

# Archaeology from a Submersible: rare physical evidence of ancient deepwater bottom fishing in Hawai‘i

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## ABSTRACT

Historical accounts of off-shore fishing and methodology are documented in Hawaiian literature yet few accounts of ancient fishing grounds exist since locations were undisclosed and lost over time. A submersible dive (216 m) now provides evidence of a historical site and verification of traditional fishing techniques. A recovered artefact and photo documentation of stones scattered throughout the pinnacle distinctly fit historical descriptions of plummet and sinker stones used in bottom fishing. This paper documents the deepest substantiated pre-contact fishing site to date and substantiates reports of the ability of early Hawaiian fishers to return to fishing sites well offshore.

*Keywords:* plummet stone, Hawaiian fishing, bottom-fishing

## INTRODUCTION

For over a millennium, fishing provided an important source of protein in the main Hawaiian Islands (MHI) where the peak population prior to the arrival of Europeans ranged from 150,000 to nearly 1 million (Dye 1994, Kirch 2007). In addition to nearshore fisheries targeting shallow water species, historical accounts also exist of fishing in deeper waters inhabited by large snappers (Lutjanidae), jacks (Carangidae), and a grouper (Serranidae), collectively referred to as ‘bottom-fish’. The essential fish habitat (EFH) for this fishery is defined as the 0–400 m depth range around each island and bank. However, each species of bottom-fish has its own preferred depth range within the EFH. Bottom-fish utilize all available habitat within their preferred range but can be found in higher abundance in areas where they feed. For example, *Etelis coruscans*, the Long-tail Red Snapper (*onaga*) concentrate in high relief areas between 180–365 m where their prey, small swimming crustaceans and fishes, are also attracted. Other species of bottom-fish also tend to associate with this type of topography (Polovina *et al.* 1985, Kelley *et al.* 2006, Parke 2007).

Knowledge of depth preferences, spatial complexity of their habitats, and seasonal distributions of bottom-fish are

used by fishers to target specific species. Hawaiian fishers centuries ago are believed to have been able to relocate productive offshore fishing grounds on pinnacles, banks and seamounts found far from shore. Unlike coastal fishing based on spawning seasons, offshore fishing was based on weather conditions (Kaha‘ulelio 2006). Prior to western contact all inhabitants were free to fish offshore providing they respected religious *kapu* (code of conduct) and any specific restrictions set by the *ali‘i* (royalty) or *kono-hiki* (overseers). Deep-sea fishing management policies were not codified into written law until the mid-1800’s (Statute Laws of His Majesty Kamehameha III, Article V, 1846). Kamakau (1869) indicates deep sea fisheries were not communal property of the *ahupua‘a* (land division) as was near-shore fishing. The proprietary locational information was therefore guarded as secret by individuals and only passed on to descendants thus the locations of most of the deep-sea fishing grounds have been lost. This practice of not revealing fishing grounds continues today but is ineffective due to modern technology such as fathometers, fish finders, and GPS receivers that reveal and record many of these sites to a wide number of fishers.

Early Hawaiians are believed to have used hand-line gear to catch these deeper bottom-fish. Their gear consisted of a main vertical line with a relatively heavy weight or sinker attached to the end that was either a natural or sculpted stone. Sinkers used across the Pacific by early islanders took many shapes but one form used exclusively in the Hawaiian Islands was called a plummet stone or *pohakialoa* that needed to weigh more than a kilogram in order to keep the hooks near the bottom. Branching lines made from ‘olona’ fiber (*Touchardia* spp.) were attached to the main line at 1 m or greater intervals above the *po-*

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*hakialoa*. At the end of each branching line was a circular hook made of bone, shell, ivory, or wood (Sinoto, 1962). The hooks were baited, but to also attract fish, a fiber bag containing chopped fish (*palu*) and potentially a second stone was secured near the hooks. The gear was deployed with the branched lines and hooks wrapped around the *palu* bag and sinker. When it reached the bottom, the fishers pulled the line which unwrapped the line and hooks and released the *palu*.

This basic handline technique for catching bottom-fish has continued through today. However, modern fishers use a strong, inflexible main line referred to as blood line, clear monofilament for the branch lines, metal circle hooks, a denim fabric *palu* bag, and a 2–3 kg lead fishing weight for the sinker. Due to the depth of the water and the combined weight of the sinker and large hooked fish, the gear are deployed and recovered using electric or hydraulic reels. In contrast, early Hawaiians had to recover their gear and fish by hand; no easy feat given that several species of bottom-fish can reach weights of over 13 kg.

