10.
Multiple Approaches towards Reconstruction of Fishing Technology: Net Making and the Indus Valley Tradition

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INTRODUCTION

Recent research into the subsistence of the Indus Valley Tradition suggests that fish comprised a substantial portion of the diet for some populations of both urban centers and rural settlements. However, little is known of the technology used to extract these animals from their natural marine, riverine and lacustrine habitats. Experimental methods, ethnographic literature, and archaeological data are used to investigate the use of fishing nets in the Indus Valley Tradition.

The Harappan Phase of the Indus Valley Tradition (circa 2600 to 1900 B.C.) represents one of the earliest and most extensive urban societies in the world (Kenoyer 1991; Shaffer 1992), encompassing a territory of around 850,000 km^2 in the northwestern region of the South Asian subcontinent (Figure 10.1). Until recently, little research into the subsistence base that supported this civilization had been conducted (Meadow 1979, 1989; Reddy 1991; Costantini 1984).

Recent investigations have suggested that a fishing industry contributed a significant portion of food for some populations in the urban centers and rural settlements of the Indus Valley Tradition (Belcher 1991; Meadow 1979, 1989); however, little is known of the technology used to extract these fish from the riverine, lacustrine and marine environments.

Copper or bronze fish hooks have been recovered from several sites: Harappa (Vats 1940), and Mohenjo-daro (Marshall 1931; Mackay 1938; Sarkar 1953), but a much more efficient means of procurement, in terms of consistent, large yields, could have been the use of various types and sizes of nets. Unfortunately, nets are rarely preserved in the archaeological record, except under exceptional circumstances, particularly in tropical and sub-tropical environments.

This paper will attempt to examine the use of fishing nets during the Indus Valley Tradition through several methods, including (1) fish remains and inferred behavior that relate to capture; (2) inferential models, based on experimental and ethnographic net manufacture that predict the presence of nets and manufacturing stages in the archaeological record; and, (4) fish and fishing motifs painted on ceramics.

ETHNOARCHAEOLOGY AND ETHNO-EXPERIMENTS

Ethnoarchaeology is the use of actualistic studies of living peoples in order to understand the processes that lead to the deposition of material remains into the archaeological record (Binford 1978; Gould 1978; Kramer 1979). Ethnoarchaeology includes the most basic assumptions of archaeology - that some behavioral elements of sociocultural systems have material correlates. Thus, observation of contemporary behavior can help to develop and to refine the investigations of past behavior (Gould 1978; Kramer 1979).

Long-term ethnoarchaeological projects can aid in the development of models and analogues that can be tested against the archaeological record. Although ethnoarchaeology has been primarily used to understand hunter-gatherer activities (Binford 1978; Bettinger 1991), this research strategy has been used by individuals working with so-called complex societies (Kenoyer 1983; Kenoyer, et al. 1991; Kramer 1979, 1982; Miller 1985). These studies in Southwest and South Asia have focused on ethnoarchaeological and experimental studies of specific craft industries where historical continuities and technological similarities are present.

In South Asia, it is thought that fishing methods, prior to mechanization processes in the 1960s, were similar to those used during the Harappan Phase of the Indus Valley Tradition. Ethnoarchaeology of fisher-folk is virtually non-existent in a formal, quantified sense (Chang 1988; Keegan 1986; Kirch and Dye 1979; Kirch 1977), and Stewart (1989) has recognized this as a major lacunae in archaeological research.

Although ethnoarchaeology is not the focus of this paper, the use of controlled "ethno-experiments" is an important part of ethnoarchaeology and can yield significant data upon which archaeological interpretations can be based. Assumptions and situations can be controlled in these experiments to understand particular factors that may correlate behavior and the formation of the archaeological record. For this project, the ethnographic literature is used, in addition to ethnographic observations of fishermen in the Punjab region of Pakistan, in order to develop a model of net manufacture and an intuitive model of discarded materials that could become deposited into the archaeological record.

MULTIPLE APPROACHES TO THE ARCHAEOLOGICAL RECORD

As nets are made primarily of perishable materials that have extremely low visibility in the archaeological record (for exceptions see Frison, et al. 1986; Marcus 1987; Croes and Blinman 1980), it is best to use several approaches in order to ascertain their presence or absence. In the absence of nets themselves, four sets of data can be used to infer the presence of netting as a fishing technology: (1) observations on faunal remains; (2) presence of tools used to manufacture nets; (3) net weights; and, (4) painted ceramic motif.

