

First Discovery and Mapping of Early Modern Grapnel Anchors in Ishigaki Island and Cultural Resource Management of Underwater Cultural Heritage in Okinawa

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Abstract

Yarabuoki site, which contains iron grapnel anchors and early modern Okinawa ceramic jars in 12 to 32 m depth off the western Coast of Ishigaki Island, was discovered by a local diver and reported to Okinawa Prefectural Archaeological Center. In 2010, the Center conducted a distributional survey to confirm the site and its location. Although the survey found and pictured seven numbers of grapnel anchors that were first findings of this type in Okinawa area, the previous study did not record each position and the accurate depth of these artifacts and the site character such as shipwreck site or discarded shipping loads site is yet unclear. With such background and tasks, our team has conducted underwater archaeological research to record each location of grapnel anchors and ceramic jars using GPS. Furthermore, Kan and Nagao conducted a broadband multibeam survey around the Yarabuoki site and visualized the bathymetric

results at a lateral grid resolution of 1m. This will enable us to create a three-dimensional site map to plot the artifacts, while Sakagami (Tokai University) developed a low-cost and human-portable underwater robot to explore and record high resolution video of underwater sites, and the robot successfully worked during our surveys. Our paper reports the results and outcomes of the research at Yarabuoki site and other underwater sites in Ishigaki and the Yaeyama Islands and discusses the early modern marine transportations in Okinawa or the Ryukyu Islands. We also discuss the future possibility for cultural resource management of underwater cultural heritages in the Yaeyama and Okinawa.

Keywords: Broadband multibeam survey, Okinawa, Yaeyama Islands, Yarabeoki site, Grapnel anchors, Cultural resource management

Introduction

The Academic and social interests on underwater cultural heritage is currently increasing in Japan. In 2011, for example, the Takashima site in Nagasaki Prefecture (in Kyushu Island) where the 13th century original Yuan ships from China were firstly discovered became the first National historical heritage of an underwater site. In such current movement, one of the hottest areas with increasing number of underwater archaeological surveys and underwater cultural heritages is Okinawa or Ryukyu Archipelago. The archipelago consists of 199 islands of various sizes and ranges about 1,200 km between Kyushu Island at its north end and Taiwan in its south end (see also Katagiri et al., in this volume). In fact, in the past 10 years surveys and researches by Kagoshima University and the Nansei Islands Underwater Cultural Heritage Study Group (2010, 2011), the Okinawa Prefectural Archaeological Center, the Okinawa Prefectural Museum and Art Museum (e.g. Katagiri 2007, 2009, 2010; Miyagi et al., 2005), and the Asian Research Institute of Underwater Archaeology (2013) have discovered and confirmed over 100 of underwater archaeological sites in relatively good condition. Yarabuoki site in Ishigaki Island is one of these newly discovered sites. The site produces a total of seven iron grapnel anchors and early modern Okinawa ceramic jars in 12 to 32 m of depth off the western coast of Ishigaki Island, which is the most populated island with the local capital city in the Yaeyama Islands (Fig. 1). Other major islands in the Yaeyama Islands are Iriomote Island, Taketomi Island, and Kuroshima

Island etc, and other underwater archaeological sites are located off the coast of these islands (see also Fig. 1). In this paper, we report the recent results and outcomes of our underwater archaeological research at Yarabuoki site and discuss the early modern maritime transportations in Okinawa or the Ryukyu Archipelago. We also report and discuss our practices on cultural resource management of underwater cultural heritages in the Yaeyama Islands and Okinawa.