Historic accounts have been the main source of proof that pre-contact Hawaiians were fishing for deep-water bottom-fish. Although the accounts were never in doubt, a manned submersible dive a number of years ago provided direct, rare evidence that this difficult and strenuous type of fishing was indeed taking place hundreds of years ago. A description of the dive and the evidence that was found are provided below.

## METHODS

On 22 August 1998, a survey was undertaken to investigate bottom-fish populations off the island of O‘ahu, Hawai‘i. The survey was conducted from the Pisces 5 three-person submersible operated by the Hawai‘i Undersea Research Laboratory (HURL). The submersible was launched and recovered with a specialized A-frame on the aft deck of their primary support vessel the R/V *Ka‘imikai-o-Kanaloa*. Typical dives lasted from 6 to 10 hours and were only conducted during the daytime, with the vehicle being serviced on board at night. Once in the water, the two scientists aboard on either side of the pilot made visual observations through view ports.

The Pisces 5 was fitted with 3 digital video cameras as well as instruments to record environmental parameters such as depth, temperature and salinity. At least one of the cameras was on at all times during a dive. Observers and the pilot chose to turn on one or both of the other two cameras to obtain additional imagery as needed. One camera was a low-light CCD black and white camera. This special camera allowed video-recording of deep (up to approx. 305 m [1000 feet]) environments under natural light conditions. The submersible also had two manipulator arms the pilot used to collect biological or geological samples and place them into an externally mounted sample basket (Misa *et al.*, 2013).

The dive site was named the North Ship Channel (NSC) Pinnacle; a well-known bottom-fishing location outside of Kāne‘ohe Bay on the east coast of the island. Of potential significance is the proximity of this site to the Kualoa ahupua‘a (Fig. 1), considered to be one of the most sacred sites on O‘ahu, closely protected by chiefs and priests, and considered a ‘symbol of sovereignty and independence’ (Summers and Sterling 1962, Fornander 1969).

## RESULTS

The dive, designated P5-366, began when the submersible reached the bottom near the base of the pinnacle at 235 m. It then was piloted upslope to survey the pinnacle summit at a depth of approximately 160 m before moving back down slope to a maximum depth of 235 m. During the dive, numerous water-rounded cobbles and boulders of roughly the same size were observed scattered over the seafloor. Toward the end of the dive at a depth of 216 m (Fig. 2), another type of unusual stone object was encountered and collected using the submarine manipulator. The object clearly appeared to be carved, weighed 1.23 kg and was conical in shape having a rounded base with a diameter of 9.5 cm (Fig. 3). The height was 9.8 cm and the top narrowed to a small knob with a shallow neck. A second object of similar size and shape near to where the first was collected was revealed while the dive video was being reviewed (Fig. 4). This object was not noticed during the dive and therefore not collected.

## DISCUSSION

The numerous rounded basalt rocks scattered throughout the site are typical of rocks found in streams and on cobble/boulder beaches. The paleo shoreline off O‘ahu has been found to be over 1000 m deep so these rocks could possibly have been rounded in place. However, from well over 1,000 submersible dives conducted by HURL since 1980, it is very uncommon to find rounded basalt cobbles on down carbonate reef terraces off of this island (J. Smith, pers comm). A more plausible alternative explanation is that these stones were collected onshore and used for deep water bottom-fishing. Pinnacles and other areas of abrupt topography emerging from the seafloor such as this site have been confirmed as fertile bottom fishing grounds (Kelley *et al.* 2006, Leitner, 2018). The round rocks would have specifically been wrapped inside *palu* bait bags and when the line was jerked, facilitated the unwrapping of the bag and release of the *palu* before dropping free to the seafloor. Further supporting evidence of use in bottom-fishing is their narrow size range which is consistent with their use for fishing. In addition, there was no obvious pattern of deposition or sorting of the rocks as might have occurred if they formed in place. The number of stream/beach rocks found at this known bottom-fishing site along with their localized accumulation on this distinct topog-