Faunal Remains

Several studies have used ethnographic data to identify technologies through the use of fish species (Kirch and Dye 1979; Stewart 1989; Allen 1986; Coutts 1975; Severance 1986). Primarily these models are based on fish behavior and habitat preference. By examining net catches, one can develop intuitive models of the types of remains that will be discarded into the archaeological record. However, it must be emphasized that aspects of processing and marketing, as well as domestic consumption, will certainly modify the contents of these deposits.

Several variables can be used to recognize net use based on the catch. These variables include fish habitat and behavior, fish size, and catch quantity. Ethnographic fieldwork conducted during the winter of 1992 enabled the author to examine the interrelationships of these variables and various types of fishing technology, albeit in a preliminary fashion.

Fish Size

Netting is an intercept strategy that captures all fish of a particular size that are swept into it either by the water's current or by people pulling the net through a body of water. Mesh size provides a minimum on the size of fish caught. Thus, fish size should approach some mode. Angling is an encounter strategy that controls size only by the size of the hook and the skill of the angler. Different types of hooks are used for various species. However, in a general sense, the size of fish cannot be controlled directly as with nets (Akazawa 1969; Hiyama, *et al.* 1952).

Fish Habitat and Behavior

Of these criteria, the habitat and behavior of fish species are more important in order to determine its exploitative constraints and method of capture. Specific types of nets are used to target specific environments and, therefore, specific fish species (Kirch and Dye 1979; Allen 1986; Coutts 1975; Severance 1986; Talwar and Jhingran 1991).

The study of fisher-folk in the Punjab and the marine zones of modern Pakistan can also help identify certain species that may be correlated with particular procurement technologies. Although, it is not the purpose of this paper to offer definitive correlations of fish species with specific technologies, some insight can be offered in a general sense.

Particular fish species are procured through specific techniques and technologies. Fish behavior and habitat preference provide a limiting factor on the types of technology that can be used for capture. By documenting contemporary techniques, it may be possible to relate the types of species represented in the archaeological record with specific technologies. Table 10.2 presents data collected through interviews with Punjabi fishermen on specific techniques used to capture various species. This methodology is more general and can be applied to several different archaeological contexts. Nets are generally used in slower-moving water and procure the fish that inhabit these areas. Angling and fish traps are more commonly used in fast-moving water.

Table 10.1. Technological Implications for Faunal Remains

Variable	Net/Intercept	Angling/Encounter
Species Diversity	Low	Variable
Fish Size	Modal	Variable
Environment/Habitat	Slow-Moving/Shallow	Fast-Moving/Deep
Catch Quantity	High	Variable