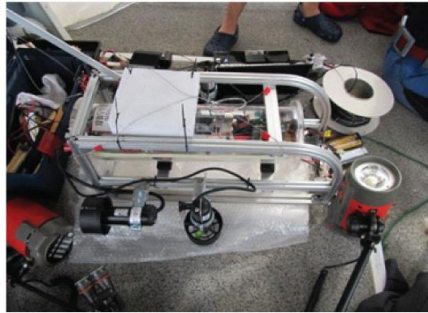


1 Fig. 1 Locations of Underwater Archaeological Sites in the Yaeyama Islands. (R. Ono)

Discovery and Mapping of Yarabuoki Site

In 2009, Yarabuoki site was firstly discovered by a local professional diver (Mr. Seiji Fujii) who has operated diving services over 30 years in Ishigaki Island. He reported the location of this site to the Okinawa Prefectural Archaeological Center. In 2010, Katagiri (2010) conducted the first survey as the chief investigator from the Center with assistance of the Nansei Islands Underwater Cultural Heritage Study Group (2011) to confirm the total of seven iron grapnel anchors of various sizes and numbers of early modern Okinawa pottery jars (Tsuboya-Yaki) in 2010. However, these previous surveys did not measure the detail location of each anchor and pottery jars, hence it was discussed whether the site could be classified as a sort of port/anchorage site or possible shipwreck site. In terms of dating the site, we could roughly estimate these artifacts belong to the early modern times between the 17th to 19th centuries (mainly Edo period in Japan), though it was hard to provide an exact date of these artifacts.

With these background and research questions, we have conducted an interdisciplinary underwater research with multiple methodologies including GPS position coordinating and archaeological analysis of each artifact (Ono and Katagiri), a broadband multibeam survey searching (Kan and Nagao), and recording high-resolution video of the site and survey progress by a human-portable underwater robot (Sakagami). This interdisciplinary research is part of the larger-scale study project “Coastal Area



A General view of the robot



B View of the robot in underwater

Fig. 2 A Human-portable Underwater Robot Made and Used in Our Research. (R. Ono)

Capability

Enhancement in Southeast Asia” (headed by Dr. Satoshi Ishikawa) by the Research Institute for Humanity and Nature, Kyoto, Japan, and the robot (Fig. 2) was

originally planned and made for this research project in low-cost value by Sakagami at Tokai University. Surveys were conducted in November 2012, August 2013, and November 2013. During these researches, GPS position coordinates and exact depth of all the seven iron grapnel anchors and the clustered area with ceramic jars were measured. Table 1 shows each position coordinate and depth of anchors and ceramics, while Figure 3 is the bathymetric map provided by Geospatial Information Authority of Japan (GIS) with each location of artifacts plotted. As shown in Figure 3, the GIS bathymetric map is only mapped in 10m scale level and it is yet hard to locate the exact position of each artifact with this map. Concerning such mapping problem, Kan and Nagao conducted a broadband multibeam survey around the Yabuoki site to visualize the bathymetric results at a lateral grid resolution of 1m during our research. Although the complete map is not come out in this moment, such map should enable us to create a three-dimensional site map to plotting the artifacts in much detail and exact position in the final stage of our research.

Description of Grapnel Anchors and Ceramic Jars

As shown in Figure 3 map, the distribution area of the grapnel anchors can be mainly separated into two zones as (1) eastern zone and (2) western zone. Each zone have about 400 m away in distance, hence it is highly possible that these seven grapnel anchors

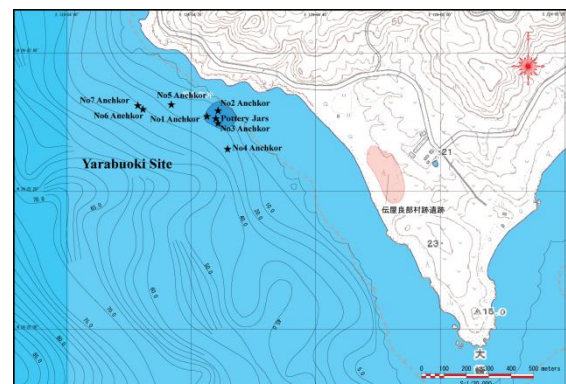
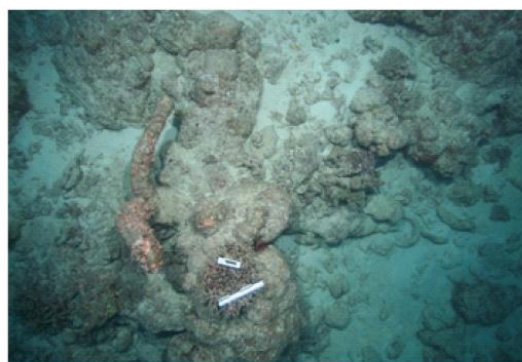


