A Re-examination of Robert Suggs' Marquesan Fishhook Collection from Nuku Hiva

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Abstract

Fishhooks are among the most widely distributed and frequently excavated artifacts in Eastern Polynesia. Their analysis contributes to understanding such wide-ranging topics as Polynesian migration and inter-island contact, subsistence and resource utilization and depression, and the establishment of relative chronologies. Emory, Bonk, and Sinoto conducted the first systematic analysis of Polynesian fishhooks in 1959. Continued work by Sinoto laid the groundwork for East Polynesian fishhook studies and their utility in comparative analysis and chronological applications. This paper reviews previous Polynesian fishhook arrangements and suggests possible variables for the construction of a function-oriented classification. A selection of these variables are applied to the collection of fishhooks excavated by Robert Suggs on Nuku Hiva, Marquesas Islands, revealing a more nuanced picture of spatiotemporal trends in fishhook size and morphology than previously established.

Introduction: A Legacy of Polynesian Fishhook Analysis

Yosihiko Sinoto's analyses of Polynesian fishhook assemblages have been foundational to the study of these artifacts. Systematic analysis of Polynesian fishhooks began with the pioneering work of Emory, Bonk, and Sinoto (1959), which established the efficacy of fishhook form analysis in developing relative chronologies for East Polynesia in the absence of pottery. Sinoto continued this work by developing a chronology of fishhook head forms for the Hawaiian Islands which demonstrated the utility of the line lashing device to serve as a relative chronological indicator throughout the archipelago (Sinoto 1962). Building on this work, Sinoto created a coding system for fishhook forms more broadly applicable throughout East Polynesia (Sinoto 1992). In addition, Sinoto's work illuminated the stages of prehistoric fishhook manufacture, allowing for the incorporation of fishhook blanks, unfinished hooks, and fishhook fragments into detailed analyses of archaeological assemblages (Sinoto 1967).

Sinoto's influence continues on in later studies. Early interest in Polynesian origins led scholars such as Robert Suggs (1961) to build on the work of Emory et al. (1959) by creating fishhook arrangements to establish relative chronologies on other islands and to attempt to trace the origins of their original settlers. Kirch (1985) identified three major axes along which fishhooks have been analyzed, and the types of questions each can be used to answer. Stylistic analyses organize stylistic variability into island-specific arrangements to evaluate migration and relative chronologies. Functional analyses examine fishhook raw materials and gross morphology to understand how changes in these variables impact the efficacy of a fishhook for a given type of fishing. Finally, ecological analyses contextualize fishing artifacts within their local environments to reconstruct fishing strategies and identify adaptations to variable marine environments. Thus, multiple arrangements may arise from the same assemblage depending on the questions of the researcher (Kirch 1985).

Researchers have applied both taxonomic and paradigmatic classifications as well as non-classificatory groupings towards the study of fishhook assemblages (see Dunnell 1971 for definitions of these kinds of arrangements). Critiques of non-classificatory systems illustrate that sole consideration of gross hook morphologies may conflate chronological, spatial, and ecological factors in resulting changes in form (Allen 1996; Pfeffer 2001a, 2001b). Additionally, non-classificatory arrangements are ad-hoc groupings designed around a single assemblage and used to describe the variation within the given set of objects. Subsequent incorporation of new fishhooks with additional attributes into these groupings proves difficult, and as a result these categories tend to suppress morphological variation within groups rather than identify new change and its significance. The separation of fishhook attributes into stylistic and functional categories for the purposes of classification remains an ongoing challenge; however this separation can be crucial for identifying meaningful trends in the archaeological record. The morphology of the fishhook head and line lashing device has been isolated as a stylistic trait that is amenable to paradigmatic classification and studies of chronological and inter-island variation (Allen 1996; Sinoto 1962), though variability in line lashing devices may also have functional implications (Graves and McElroy 2005; Pfeffer 2001b).

Developing a Marquesan Fishhook Typology

The first systematic excavations in the Marquesas were carried out by Robert Suggs on Nuku Hiva (Suggs 1961), the largest island in the archipelago. Though modern standards for radiocarbon dating call into question the accuracy of Suggs' absolute chronology for Marquesan settlement (Allen 2004; Conte and Molle 2014), the prehistoric sequence he developed utilizing variations in artifacts (including fishhooks, coral files, and adzes), architecture, and site placement persists today. The Settlement Period begins at first sign of human colonization of the islands, with small coastal habitation sites. Suggs sees the Developmental Period as the first emergence of a distinctly Marquesan culture, while the Expansion Period is marked by increasing population growth and the first appearance of monumental architecture and clear social stratification. The Classic Period encompasses the apex of hostility and competition between chiefdoms and increasing social divisions marked by massive investments in monumental architecture. Finally, the Historical Period begins at European contact in AD 1790 and continues to the present. The Ha‘atuatua Dune Site contains the earliest evidence of human occupation on Nuku Hiva from Suggs' excavations and is the only site with representation from both the Settlement and early Developmental periods. Reinvestigation of this site suggests that the dune was occupied no earlier than AD 1000 (Rolett and Conte 1995).