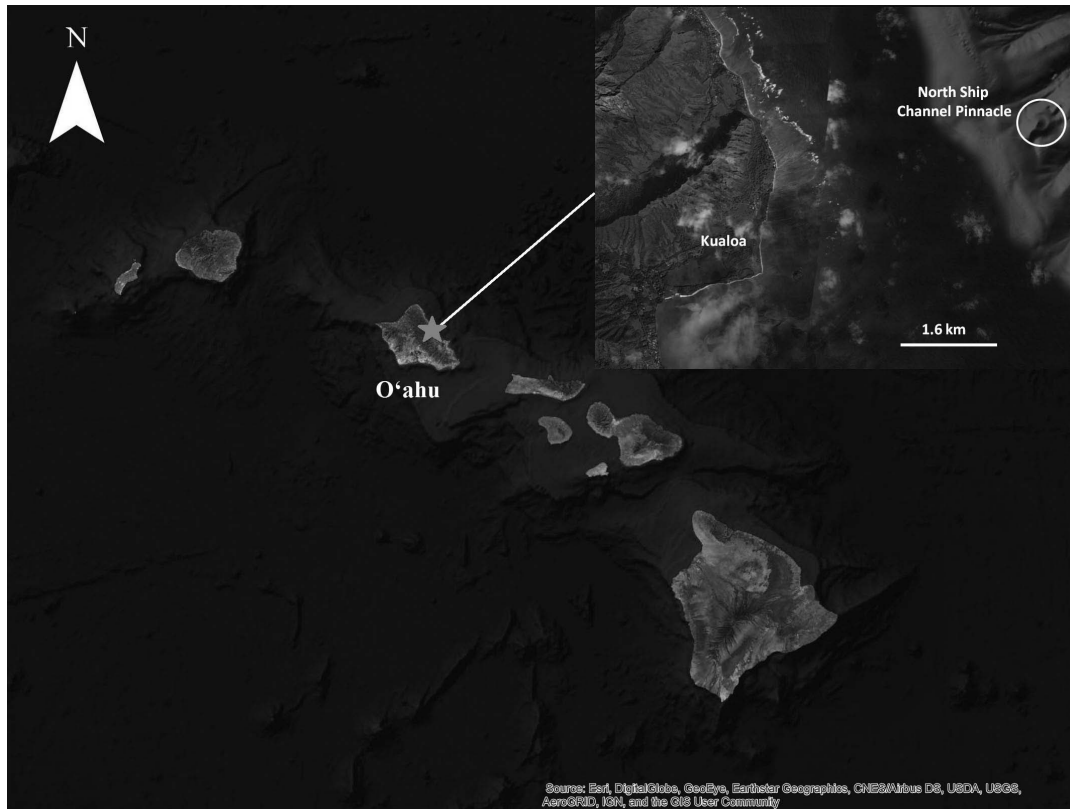


Figure 1. Map showing the main Hawaiian Islands identifying the site off O'ahu. Inset shows the North Ship Channel Pinnacle off east O'ahu and its proximity to Kualoa.