Fig. 3 The GIS Bathymetric Map with Plotted Each Location of Artifacts. (R. Ono)



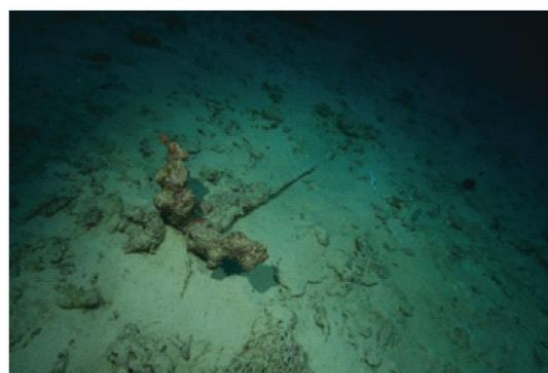
A No.1 grapnel anchor



B No.2 grapnel anchor



C No.3 grapnel anchor



D No.4 grapnel anchor



E No.5 grapnel anchor



F No.6 grapnel anchor



G Exposed arms of No.6 grapnel anchor



H No.7 grapnel anchor

Fig. 4 The Iron Grapnel Anchors in Yarabuoki site. (Y. Yamamoto)

could belong to more than two ships rather than a single ship. Such possibility might be also supported by the existence of various sizes of anchors in the site. Concerning the clustered area of ceramic jars, these jars are distributed close to the No. 1, 2, and 3 grapnel anchors, and there might have been any relationships with these anchors and jars. Here, we firstly introduce the condition and form of each grapnel anchors and ceramic jars, then discuss the possible age and character of the site from various aspects.

No. 1 Grapnel Anchor

The size of No.1 anchor shank is 1.97 m in length. All the four arms left in good condition, while two of them are buried in the sandy bottom (Fig. 4A). The width of joint base with shank and arm is about 20 cm and its cross section is square size. The width of shank point is about 15 cm and no arm ring attached.

No. 2 Grapnel Anchor

The size of No.2 anchor is a bit smaller than No.1 as its shank is about 1.8 m in length. All the four arms left with good condition, while two of them are buried in the sandy bottom (Fig. 4B). The width of joint base with shank and arm is now surrounded by corals but its cross section can be estimated as square size. The width of shank point is about 15 cm with an arm ring attached.

No. 3 Grapnel Anchor

The size of No.3 anchor is much smaller as its shank is about 1.5 m in length. Among the four arms, two of them are buried in the sandy bottom, while other two are expose only its point part. Both of these exposed arm points are not complete and broken (Fig. 4C). The width of joint base with shank and arm is now surrounded by corals but its cross section can be confirmed as square size. The width of shank point is about 15 cm with an arm ring attached.

No. 4 Grapnel Anchor

The size of No.4 anchor is one of the smallest as its shank is about 1.2 m in length. Among the four arms, two of them are buried in the sandy bottom, while other two are expose only its point part. Both of these exposed arm points are not complete and broken (Fig. 4D). The width of joint base with shank and arm is now surrounded by corals but its cross section can be confirmed as square size. The width of shank point is

about 15 cm with an arm ring attached.

No. 5 Grapnel Anchor

The size of No.5 anchor shank is 1.6 m in length and almost. Among the four arms, two of them are buried in the sandy bottom, while other two are exposed in good condition as complete form (Fig. 4E). The width of joint base with shank and arm is now surrounded by corals but its cross section can be estimated as square size. The width of shank point is about 15 cm with an arm ring attached.