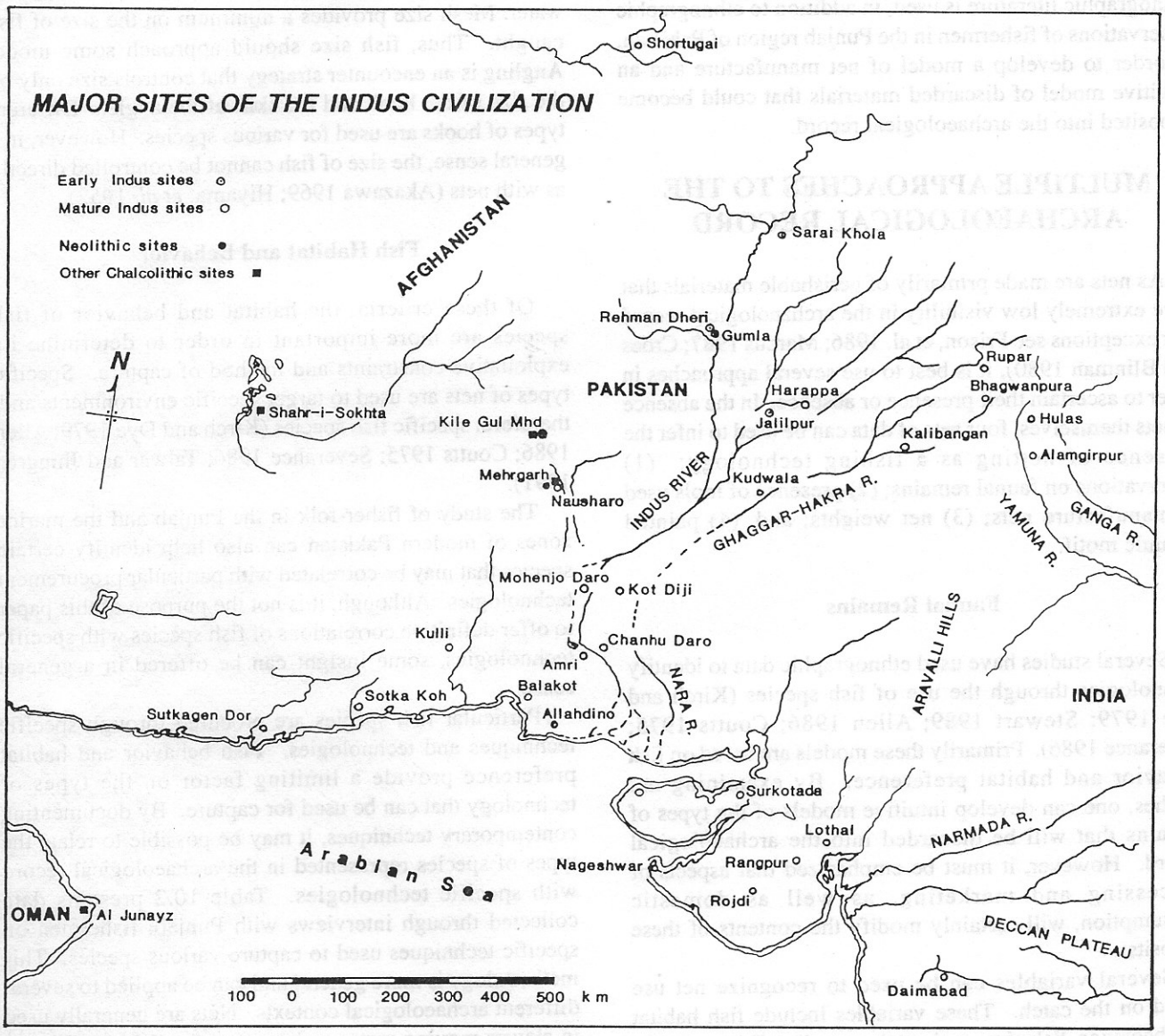

Figure 10.1. Major Sites of the Indus Valley Civilization

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Table 10.2.
Preliminary correlations of Some fish Species and Procurement Strategy, Punjab, Pakistan
Note: Linnaean nomenclature follows that in Talwar and Jhingran 1991.

Fish Taxon	Netting	Angling	Fish Traps	Hand
Cyprinidae (Carps)				
Labeo rohita	X			
Labeo calbasu	X			
Labeo sindensis	X			
Catla catla	X			
Barbus sarana	X			
Siluriformes (Catfish)				
Aorichthys aor	X	X	X	
Aorichthys seenghala	X	X?		
Wallagu attu	X	X	X	
Rita rita	X	X		
Eutropiichthys vacha	X	X		
Bagarius bagarius	X	X		
Ophicephalidae (Snake-head)				
Ophicephalus sp			X	X
Mastacembelidae (Spiny Eels)				
Mastacembelus sp			X	X

Catch Quantity

Generally, nets provide a large quantity of fish that are procured within a very short period of time and minimal labor. Nets can be used to capture large quantities of schooling or spawning fishes. Additionally, nets are used to capture all fish that are within a particular environment and will intercept all fish larger than the mesh size that move into it.

Failures of fish runs or miscalculations by the fisher can result in empty nets. Angling can provide large quantities of fish, but the labor cost is usually much higher. Often, these types of activities are associated with large or dangerous fish and may present the fisher with some form of status (Kirch and Dye 1979). Angling is considered a passive method of fishing in the Punjab and is only used on specific types of fish.

Context

An important criteria for these variables to be applied to the archaeological record is that these remains must be from primary contexts, such as processing areas and market places (Belcher 1991; Zeder 1991). Zeder (1991:36-44) has suggested that strategies of access to herd animals can be classified as direct and indirect modes of distribution. The structure of direct access entails provisioning through direct contact between provider and the consumer. Indirect distribution is determined by "...the provisioner's interest in efficiently meeting distribution requirements..." (Zeder 1991:38). This situation would favor species that were high in meat content or highest in nutritional value or some combination of these factors.