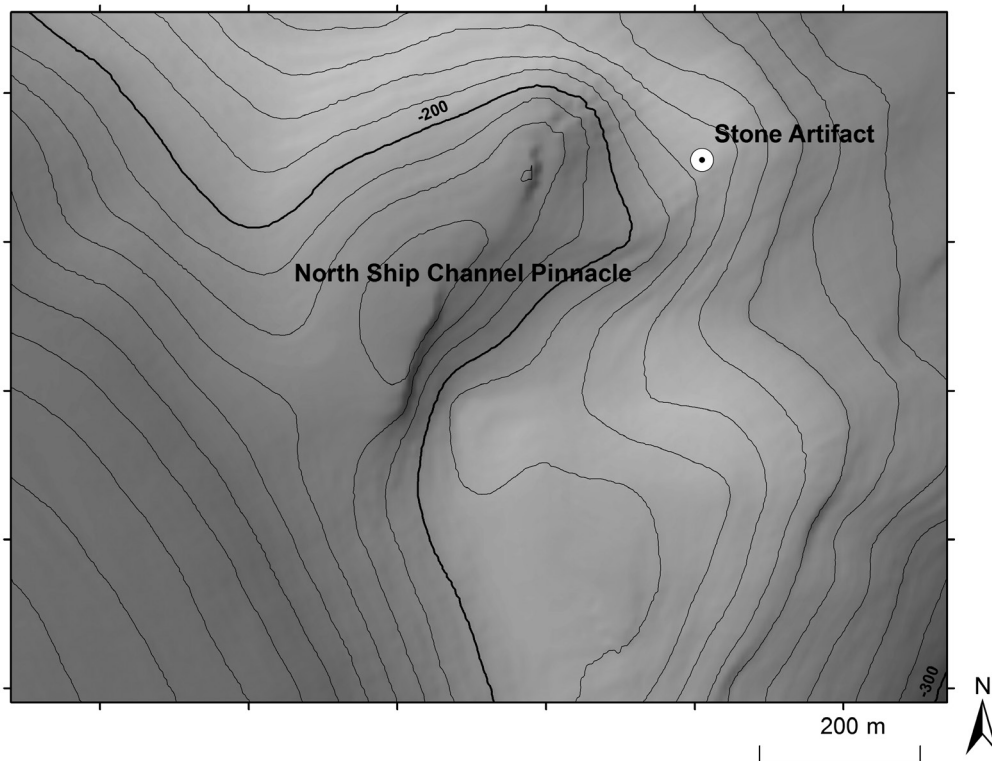


Figure 2. Bathymetric map showing pinnacles, depth (216 m), and location (white circle) of retrieved stone artifact.

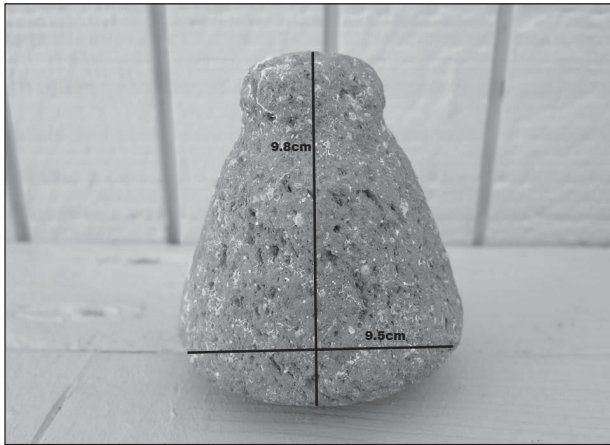


Figure 3. Carved stone object retrieved by submersible on August 22, 1998 at 216 m off the east side of O‘ahu island.

raphy feature, suggests the North Ship Channel Pinnacle was known to, and frequented by, early Hawaiian bottom fishers. Their size, shape, and basalt composition are consistent with historic accounts of stones used to transport *palu* to the bottom.

The two similarly carved objects, one collected and the other recorded on video during the dive on this pinnacle, fit historical descriptions of plummet stones (*pohakialoa*) used for bottom-fishing by early Hawaiians (Buck, 1957;

Kamakau, 1868). *Pohakialoa* were ‘made like poi pounders with the upper end narrowed and surmounted by a small knob for the attachment of the line, in addition, the bottom end is globular instead of flat resembling a large plumb reversed, the small end uppermost’ (Buck 1957). Unlike rounded stream/beach stones placed inside *palu* bags, *pohakialoa* were typically retrieved with the fish and fishing gear. It is likely that both types of stones were used during bottom-fishing, since one provided the weight to open the *palu* bag with a jerk once the line reached the bottom, while the other kept the hooks close to the bottom near where the *palu* was deployed. Assuming this is correct, then it is no surprise that a significantly larger number of ‘*palu* stones’ were observed during the dive since those were expendable whereas *pohakialoa* were not. Considerable time and effort was required to carve the *pohakialoa* so it is understandable why they became obsolete after the introduction of lead sinkers.

The rarity and importance of this collected artifact as well as the others recorded during the dive can be attributed to their land-based source, manufactured origin, deep-sea location where they were found, and link to traditional bottom-fishing. The dimensions, shape, and material (basalt) of the recovered *pohakialoa* fits those of the thirty-five shallow water *pohakialoa* in the Bernice Pauahi Bishop Museum collections. In the 1960’s a similar stone was found and placed for auction by a diver in shallow water off Waikiki measuring 20.3 cm by 10.2 cm.