No. 6 Grapnel Anchor

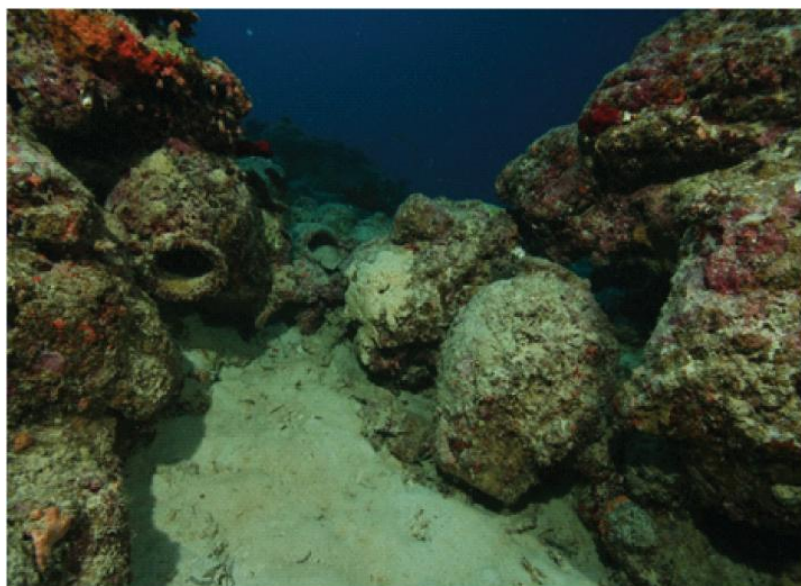
The size of No.6 anchor shank is about 1.65 m in length. Among the four arms, two of them are buried in the sandy bottom, while other two are exposed only its point part. Both of these exposed arm points are not complete and broken (Fig. 4F). The width of joint base with shank and arm is now surrounded by corals but its cross section can be confirmed as square size. The width of shank point is about 15 cm with an arm ring attached.

No. 7 Grapnel Anchor

The size of No.7 anchor shank is about 2.05 m in length. Among the four arms, three of them are exposed in good condition as complete form (Fig. 4G), while another one is buried in the rocky bottom. The width of joint base with shank and arm is now surrounded by corals but its cross section can be confirmed as square size. The width of shank point is about 20 cm with an arm ring (30cm in diameter) attached.

Pottery Jars

As shown in Table 1, these pottery jars locate close from No. 1 to 3 grapnel anchors and about 20 m in depth. In total of 12 jars are recently confirmed with some variety in size from about 40 cm up to 100 cm in height. Yet, all of these jars are similar in form and source material, and can be identified as early modern Okinawa pottery jars called “tsuboya-yaki” in local name and originally made in Okinawa Island (Fig. 5A). We measured the detail size and location of all of these jar but did not salvaged and kept them in the original position except one small jar (Fig. 5B) which was not fixed with coral or rocky bottom and easily movable. This salvaged jar is now kept in the Okinawa Prefectural Museum for further archaeological analysis to indentify the original production location and exact date of these jars.



A Pottery jars complex



B A salvaged jar

Fig. 5 The Early Modern Okinawa Pottery Jars in Yarabuoki site. (Y. Yamamoto)

Discussions and Future Perspectives

Early modern maritime transportations in Okinawa

As described and discussed in previous chapters, the seven grapnel anchors are variety in size and its shape. Among these, No.1 to 4 anchors are basically distributed in eastern zone with pottery jars, while the other No. 5 to 7 anchors are located in western zone in the site around 13-32 m in depth. Such distribution patterns of the anchors tentatively indicate that more than two ships dropped their anchors around the site. In the Yaeyama Islands, including Ishigaki Island, there is no record of public port in historic times or during the Ryukyu Kingdom Period (from 1429 AD to 1879), and most of trading or loading activities were possibly done in off-coast by use of small boats (e.g. Oohama, 1999). With such situation, large size ships were basically anchored inside bays such as Nagura bay in western coast of Ishigaki or some anchorage points where they could avoid strong winds and waves. Yarabuoki site is located in the northern coast of Yarabu peninsula next to the large Nagura bay is also known as one of these anchorage points from historic times. In fact, there were some historical records of anchorage by drifting ships in local historic documents during the 17th to 19th centuries. Based on these historic facts, these grapnel anchors could belong to ships originally from Okinawa Island (where the capital of Ryukyu Kingdom located), Satsuma in

Kyushu Island (where had occupied the Ryukyu Kingdom since 1609), or mainland China (during the Chin Dynasty) to visit in some purposes or drift off by accident to Ishigaki Island.