For fish resources, I believe that the types of fish available for direct distribution would be determined more by the method of procurement (i.e., nets, angling, traps) than any other factor. Indirect distribution of fish resources would follow Zeder's model. Thus, the farther one is away from direct distribution contexts, the less likely that the fish remains will reflect procurement strategies. For example, domestic food preparation debris would provide a poor sample to use as it is far removed from the initial procurement.

Processing of large quantities of fish remains immediately after capture will provide the best sample to examine procurement strategies. In lieu of these areas, market places can provide a particular type of debris that can reflect procurement strategy. However, it is much more likely to reflect an indirect form of distribution with selection of particular species conducted by the merchant, instead of the fisher (Belcher 1991).

Specific examples of this approach are drawn from current analyses of the Harappan site of Balakot, located near Sonmiani Bay, Pakistan and from Harappa in the Punjab region of Pakistan (Figure 10.1). Metric data based on neurocranial remains of *Pomadasys hasta* (Figure 10.2) from Balakot suggest that a large quantity of these fish were of intermediate size. The minimum number of individuals approaches 2,000; these remains are concentrated in specific loci of the site (sump pits). This

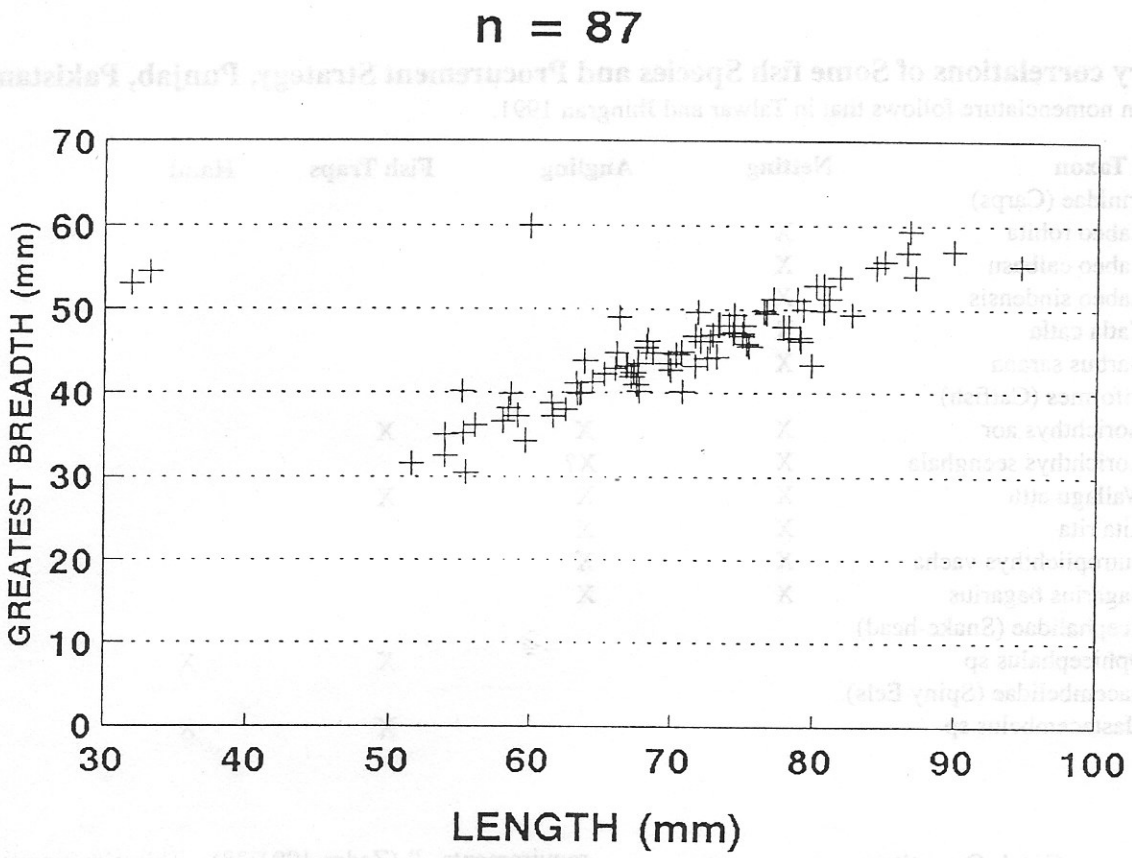


Figure 10.2. Neurocrania Size of *Pomadasys hasta* (Balakot)

