed to be located in the center of Nahkapw Harbor, a detail underwater topography map covering entire part of the harbor must be needed to evaluate the existence of potential underwater cultural heritage, as recommended in the 2012 technical consultation workshop. Following the recommendation, in cooperation with the Office of the National Archive, Culture, and Historic Preservation, FSM National Government, we at JCIC-Heritage experts' team conducted an underwater survey at

Nahkapw Harbor for reconnaissance of potential underwater cultural heritage in February 2013.

Research Objective

The main objective of our research is to produce the entire map of underwater topography in Nahkapw Harbor, in order to assess the possibility of existence of underwater cultural heritage in this location. In addition, to examine the possible anthropogenic underwater features is also an important task.

Research Method

First, we used multi-beam sonar (Sonic 2024) to produce an underwater topography map. The multi-beam sonar was equipped to a 25' boat (Fig. 3). Second, we used a remotely operated vehicle (ROV) (Mini ROV LBV300-5) to investigate underwater features and to carry out video recording. The ROV was controlled and monitored by another 23' boat (Fig. 4). Third, we conducted a scuba diving survey to examine underwater features by eye observation.



Fig. 3 (left) Multibeam sonar (SeaBat 8125) equipped with boat. (Y. Matsumoto)

Fig. 4 (right) ROV (Mini ROV LBV300-5) in the sea. (Y. Matsumoto)

Research Team

Field survey was conducted by Tomo Ishimura (Nara National Research Institute for Cultural Properties), Tamaki Ura (University of Tokyo, at the time of field survey), Fumitaka Maeda (University of Tokyo, at the time of field survey), Ken'ichi Sugimoto, Toshihiro Ogawa, Akio Hikoyama, Yoshinori Matsumoto, Yusuke Sugimoto (Windy Network), Charles Brennan (R2 SONIC) and Tomomi Haramoto (National Research Institute for Cultural Properties, Tokyo). Akira Asada (University of Tokyo) and

Augustine Kohler (Office of the National Archive, Culture, and Historic Preservation, FSM National Government) contributed to the arrangement and logistics for the survey. The data obtained was processed in a laboratory by Ura, Asada, Maeda, and the team of Windy Network. The multibeam sonar was provided by Brennan and the ROV was provided by the team of Windy Network. The boats, their operators and the scuba diving gear was arranged by the Village Hotel.

Period of Research

The field research was carried out in the period from 12th to 16th February, 2013.

Results

By using the multi-beam sonar, we produced an underwater topography map in the entire part of Nahkapw Harbor, except just in front of the Nan Mwuluhsei, the massive wall and entrance to the inside of the Nan Madol complex, due to strong winds and waves. The map indicates that the bottom of the harbor is flat in a depth of approximately 40 to 50 m, and there is no noteworthy complex topography such as stalagmites, passages or tunnels, as the “Blue Hole” hypothesis had expected. In the meanwhile, occasional distributions of block-shaped features are observed along the drop-off between the reef flat and the bottom, in the depth of 20 to 30 m (Fig. 5). Afterward we used the ROV to examine the features of the block-shaped features. Monitoring by the video camera equipped with the ROV, it was clarified that most of these objects are columnar in shape, a couple of meters high with sides of approximately 1m, covered by coral encrustation. By the observation using the ROV, it was not clear whether these columns were coral or basalt, and whether anthropogenic or natural. Then we selected some locations of the clusters of the columnar objects, and carried out scuba diving survey to examine them in detail by eye observation (Fig. 6). We observed that the columnar objects were fully covered by coral encrustation and no exposed surface of basalt was noted. In this survey, no evidence of anthropogenic pillar made by basalt column was obtained. It seems that these objects are equal to the counterparts investigated by the team of the University of Oregon (Ayres, 1993).

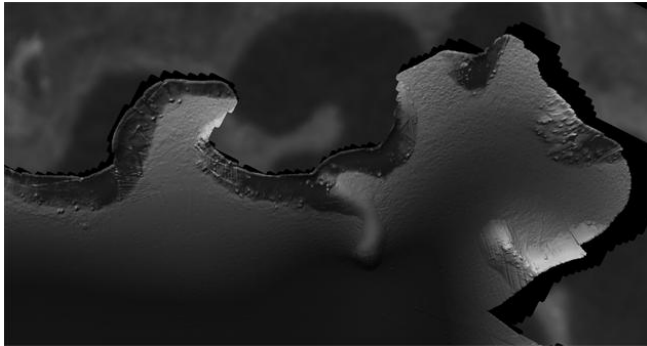


Fig. 5 (left) A part of the underwater topography map in Nahkapw Harbor, showing some clusters of features along the drop-off. (University of Tokyo and Windy Network)



Fig. 6 (right) An erect, columnar object at a depth of approximately 30m. (T. Ogawa)

Conclusion

The results of our research do not support the “Blue Hole” hypothesis proposed by Saxe, so it is not probable that the “first city” was built on the former cavern in Nahkapw Harbor and which then sunk in the sea due to the collapse of the cavern roof by its weight. Neither does our research provide any evidence that the underwater columns are man-made structures. However, the results of our research do not necessarily deny the possibility of the existence of the legendary sunken city. The people of Pohnpei may have seen the bizarre feature under the sea and interpreted it as remains of a sunken city, and created a legend of the “City of Gods” inhabited by spirits. As a cultural heritage, the value of Nan Madol is not only limited to its tangible aspects such as architecture and archaeological remains but also in its intangible aspects such as legends and oral traditions associated with it (Hadley, 1987). The legend of Kahnihmweiso, including the story of the establishment of Nan Madol, is also an important component of the cultural heritage of Nan Madol, and the site of Nahkapw Harbor is closely associated with the legend. Therefore, the legendary site of Kahnihmweiso must also be protected as a component of intangible heritage of Nan Madol. We recommend that the sea area of Nahkapw Harbor should be included in the

zoning (core/buffer zones) plans for protection and management of the ruins of Nan Madol.

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