Suggs undertook the first fishhook assemblage analysis for the Marquesas from his excavations on Nuku Hiva. Suggs' goals were to determine a relative sequence of fishhook forms and to trace the origins of the island's initial settlers. The fishhooks were organized into non-classificatory descriptive groupings based on variations in shank, bend, point, and barb (see Figure 1). Suggs identified eight unique groups of one-piece hook as well as the compound shank hook and seven variations of bonito shanks and points (Suggs 1961: fig. 26). Several of Suggs' groups, including the jabbing hook, the rotating hook, the curved shank, compound shank, and bent upper shank hooks, demonstrated chronological significance and were incorporated into Suggs' artifact seriations to establish a relative chronology for Nuku Hiva.

Sinoto's excavations at Hane (1966) resulted in a large assemblage of fishhooks and led to a modification of Suggs' system to incorporate additional hook forms found in Ua Huka, elaborating the chronological sequence for the Northern Marquesas Islands. Sinoto's analysis highlighted one challenge of incorporating additional hooks into non-classificatory systems: because Suggs only included illustrations of one hook from each group, it was difficult for Sinoto to establish the full range of variation within each group, including variability in key factors such as line lashing devices (Sinoto 1966:299; and see Rolett 1998:149-150). Later excavations by Barry Rolett at the Hanamiai Site, Tahuata Island (Rolett 1998) expanded these fishhook groups to the rest of the Marquesan archipelago by conglomerating the fishhook arrangements from Nuku Hiva, Hane, and Hanatekua (Bellwood 1972). In contrast to Suggs and Sinoto, the ultimate goal of Rolett's fishhook analysis was to investigate changes in fishing technology and subsistence at Hanamiai. Rolett compared the patterns seen in fishhook variation at Hanamiai with associated faunal materials and an extensive ethnoarchaeological analysis of contemporary Marquesan fishing practices.

The chronological distribution of fishhooks throughout these sites demonstrates a tendency for great variability in fishhook forms in early sites and occupation layers, followed by an abundance of jabbing hook forms in the later phases (Sinoto 1966; Suggs 1961; Rolett 1998). Many of the early hook forms disappear in later prehistory, perhaps indicating an early experimentation phase followed by shifting focus to a smaller subset of fishing activities that were well-adapted to the Marquesan marine environment (Kirch 1984:88-89, fig. 22). Rolett notes an overall trend of decreasing fishhook size in later occupation layers, which may indicate a shift of focus towards inshore fishing and the capture of smaller fish (Rolett 1998:172). A notable exception to these patterns are the fishhooks recovered from excavations at Hanatekua, Hiva Oa by Peter Bellwood, where an unusually high quantity of jabbing hooks are found in the early phases of occupation (Bellwood 1972). Rolett suggests that this variation is due to ecological factors. Although Hanamiai is geographically much closer to Hanatekua than Hane, the Hanatekua site is located in an exposed, windward rockshelter whereas both Hanamiai and Hane are in sheltered bays (Rolett 1998).

Dye's (1990) analysis of archaeofaunal remains from sites on Ua Huka and Hiva Oa provide a second line of evidence for understanding changes in prehistoric Marquesan fishing practices. His results also indicate a temporal shift from utilizing a wide range of fishing techniques to a focus on exploiting inshore habitats, as well as a decline in the economic importance of fish relative to terrestrial resources such as pig (*Sus scrofa*). However, Dye argues against the notion that these trends were purely adaptive responses to ecological conditions. He points to social factors such as increased warfare and sea raiding, as well as restricted access to fishing canoes and prime fishing locations, as significant influences on the changing economic focus visible in later prehistory (Dye 1990). This variability highlights once again the multivariate causes for changes in gross fishhook morphology and the potential utility of creating multiple fishhook classifications to separately address questions of spatiotemporal variability along stylistic, functional, and ecological axes.