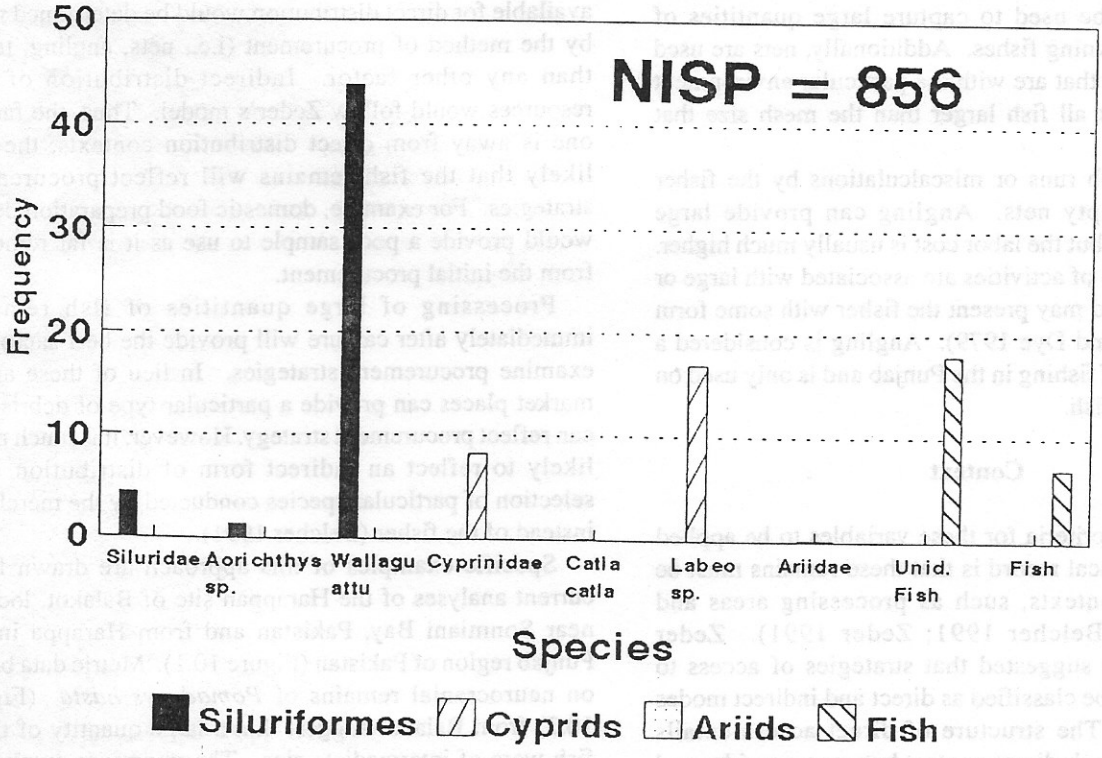


Figure 10.3. Species Representation (NISP) from Harappa (1990 Season Sample)