However, there were no grapnel anchors discovered or kept in Okinawa except these seven anchors from Yarabuoki site. This fact can be the possible hint to estimate the types and origins of ships that equipped or loaded these anchors and pottery jars. There are no historical records either that mentioning what types of anchors were equipped with the local ships during the Ryukyu Kingdom period. The major ship types in Okinawa during the early modern times were “Shinko-sen” as the largest sized junk typed ship for international trading mainly with China (Ming and Chin Dynasty) and “Maran-sen” as the middle to small sized wooden ship for domestic trading mainly inside the territory of the Ryukyu Kingdom. The types of anchor equipped in these ships are unclear since no historic documents or records were discovered except a drawing of the old Ryukyu trading port (Naha city) on folding screen in the early 19th century (owned by Urasoko City Museum). Some Shinko-sen ships and the equipped anchors were drawn in the folding screen, though these anchors are not grapnel and its material seems like wood and not iron (Katagiri, 2011).

On the other hand, iron grapnel anchors were major anchors for Japanese style wooden ship called “Kai sen” and “Benzaisen” (sen=ship) during the Edo period after the 16th century. These early modern ships are usually equipped 6 to 8 different size of iron grapnel anchors identified as the first anchor to the eighth anchor. The first anchor was usually the largest, while the eighth anchor was the smallest among them (e.g. Kojima, 2012). For example, the largest sized-class wooden ship “Sengoku sen” (sen=1000, goku/koku = basic unit of volume used during the Edo period) which had over 278 kL/m³ loading capacity, was usually equipped with a first anchor of over 2-3 m length and 300-400 kg weight.

Based on these historical backgrounds and the size variety of Yarabuoki grapnel anchors between 2.0 to 1.2 m in length, it is possible that these anchors were equipped with Sengoku-sen class Japanese style wooden ship. Another possibility is visits of Chinese ships to Ishigaki and other islands in the Yaeyama since the early modern Chinese ships also usually equipped iron grapnel anchors. However, considering that all

the pottery jars in Yarabuoki site are Tsuboya-yaki as the early modern Okinawa jars originally produced in Naha City in Okinawa Island, it is highly possible that at least the No. 1 to 3 grapnel anchors could be equipped with Japanese style wooden ship(s), probably from Satsuma in Kyushu Island since most of this type of ships in Okinawa were mainly from Satsuma after 1609 when the Ryukyu Kingdom was dominated by Satsuma. According to another drawing of the old Naha port on a folding screen from the 19th century (owned by Okinawa Prefectural Museum), there are some Satsuma ships equipped with iron grapnel anchor (Katagiri, 2011). Although it is yet unclear in which types of ships these anchors were used, we estimate some of them could belong to Satsuma ship(s). For further investigation and dating of these anchors and exact ships anchored in Yarabuoki, we need much detail analysis including accurate measuring of each anchor and comparative study of early modern iron anchors in China and Kyushu particularly Satsuma. In terms of the site type, there are still two possibilities as (1) the site also contains shipwreck(s) or (2) the site is just scattered seabed artifacts site with only anchors and pottery jars and no shipwreck (Ono et al., 2013). Although it is required to discover part of the shipwreck(s) to identify Yarabuoki as shipwreck site in future study, we consider that the distribution pattern as No.1 to 3 anchors are concentrated with clustered pottery jars in their center position may indicate the presence of a shipwreck. To confirm such possibility, further surveys including test excavation around the area are required.