Towards a Functional Analysis

Functional variation in fishhook morphology arises through the balance of three separate aspects of Oceanic fishing: prey attraction, prey retention, and prey retrieval (Pfeffer 2001a, 2001b). While some factors such as the addition of barbs may help retain prey, these modifications sacrifice the ability to quickly remove the hook from the fish and recast the line—a crucial skill for certain types of fishing, particularly offshore trolling for tuna. Reinman (1967, 1970) provides a detailed analysis of the relationship between fishhook morphology and probable function, and Johannes' (1981) ethnographic study of Palauan fishing methods confirms the functional relationship between fish capture strategies and variations in fishhook form. From these descriptions, a set of possible functional traits emerge (see Table 1).

The first and perhaps most fundamental functional distinction is that between rotating and jabbing forms. Nordhoff first observed this functional difference in fishhooks of the Society Islands, contrasting the Polynesian rotating form to the "European" jabbing

Table 1. Possible functional traits of Polynesian fishhooks.

Morphological Variable	Functional Correlate
Straight vs. incurved point or shank	Jabbing vs. rotating functional differences; ecological adaptations (e.g., tides, coral heads)
Hook gape width	Prey capture speed; prey retention; water depth
Barbs	Prey retention; ease of prey removal
Shank-to-point ratio	Prey mouth shape; prey capture speed
Hook bend width	Prey retention; mechanical stress distribution
Hook size	Prey mouth size

style (Nordhoff 1930:156). He observed that the European style of fishing with jabbing hooks requires the fisherman to strike with the line in order to set the point into the fish's mouth. In contrast the rotating hook, with fishing line lashed to the inner part of the shank, hooks the fish by holding a steady tension on the line. Striking with a rotating hook in the same manner as with a jabbing form would prove ineffective. Although Nordhoff referred to the jabbing form as a European style, prehistorically Polynesians created and used both hook forms and the distinction has been integrated into most if not all subsequent fishhook typologies.

There are advantages and disadvantages to both the rotating and jabbing forms. Although the constant tension applied to the rotating hook can strongly secure the fish, it follows that the more securely a fish is hooked, the more difficult and time-consuming it is to subsequently remove. In situations that necessitate rapid prey acquisition and resetting the hook, the jabbing form is superior. In addition, jabbing hooks are effective on small inshore fish that do not require much effort to set the hook in the fish's mouth, as well as carnivorous fish which are accustomed to rapidly striking at their prey (Reinman 1970). However, since the jabbing hook point must be set into the fish, this form is more difficult to use in stronger currents. Thus, jabbing hooks are well suited to calm inshore waters.

Rotating forms distribute stress across the fishhook more evenly, making them useful for benthic fishing and large prey (Reinman 1970). However, Johannes (1981) notes that rotating hooks are also useful in shallow waters, as circular forms are less likely to catch on coral formations. This form is well-suited to catching omnivorous fish which do not tend to capture fast-moving prey and instead take time to consume their food, allowing for the constant tension on the line needed to hook the fish. However, many inshore omnivores (as well as herbivores) are just as easily taken with netting techniques, which may have been a more productive strategy than catching each fish individually on hook and line (Reinman 1970). In Allen's functional paradigmatic classification of fishhook curvature, she finds that hooks with an incurved shank and parallel point combine the advantages of both rotating and jabbing type hooks: increased penetrative ability along with a more open form for rapidly striking fish or quick removal of prey (Allen 1996:110).

The ideal width of the hook gape (the distance between the hook point and the hook shank) can vary depending on the type of fish being targeted. Narrower hook gapes are more effective in deep water with slack fishing lines as the narrow gape will help keep the fish more securely on the hook. In contrast, a wider gape will not retain prey as easily, however it will make it much quicker and easier to capture the fish. Correspondingly, jabbing hooks tend to have wider gapes than rotating hooks (Johannes 1981).

The addition of barbs to either the jabbing or rotating hook form provides further security against the fish escaping the hook. However, there are many reasons not to include a barb: barbs on rotating hooks make it more difficult for the hook to penetrate the fish's mouth, and can be a further impediment to unhooking a fish once it is reeled in. Finally, a barb might sabotage its intended purpose by widening the hole through which the hook has penetrated the jaw, making it easier for a struggling fish to escape (Johannes 1981). Nordhoff observed that in the rare instance of barbs on bonito hooks, the barb actually served the opposite function by preventing the fish from penetrating too deeply on the hook. With this modification, the less-skilled fisherman would have time to cast again before the school disappeared (Nordhoff 1930:246). An incurved point tip might also act as a barb, as with the *fong* hook for catching triggerfish on Tobi Island (Johannes 1981:118).