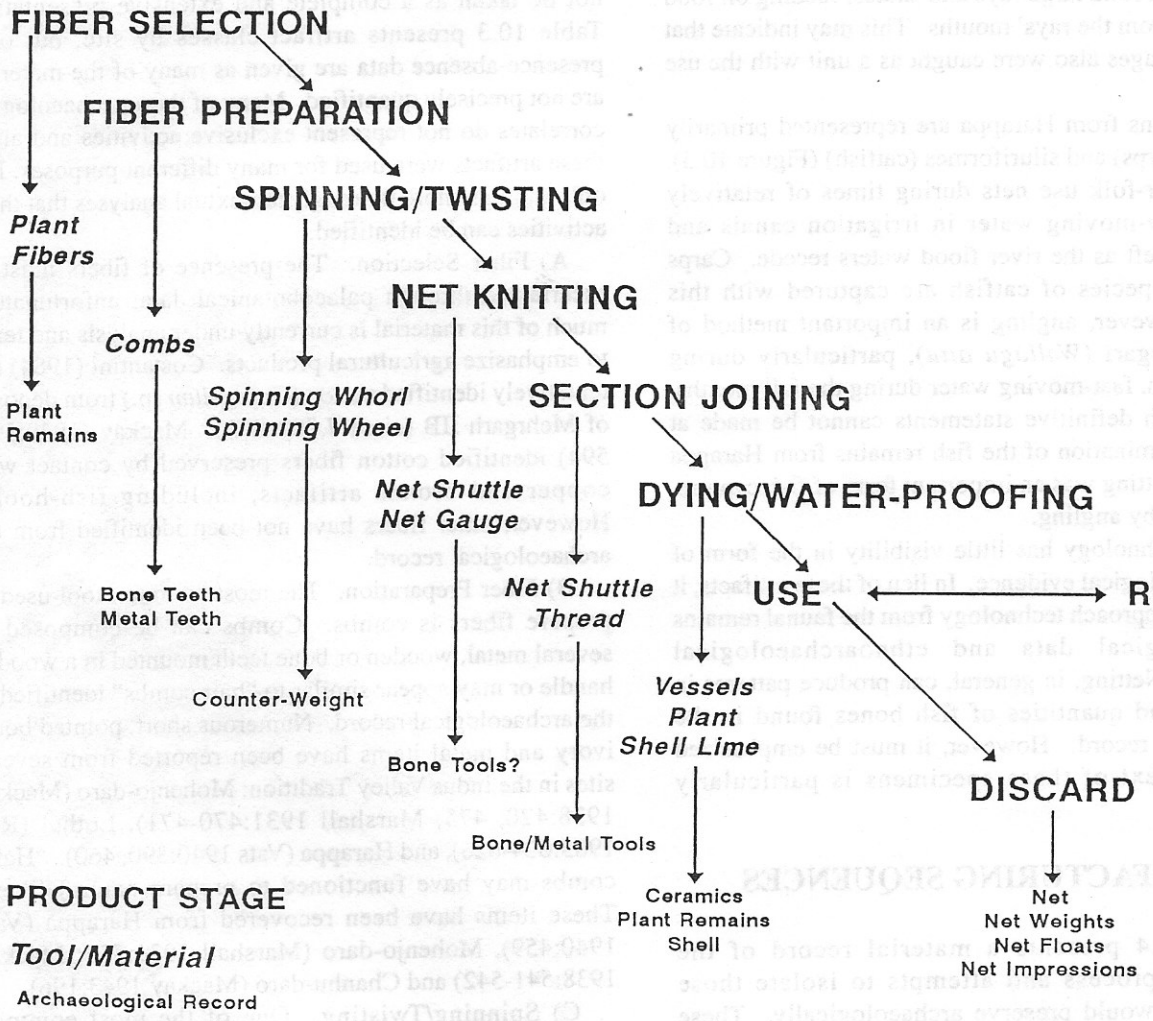


Figure 10.4. Manufacturing Stages of Net Manufacture and their Archaeological Correlates