Use and Management of Underwater Cultural Heritages in Okinawa

Lastly, regarding the use and management of underwater cultural heritages in the Yaeyama Islands or Okinawa Archipelago, we strongly consider there is great potential for cultural resource management of underwater cultural heritage in the Yaeyama or Okinawa. Since Okinawa Archipelago including the Yaeyama Islands locate in sub-tropic climatic zone with developed coral reefs in Japan, these islands, particularly the Yaeyama, located in the southern part of Okinawa, are the most popular diving area in Japan. Because of such environmental and social backgrounds, there is great potential for the use and management of underwater cultural heritages including Yarabuoki site as cultural, educational and tourism resources that the local community can properly manage and conserve (see also Ono et al., 2013). Our interdisciplinary underwater

research and current surveys reported here can be considered as the first stage for this initiative of use and management of underwater cultural heritages in the Yaeyama and Okinawa in the near future. This work is important as an initial stage because it is essential to identify underwater archaeological or historical sites put forward the significance of cultural heritage in order to manage them. For the second stage, we should report and spread research outcomes to the public, particularly to the local community. Concerning this stage, we have also tried to report our research outcomes and information to the local schools, the museum and public offices after our first survey. With such outreach activities, the local museum (Ishigaki City Yaeyama Museum) held a special exhibition focusing on the underwater cultural heritage of the Yaeyama Islands, including Yarabuoki site and exhibited many of our research outcomes. The robot designed and tested by Sakagami during the surveys of 2013 was also exhibited.

For the third stage, we consider the significance of operating educational and cultural programs to tell the historical or archaeological significance and future potentials of underwater cultural heritage to the local young generations (school students). With such reason, we also tried to operate the educational program for school students (mainly Junior high school and High school students) to make small-sized low-cost underwater robots to investigate shallow underwater in near shore coral reef zone in Ishigaki Island. As the robot could be one of the key tools to attract the student's interest, trigger their curiosity and increase interest on underwater and underwater cultural heritage, Sakagami has leaded the program since 2012. In November 2013, we also conducted co-research in Yarabuoki site with some local high school students who had joined the robot making program. During this co-research program, the diving team members conducted their research of some anchors and pottery jars in the site, while Sakagami supervised the students on how to manage and operate the human-portable underwater robot for the observation of the underwater cultural heritage and underwater survey activity. Following such educational practices, we also held some town meetings in Ishigaki city to invite the school teachers, students, and local members of Educational board to openly discuss about the possibility of the underwater cultural heritages around Ishigaki Island and its potential use for further educational and cultural program. All of these trials and practices seem to have worked to get the local community involved and

to increase their interests in our research and underwater cultural heritage as well. Now, our next target is to create the local society and its core members who want to join and continue to conserve their underwater cultural heritages as educational, cultural and tourism resources. As also mentioned by other Japanese scholars (e.g. Iwabuchi, 2012; Katagiri et al., 2010, Katagiri et al., in this volume), the concept of establishing Seabed Site Museums can be one of the ideal ways to accomplish our final goal for the use and management of underwater cultural heritage in the Yaeyama and Ryukyu Archipelago in the near future.

No.	Artifact(s)	Latitude	Longitude	Water Depth
1	No.1 Grapnel Anchor	24°25'31.2"	124°4'22.74"	21m
2	No.2 Grapnel Anchor	24°25'31.14"	124°4'24.36"	13m
3	No.3 Grapnel Anchor	24°25'29.88"	124°4'24.24"	19m
4	No.4 Grapnel Anchor	24°25'25.98"	124°4'25.98"	19m
X	Pottery Jars	24°25'30.183	124°04'24.03	20m
5	No.5 Grapnel Anchor	24°25'32.83"	124°4'16.96"	25m
6	No.6 Grapnel Anchor	24°25'32.94"	124°4'11.04"	29m
7	No.7 Grapnel Anchor	24°25'33.3"	124°4'10.98"	32m

Table 1 GPS Position Coordinate and Depth of Anchors and Ceramics. (R. Ono)

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Biography

Rintaro Ono is an Associate Professor in the School of Marine Science and Technologies at Tokai University, Japan. He has conducted numbers of archaeological fieldworks in Island Southeast Asia, the Pacific islands, and Okinawa. The primary focus of his research is development of the human's maritime adaptation, maritime networking and resource exploitation in island ecosystem.

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