Johannes highlights functional differences in point lengths: long points are well suited to fish species with narrow, deep mouths, while a short point is ideal for fish with shallow mouth cavities. Short points also penetrate and capture fish quickly, though they are more easily loosed by species that struggle vigorously to break away (Johannes 1981). As Reinman points out, a shorter point also distributes mechanical stress more effectively throughout the hook (Reinman 1970). This distinction is also highlighted in Sinoto's (1967) measurement of shank-to-point ratio. Sinoto found that the shank-to-point ratios of fishhooks differed between the Hawaiian, Marquesas, and Society Islands, though rotating hooks had comparatively longer points in all three groups. In Hawai‘i, these ratios vary temporally and perhaps illustrate both stylistic and functional variability. Hooks with high shank-to-point ratios tend to be less incurved than those with relatively equal shank-to-point ratios in order to maintain an ideal line of penetration (Reinman 1970). This measurement can be difficult to apply to archaeological collections however, as complete hooks are required to calculate the ratio.

The width of the hook bend might also integrate into functional analyses. As the greatest stress on a hook is at its bend, increasing the width of the bend will reinforce this region and protect against fracture. A wider hook bend also makes it more difficult for the fish to spit the hook out. A unique form of two-piece jabbing hook, the compound shank hook (Suggs 1961:82) is similar in morphology to a simple jabbing hook, however it is modified to allow for the attachment of a second shank which likely provides reinforcement against fractures (Figure 2).

Some hook forms were designed for specific types of fishing, including the *Ruvettus* hook as well as trolling points and lures for offshore pelagic fishing (Figure 3). The ethnohistoric and archaeological records point to tuna fishing as a popular and highly prestigious activity in the Marquesas and throughout Polynesia (Fraser 2001; Rolett 1998). Although it

Figure 1. Hooks recovered from Site NHo-3, Unit 1056. Both jabbing (top left) and rotating (bottom row) hooks were recovered. Accession Numbers 85-106B, 85-106C (top row) and 85-1056G (bottom). Courtesy of the Division of Anthropology, American Museum of Natural History.

Figure 2. An example of compound-shank fishing gear recovered from Site NH-4, Unit 1003. AMNH Accession Number 85-1003D. Courtesy of the Division of Anthropology, American Museum of Natural History.

Figure 3. Fishing gear recovered from site NH-4, including a complete trolling lure (left). AMNH Accession Numbers 85-1017B, 85-1017E01, and 85-1017E02. Courtesy of the Division of Anthropology, American Museum of Natural History.

is difficult to integrate these specialty hooks into the same arrangements used for one-piece hooks, the quantities of trolling points and lures will be considered separately here as a proxy for offshore pelagic fishing activities. Future research would consider the diversity within the trolling equipment category (as noted by Suggs 1961) to evaluate further functional divisions within these forms.

The Nuku Hiva Fishhook Assemblage Revisited

During my undergraduate study at New York University, I was granted the privilege of accessing the American Museum of Natural History's Pacific Archaeological collections to reexamine Robert Suggs' excavated materials from Nuku Hiva. My aim was to explore whether the application of a function-oriented classificatory system might shed new light on regional and temporal variation in Marquesan fishhook assemblages. Because Suggs' original fishhook grouping was created with the aim of developing a chronological seriation, I chose to abandon this system in favor of exploring new classifications based on functional hypotheses. For an exploratory analysis, I chose to focus on three variables: the distribution of rotating versus jabbing hooks based on shank-to-point alignment, relative abundances of trolling gear, and spatiotemporal trends in hook size. Although limited in scope, this reevaluation of the Nuku Hiva fishhook assemblage illuminates the potential for further analysis along these lines.

Five sites yielded sufficient quantities of fishhooks for an attempt at chronological analysis (Table 2), however once hooks were further subdivided into jabbing, rotating, trolling, and compound shank forms, only the jabbing hook form was present in significant quantity (Table 3). Small sample sizes prevented further subdivisions of fishhooks based on other functional hypotheses. Combining the assemblages from all five sites would yield a much larger sample size, however this would defeat the intended aim of investigating localized variations in fishing gear within islands. Further, combining all five assemblages into an appropriate temporal sequence would prove difficult given the radiocarbon data presently available (Allen 2004). Suggs excavated by stratigraphic layer (NHi-1) or 5" arbitrary levels (NBM-1, NBM-4, NH-4, and NHo-3) using ¼" screens. As I was unable to correlate excavation levels with archaeological strata, the 5" levels were used to temporally subdivide the latter four assemblages. Ideally this functional analysis would be accompanied by a comparison of the corresponding icthyofaunal record at each site, however due to the large mesh size used for screening and the standard excavation techniques at the time, few faunal remains were recovered and recorded only as presence-absence data.