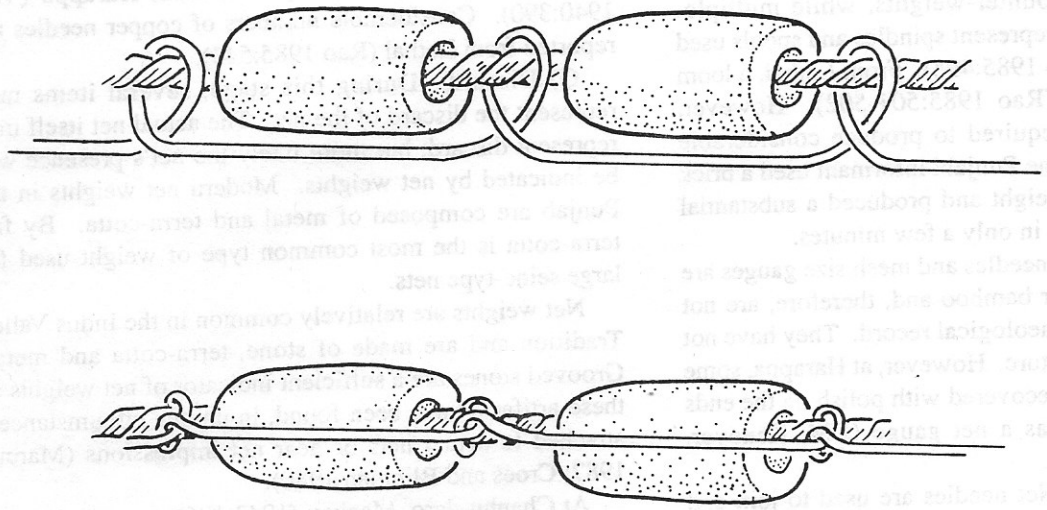


Figure 10.5a. Ethnographic Terra-cotta Net Weights: method of attachment

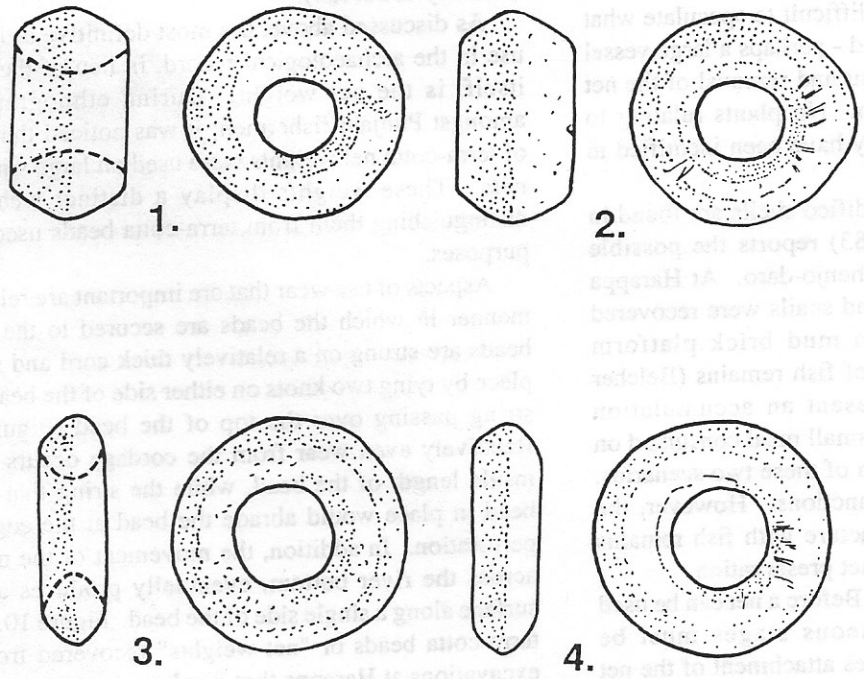
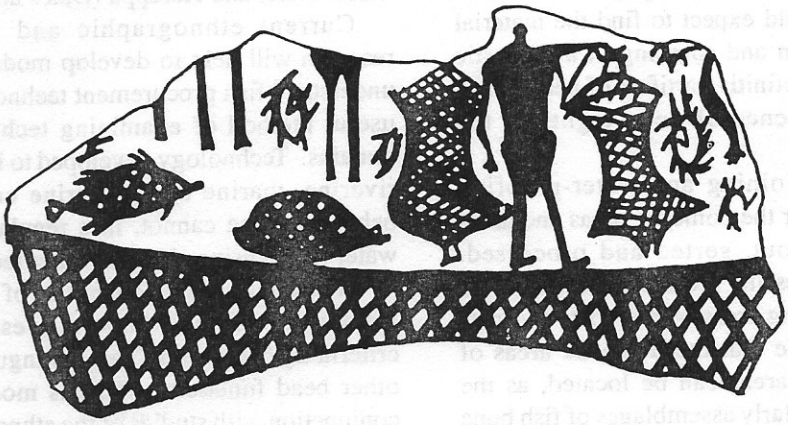
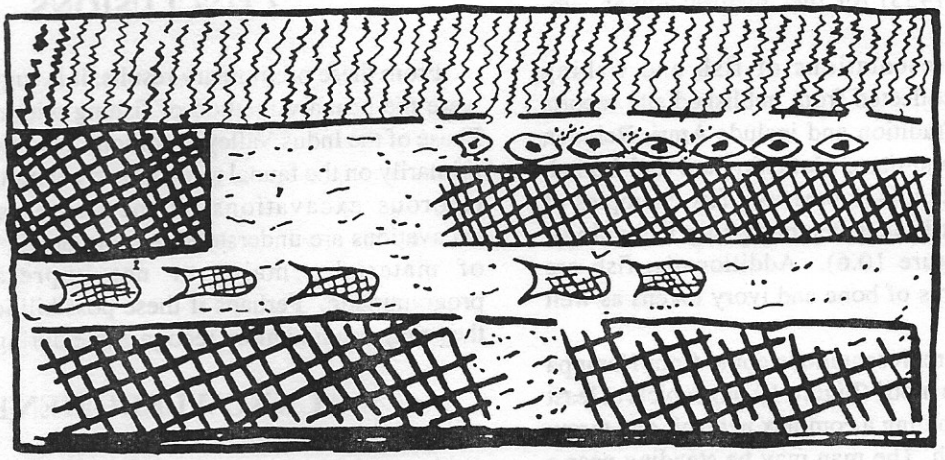