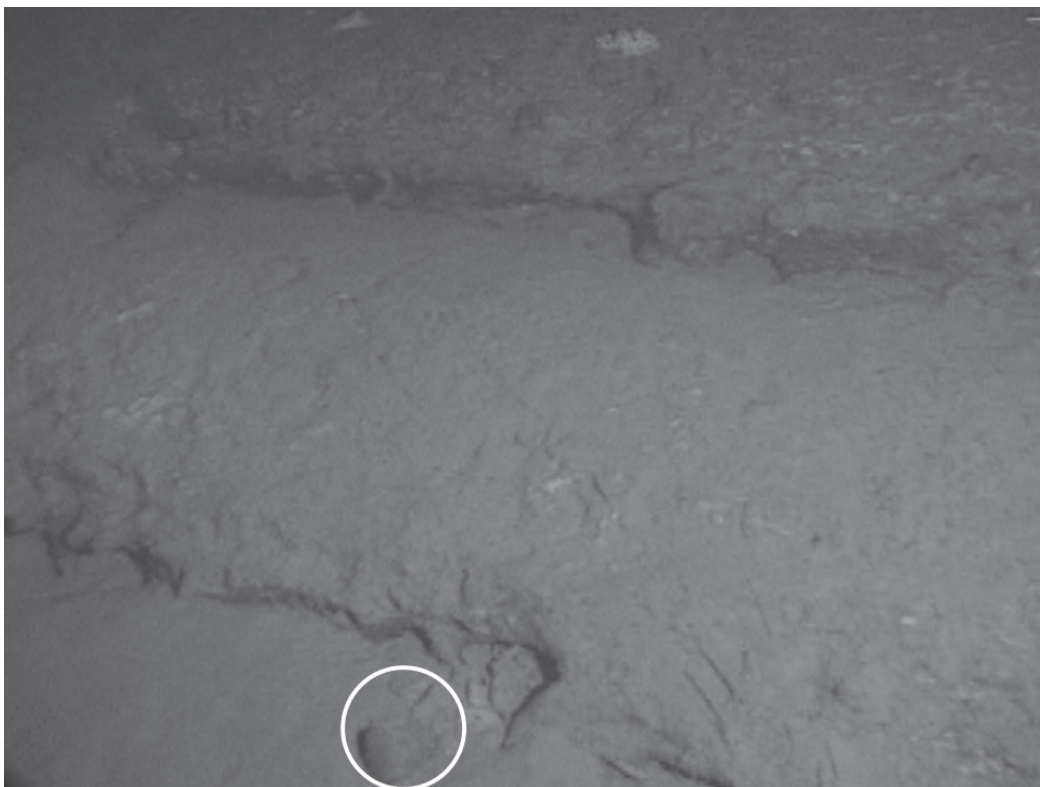


Figure 4. Second carved stone object recorded on video but not retrieved.

Shallow water finds can be problematic. Weathering from sand scour can remove the external layers over time. Distribution of artefacts can be affected by wave regimes or anthropogenic interference. Shoreline erosion can relocate terrestrial artifacts into the nearshore marine environment misrepresenting the purpose of the site. These obstacles do not occur at deep-water locations, providing more valid information and allowing for more positive identification as a fishing site.

Only one other known presumptive pre-contact fishing site has been previously documented (<https://molokini-maui.com/ancient-hawaiian-relics/>) However, this account is non-peer reviewed by an author with no formal archeological training. Similar to the North Channel Pinnacle site, this archaeological site located off Molokini Island, Maui contained hundreds of round stone sinkers and a *pohakialoa* stone. However, this site is considerably shallower at 26 m depth and within Self-contained Underwater Breathing Apparatus (SCUBA) diving range.

The submersible dive on this site had the objective of conducting a modern-day fishing site survey and not a historic fishing site survey. The observers did not expect to find any objects of potential historic importance and this artefact had not been identified as being a *pohakialoa* stone when collected. The authors in no way support or condone opportunistic collection of cultural artifacts whether on land, in shallower water accessible to sport divers, or in deep water. Now that this site has been identified as a potential historic fishing site, any future surveys by deep water vehicles should either 1) refrain from collecting any object that appears to be manmade or used by early Hawaiians, or 2) should be permitted by the appropriate state or federal agency to conduct such a collection for the purpose of increasing our knowledge of their practices.

## CONCLUSIONS

The recovery of this plummet stone (*pohakialoa*) documents several important cultural aspects of traditional Hawaiian fishing.

- This site represents a pre-contact off-shore Hawaiian fishing ground.
- The large number of river stones provides evidence of a repeatedly, well visited, productive site.
- This is by far the deepest archaeological underwater fishing site documented (216 m).
- This site offers a glimpse into the past of where early Hawaiian offshore fishing occurred.
- The type of stones documented provides verification of previously described early traditional fishing methods. The recovered artifact and photo documentation of numerous stones scattered throughout the pinnacle site distinctly fit historical descriptions of plummet and sinker stones used in traditional bottom fishing.

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