Table 2. List of sites yielding large quantities of fishhooks.

Site	Time Periods	Description
NHi-1	Expansion, Classic	Rockshelter underneath overhanging basalt ledge, roughly 15 feet away from water's edge. Only suitable area between Ha‘atuatua and Ho‘oumi to land canoes. Possible temporary habitation site for fishermen and fish preparation area. High concentration of tiny fish bones noted here but not quantified.
NBM-1	Expansion, Classic	Long, narrow rock shelter at base of overhanging cliff on south side of Uea valley. Associated with small *paepae* (stone platform) and equipment for manufacturing fishhook gear.
NBM-4	Expansion, Classic	Small natural volcanic gas vent approximately 50 yards east of NBM-1, above small intermittent stream. Contains three hearths, one with cooked remains of a human child.
NH-4	Expansion, Classic	Large cave opening out from high, unscalable cliff on coast of Hapa‘a. May have been used for tattooing and circumcision ceremonies. Several *paepae* and stone enclosures (possible canoe storage), and a sleeping platform on top of one *paepae*.
NHo-3	Developmental, Classic	Open village site on beach of Ho‘oumi Valley with several large *paepae*. Temple may have existed here on north bank of stream in prehistory. Developmental phase includes sherd of poorly fired pottery (see Dickinson and Shutler 1974).

Table 3. Quantities of rotating versus jabbing hook forms at each site.

Site	Level	Jabbing	Rotating	Trolling	Compound Shank
NHi-1	Stratum I	4	0	0	1
	Stratum II	1	0	0	0
	Stratum III	1	0	0	0
NBM-1	0-5"	5	0	0	1
	5-10"	14	0	0	4
	10-15"	15	1	2	2
	15-20"	4	1	1	0
	20-25"	2	0	0	0
NBM-4	0-5"	3	3	1	3
	5-10"	2	1	1	8
	10-15"	2	1	1	4
NH-4	0-5"	2	6	0	1
	5-10"	5	0	0	3
NHo-3	0-5"	8	0	0	2
	5-10"	18	1	0	1
	10-15"	6	3	4	1
	15-20"	5	1	0	0

Table 4. Mean shank heights and midpoint widths of rotating versus jabbing hooks at each site.

Site	Level	Jabbing height	Jabbing width	Rotating height	Rotating width
NHi-1	Stratum I	23.5 mm	4.75 mm	-	-
	Stratum II	27 mm	4 mm	-	-
	Stratum III	21 mm	3 mm	-	-
NBM-1	0-5"	26 mm	4.5 mm	-	-
	5-10"	22.1 mm	3.7 mm	-	-
	10-15"	21.8 mm	2.9 mm	-	-
	15-20"	22 mm	2 mm	34 mm	5 mm
	20-25"	-	-	-	-
NBM-4	0-5"	35 mm	3 mm	38 mm	8 mm
	5-10"	23 mm	2.5 mm	42 mm	7 mm
	10-15"	26 mm	4 mm	27 mm	5 mm
NH-4	0-5"	15 mm	5 mm	30 mm	5.2 mm
	5-10"	34.5 mm	4 mm	-	-
NHo-3	0-5"	26.6 mm	4.3 mm	-	-
	5-10"	27.4 mm	4.3 mm	29 mm	5.3 mm
	10-15"	19.4 mm	2 mm	43 mm	7.8 mm
	15-20"	21.33 mm	3 mm	44 mm	4 mm

Rotating versus jabbing hooks were distinguished following a modified version of the criteria established by Sinoto, wherein if an imaginary line extended from the outer edge of the point intersected with the shank, the hook is classified as a rotating form (Sinoto 1991:86). This system is modified here to continue the trajectories of both hook shank and hook point. If the two lines continue parallel to each other or diverge, the hook is classed as jabbing. If they intersect, the hook is classed as rotating. This modification was devised to minimize potential confusion in classification due to non-standardized methods of fishhook orientation (though see Graves and McElroy 2005), as well as to provide a function-oriented basis for the distinction between rotating and jabbing hooks, as it is hypothesized that either incurving the hook shank or point would create a similar rotating effect. Allen's (1996) paradigmatic hook classification utilizing a binary system to address separately the curvature of the shank and the point was considered but ultimately tabled for future use as this would further subdivide already small sample sizes.