Figure 10.5b. Harappan Terra-cotta "Net Weights": Nos. 2, 3, & 4 show severe cordage wear



A



B

Figure 10.6. Ceramic Motifs Depicting Net-Fishing; a & b from Harappa

present. Being able to define the context of these materials will be extremely important in the course of future excavations as many of the non-perishable items can be used for a variety of activities not specifically associated with net manufacture.

However, one can divide the stages into contextual analogies to create a more precise ethnographic model. In a primary context, one would expect to find the material remains of fiber preparation and spinning in a domestic context. By far, the most definitive artifact of net use and manufacture are the presence of net weights in the archaeological record.

Net knitting, section joining and water-proofing usually were performed near the domestic areas and areas where fish were hauled out, sorted and processed. Ethnographically, fish processing areas are located in the market places and the landing areas where boats and nets are hauled up. It is possible that the domestic areas of fisher-folk and processing areas can be located, as the debris would contain particularly assemblages of fish bone elements as these individuals would have direct access to fish resources (Belcher 1991).

CERAMIC MOTIFS

Other evidence of net use is seen in the painted motifs of nets and fishing activities on ceramics. Similar strategies of analysis have been done by Jett and Moyle (1986) for Mimbres ceramics from the southwestern North America and Hora (1955) for the historic Indian sub-continent.

Nearly fifty representations of fish and fishing activities have been collected from published site reports of the Indus Valley Tradition and include Amri, Rehman Dheri, Harappa, Chanhu-daro, Mohenjo-daro and Lothal. The focus of this section is to present a few examples of painted, ceramic motifs that depict fishing technology, particularly nets (Figure 10.6). Additionally, fish are represented in the forms of bone and ivory tokens as well as in the Indus script.

The most detailed representations come from Harappa (Figure 10.6a, b). One motif (Figure 10.6a) depicts at least one male individual holding a complex net weir or a throw net, surrounded by fish. The man may be standing near a large net that runs along the bottom of the sherd. The other motif (Figure 10.6b) illustrates several fish along a seine net that appears to be equipped with floats.

DISCUSSION

Although nets do not usually preserve in the archaeological record, they can be recognized through the use of several approaches. Much of the physical remains, outlined above, which would preserve in the archaeological record, are found at several Indus Valley Tradition sites. However, due to the recording methods used at several of the sites, it is difficult to assess the context in which these materials were recovered. Thus, much of this research is of hypothetical interest. Perhaps, net impressions will be located, similar to basketry impressions found at Lothal (Rao 1985:518; Pl. CCXXXIII) and Harappa (Dales and Kenoyer 1989).

Current ethnographic and ethnoarchaeological research will help to develop models that can be used to understand fish procurement technology. By far, the most useful method of examining technology are the faunal remains. Technology developed to be specific to particular riverine, marine and estuarine environments and fish behavior. One cannot, in a regular fashion, catch deep-water fishes using shallow-water techniques.

Studies of the vast quantities of terra-cotta beads from Harappan sites will hopefully establish more explicit criteria by which one can distinguish net weights from other bead functions. This is most productive done in conjunction with studies of the ethnographic terra-cotta net weights and experimental net weights manufactured by the local fishers and potters.

Ceramic motifs offer a unique look into the fishing industry of the Harappan civilization. It is possible to gain insight on the types of net-gear used and the manner in which they were set and used. Unfortunately, sherds with useful depictions are relatively rare in comparison to other motifs.

CONCLUSIONS

From these preliminary results, it is suggested that nets were the primary method of fishing within the Harappan Phase of the Indus Valley Tradition. This assertion is based primarily on the faunal remains and net motifs. Until more rigorous excavations or the contexts of previous excavations are understood in more detail, the occurrence of material remains or net impressions remain programmatic. Perhaps if these possibilities are realized, they may become more recognizable during excavations.

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