Fishhook size was determined using the guidelines established by Emory et al. (1959). The length of one-piece hooks was measured as a line perpendicular to the base, and width was taken from the outer edge of the shank to the outer edge of the point, parallel to the base. In future analyses, these measurements will be further standardized utilizing the orientation method described by Graves and McElroy (2005). Measures of hook height are most effective at tracking changes in hook size over time, as changes in hook width might also be reflective of a change in bend shape or overall hook morphology. A second measure of hook size was taken at the midpoint of the hook shank to serve as a measure of overall hook robusticity. This measure was taken at the shank midpoint in order to standardize across hook forms as well as to incorporate as many hooks as possible into this evaluation. Taking this measurement at the widest point of the hook would require whole specimens, and a widening of the bend does not necessarily equate to a widening of the shank; these changes may be more reflective of functional or stylistic differences in gross fishhook morphology rather than overall size. It is assumed that more robust hooks would naturally require a wider shank to prevent fracture.

Results and Discussion

The results for each site are considered separately due to the difficulties of correlating site-to-site stratigraphy. Although this does not allow for an island-wide temporal analysis, it does provide insight into how fishhook assemblages might vary based on local site ecology. Most of the sites analyzed here are assumed by Suggs to cover the Expansion to Classic periods. If this is correct, temporal trends can be considered roughly equivalent in time. The exception to this sequence is site NHo-3, which has two distinct occupational phases: one in the Developmental Period and once again in the Classic Period. Tables 3 and 4 list the quantities of hook forms and size averages of all measurable hooks.

The trend observed elsewhere in the Marquesas of increased jabbing hooks relative to other forms later in prehistory holds at most sites on Nuku Hiva. However, Site NH-4 displays the opposite trend, and at Site NBM-4, rotating hook forms increase over time along with jabbing forms. Sites NBM-1, NHo-3, and NHi-1 are predominantly focused on jabbing hook fishing, though the earlier Developmental Phase occupation of NHo-3 shows an early use of rotating hooks which dissipates in the Classic Phase. These trends were initially obfuscated in the Nuku Hiva fishhook analysis, as both rotating and jabbing forms were subdivided into multiple morphological categories and considered separately. For instance, Suggs placed the rotating hook as exclusively within the Settlement Period and disappearing completely during the Developmental Period (Suggs 1961). While this is true within his fishhook arrangement, other hooks that might serve similar rotating functions persist throughout Marquesan prehistory. Thus, this new quantification of a simple division between rotating and jabbing hooks reveals a more nuanced picture of spatiotemporal variation in fishhook forms.

Trolling points and lures are more abundant in the early levels of all sites analyzed, and all but disappear in later phases. The disappearance of trolling gear along with the increased abundance of jabbing hooks indicates a gradual movement towards more inshore fishing. In addition the compound shank hook, a jabbing style hook with a reinforced shank, appears with greater frequency in later excavation levels. Perhaps as Dye suggests, fishing for skipjack with the compound shank hook replaced the popularity of offshore trolling in the

Classic Period due to the decline in quality and availability of fishing canoes (Dye 1990:82).

The division of hooks into simple jabbing or rotating categories also allows for a new analysis of changes in fishhook size. At Hanamiai, fishhook size decreases over time, likely reflecting an overall decrease in fish size or an increased adaptation towards fishing inshore (Rolett 1998). This picture is more complicated in the Nuku Hiva sites. Along with the trend of increasing jabbing hooks in later periods, the shank height of these hooks increases through time at three out of the five sites analyzed. The mid-shank width of jabbing hooks increases at four out of five of these sites. The increased abundance of compound shank hooks, along with the increasing size of jabbing hooks, suggests an overall intensification of inshore fishing techniques.

Rotating hooks are on average significantly larger than jabbing hooks. Thus, when hook measurements are not divided into jabbing versus rotating sizes, the general disappearance of rotating hooks from sites could lead to an artificial decrease in size. The number of rotating hooks intact enough for accurate size measurements is small in all five sites, and only two sites yielded measurable rotating hooks from throughout their sequence: NHo-3 and NBM-4. Rotating hooks appear to increase in size over time at NBM-4, while hooks at NHo-3 become smaller. However, the size trends seen with rotating hooks may simply be a function of sample size. Additionally, the wide morphological variability captured within the rotating hook form likely subsumes additional functional differences which may require different sizes of hooks. Further subdividing these categories based on additional functional attributes may illuminate size trends, however this would continue to diminish already small sample sizes.

Some correlation exists between the prevalence of trolling points and lures and the abundance and size of rotating hooks. Evidence for pelagic fishing at NHo-3 peaks at the 10-15" level, as does the size and abundance of rotating hook forms. Similarly, Site NBM-4 is the only site to have both rotating hooks and trolling gear throughout the occupational sequence, while rotating hooks and trolling gear disappear simultaneously at NBM-1. Both trolling equipment and large incurved hooks are commonly utilized in offshore canoe fishing and appear to have disappeared (or persisted) hand-in-hand.

The variability in Classic Period fishhook assemblages supports Dye's argument that the intensification of social stratification and warfare played a key role in changing Marquesan fishing practices (Dye 1990). NBM-4 contains the most balanced and representative sample of all hook forms. It is located adjacent to NBM-1, a postulated fishhook manufacturing area, as well as a small fishing shrine (NBM-6). This region of Uea Valley being within the purview of fishermen could explain the persistence of all four quantified hook forms throughout the occupational sequence. The lack of offshore fishing equipment at most other sites points to a gradual development of offshore fishing as a specialized practice, restricted to the most knowledgeable fishermen. Restricted access to canoes, canoe landings, and ideal fishing spots by a growing elite population may have contributed to this trend (Dye 1990). Marquesan topography, with its deeply incised valleys and steep cliffs, made long-distance overland travel difficult. It was much simpler to travel to neighboring villages by sea. Thus, during the Classic Period most of Nuku Hiva's population had moved from coastal sites to fortified inland habitations in defense against sea raids by aggressive warriors from neighboring valleys (Suggs 1961:185). Increasing hostilities and maritime warfare would certainly have lessened the appeal of offshore fishing to all but the most dedicated fishermen. The creation of larger and stronger jabbing style hooks may have been an attempt to catch larger inshore fish in order to compensate for the decline in access to large offshore fish.

Conclusions

While previous work by Yosihiko Sinoto and others have created effective fishhook arrangements for understanding morphological variation through time and between islands, function-oriented classifications have been less frequently employed. In reevaluating a set of Marquesan fishhooks from a function-oriented perspective, a more nuanced picture of regional and temporal trends in Marquesan fishing practices is revealed. Throughout the island of Nuku Hiva, fishhook assemblages reflect a temporal shift towards increased exploitation of inshore environments. However, this was not simply a case of offshore hook forms becoming scarce. Marquesan fishermen continued to innovate with inshore fishing techniques, producing compound hooks with reinforced shanks as well as much larger jabbing hooks. Offshore fishing did not disappear entirely, but became a more restricted activity practiced by those who had the knowledge and the means. This change in fishing practices coincides with a period of increased social stratification, aggressive warfare, and abandonment of coastal settlements in favor of fortified inland regions. It was likely a much less risky proposition to fish inshore with safety nearby than to risk being caught by a seafaring raiding party. The creation of larger and stronger jabbing hook forms may have been a compensatory response to losing the large fish that were commonly acquired through offshore fishing.

Additional variables could be integrated into a functional fishhook classification with a larger sample size in the future, including the presence or absence of barbs and incurved points, or distinguishing between the curvature of the shank and the point (Allen 1996). There are several fundamental distinctions between hooks that should arguably be preserved and prioritized above other features, such as one-piece versus two-piece and rotating versus jabbing hooks. A method with a taxonomic aspect such as that established by Sinoto (1962) and a functional orientation might be best suited to the development of this classification, as the inherent hierarchy in this system would ensure the preservation of certain fundamental classes. The continuation of this research necessitates the examination of additional fishhook assemblages from well-stratified contexts as well as consideration of their ecological context and associated ichthyofaunal remains. With these parameters, and through rigorous testing of additional functional hypotheses, a function-oriented classificatory system which would help illuminate prehistoric fishing practices throughout Polynesia is within reach.

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References

Allen, M.S. 1996. Style and function in East Polynesian fishhooks. *Antiquity* 70:97–116.

——2004. Revisiting and revising Marquesan culture history: New archaeological investigations at Anaho Bay, Nuku Hiva Island. *Journal of the Polynesian Society* 113(2):143–96.

Bellwood, P. 1972. A settlement pattern survey, Hanatekua Valley, Hiva Oa, Marquesas Islands. *Pacific Anthropological Records* 17:1–50.

Conte, E. and G. Molle 2014. Reinvestigating a key site for Polynesian prehistory: New results from the Hane dune site, Ua Huka (Marquesas). *Archaeology in Oceania* doi: 10.1002/arco.5037

Dunnell, R.C. 1971. *Systematics in Prehistory*. The Free Press, New York.

Dickinson, W.R. and R. Shutler 1974. Probable Fijian origin of quartzose temper sands in prehistoric pottery from Tonga and the Marquesas. *Science* 185(4149):454–57.

Dye, T. 1990. The causes and consequences of a decline in the prehistoric Marquesan fishing industry. In *Pacific Production Systems: Approaches to Economic Prehistory*, edited by D.E. Yen and J.M.J. Mummery, pp. 70–84. Occasional Papers in Prehistory 18, Australian National University, Canberra.

Emory, K.P., W.J. Bonk, & Y. Sinoto. 1959. *Hawaiian Archaeology: Fishhooks*. Special Publication 47, B.P. Bishop Museum, Honolulu.

Fraser, K.L. 2001. Variation in tuna fish catches in Pacific prehistory. *International Journal of Osteoarchaeology* 11:127–37.

Graves, M.W. and W. McElroy 2005. Hawaiian fishhook classification, identification, and analysis, Nu‘alolo Kai (Site 50-30-01-196), Kaua‘i. In *Na Mea Kahiko O Kaua‘i: Archaeological Studies in Kaua‘i*, edited by M.T. Carson and M.W. Graves, pp. 188–211. Society for Hawaiian Archaeology, Honolulu.

Johannes, J.E. 1981. *Words of the Lagoon: Fishing and Marine Lore in the Palau District of Micronesia*. UC Press, Berkeley.

Kirch, P.V. 1984. *The Evolution of the Polynesian Chiefdoms*. Cambridge University Press, Cambridge.

——1985. *Feathered Gods and Fishhooks: An Introduction to Hawaiian Archaeology and Prehistory*. UH Press, Honolulu.

Nordhoff, C. 1930. Notes on the off-shore fishing of the Society Islands. *Journal of the Polynesian Society* 39:221–62.

Pfeffer, M.T. 2001a. Implications of new studies of Hawaiian fishhook variability for our understanding of Polynesian settlement history. In *Style and Function: Conceptual Issues in Evolutionary Archaeology*, edited by T.D. Hurt and G.F.M. Rakita, pp. 165–82. Bergin & Garvey, Westport.

——2001b. The engineering and evolution of Hawaiian fishhooks. In *Posing Questions for a Scientific Archaeology*, edited by T.L. Hunt, C.P. Lipo, and S.L. Sterling, pp. 73–95. Bergin & Garvey, Westport.

Reinman, F.M. 1967. *Fishing: An Aspect of Oceanic Economy: An Archaeological Approach*. Field Museum of Natural History Publication 56(2). Field Museum of Natural History, Chicago.

——1970. Fishhook variability: Implications for the history and distribution of fishing gear in Oceania. In *Studies in Oceania History*, edited by R.C. Green and M. Kelley, pp. 47–60. B.P. Bishop Museum, Honolulu.

Rolett, B.V. 1998. *Hanamiai: Prehistoric Colonization and Cultural Change in the Marquesas Islands (East Polynesia.)* Peabody Museum, New Haven.

Rolett, B.V. and E. Conte. 1995. Renewed investigation of the Haatuatua Dune (Nukuhiva, Marquesas Islands): A key site in Polynesian Prehistory. *Journal of the Polynesian Society* 104:195–228.

Sinoto, Y.H. 1962. Chronology of Hawaiian fishhooks. *Journal of the Polynesian Society* 71:162–66.

——1966. A tentative prehistoric cultural sequence in the Northern Marquesas Islands, French Polynesia. *Journal of the Polynesian Society* 75(3):283–303.

——1967. Artifacts from excavated sites in the Hawaiian, Marquesas, and Society Islands. In *Polynesian Culture History: Essays in Honor of Kenneth P. Emory*, edited by G.A. Highland, R.W. Force, A. Howard, M. Kelly, and Y.H. Sinoto, pp. 341–62. B.P. Bishop Museum, Honolulu.

——1991. A revised system for the classification and coding of Hawaiian fishhooks. *Bishop Museum Occasional Papers* 31:85–105.

——1992. The development and distribution of fishing gear in the Pacific: The typology and distribution of fishhooks in Polynesia. In *Proceedings of the International Conference on Anthropology and the Museum*, edited by Tsong-yuan Lin. Taiwan Museum, Taipei.

Suggs, R.C. 1961. *The Archaeology of Nuku Hiva, Marquesas Islands, East Polynesia*. Anthropological Papers 49(1). American Museum of Natural History, New York.