

Table 2. Characteristics of mice used

Parameter	Male	Female
Age (days)	90 \pm 5	90 \pm 5
Initial body weight (g)	27 \pm 4	26 \pm 4.5
Final body weight (g)	33 \pm 5	33 \pm 6
Serum Ca (mM)	2.4 \pm 0.10	2.3 \pm 0.12
Serum PO ₄ (mM)	2.2 \pm 0.02	2.1 \pm 0.01

diet⁷, vitamin D⁸ and other endocrine factors are known to affect the intestinal absorption of phosphate. Since the animals are fed with the standard pelleted mouse diet, it is unlikely that dietary differences are responsible for the observation. Since there is no difference in the age, body weight or weight gain of male and female groups of mice, food intake and age factors may not be responsible for the difference noticed in phosphate absorption (Table 2). Previous observations² indicate that there is no difference in the status of vitamin D or its receptors between the sexes. It is possible that sex

hormones may play a role in phosphate transport. A fall in serum phosphate level has been reported⁹ in patients of metastatic prostate cancer treated with high dose of diethyl stilboesterol, a synthetic estrogen. Testosterone seems to enhance calcium absorption in the duodenum of rats¹⁰, probably through a mechanism distinct from vitamin D-mediated process¹¹. Further research is needed to see if phosphate transport, especially by the duodenum, is also influenced by testosterone.

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A unique Late Bronze Age copper fish-hook from Bet Dwarka Island, Gujarat, west coast of India: Evidence on the advance fishing technology in ancient India

There are numerous evidences of the exploitation of marine resources, specially fishing by prehistoric man along the Indian coast. Hora¹ has rightly observed that 'prehistoric man in several parts of the world has gathered sufficient knowledge about fish through observation and made use of it in catching fish for food by the use of hook and line'. People of the Indus Valley Civilization were great seafarers and perhaps established their colonies overseas in Gulf countries^{2,3}. While studying painting of fish on the pottery of the Harappan period, Hora¹ concluded that the fish painted on pottery are marine type. Perhaps baskets or traps were in use for catching fish, as a fisherman carrying two such baskets is painted on a potsherd. These records indicate that Harappans were more familiar with marine fishing. The distribution of shell bangles and other shell artifacts in every Harappan site is also indicative of a well-organized marine fishing activity. There are several fish-hooks from Mohenjo-

dar⁴, Harappa, Chanhudaro⁵, Lothal⁶, Padari and many other sites located on coastal belt of Gujarat. Sarkar⁷ has suggested great similarity between fish-hooks of the Indus Valley sites and modern ones; and he believes that this feature is suggestive of continuity of cultural trait.

The Sanskrit word *badisha* has been used for fish hook in ancient Indian literature, including the *Mahabharata*¹. A 12th century AD Indian text *Manasollasa* written by the Chalukya king Someswara, mentions a chapter entitled¹ 'Matsyavinod' (pastime of fishing), and how a king can derive pleasure out of angling¹.

An onshore excavation was undertaken in Bet Dwarka island to obtain the cultural sequence and to understand the man-sea relationship. A large number of pottery items, beads of stone, shell and terracotta were found, besides copper artifacts. The recovered copper artifacts are coins, finger- and ear-rings and a well-preserved fish-hook. The present communication

deals with the latter recovered from trench BDK-VI, located on the northern part of the island. A detailed discussion of its dating and a comparative study have been made here.

Bet Dwarka Island is situated in Okhamandal taluka, Jamnagar district, Gujarat. The island is about 3 km plying by boat from Okha port (Figure 1). The island is aligned northwest to southeast in 13 km with an average 4 km in east-west direction. Many archaeological sites have been discovered on this island since 1969 (refs 8–10), with much concentration on the southeastern and eastern coast of the island. A Late Harappan site was discovered in Par village near white tomb, on the northeastern coast of the island. The site is under cultivation and has been disturbed badly. A large number of Late Harappan period pottery has been collected from here.

A small trench (measuring 2 m \times 2 m) laid at the highest point (Figure 2) yielded the habitational remains of 95 cm. The

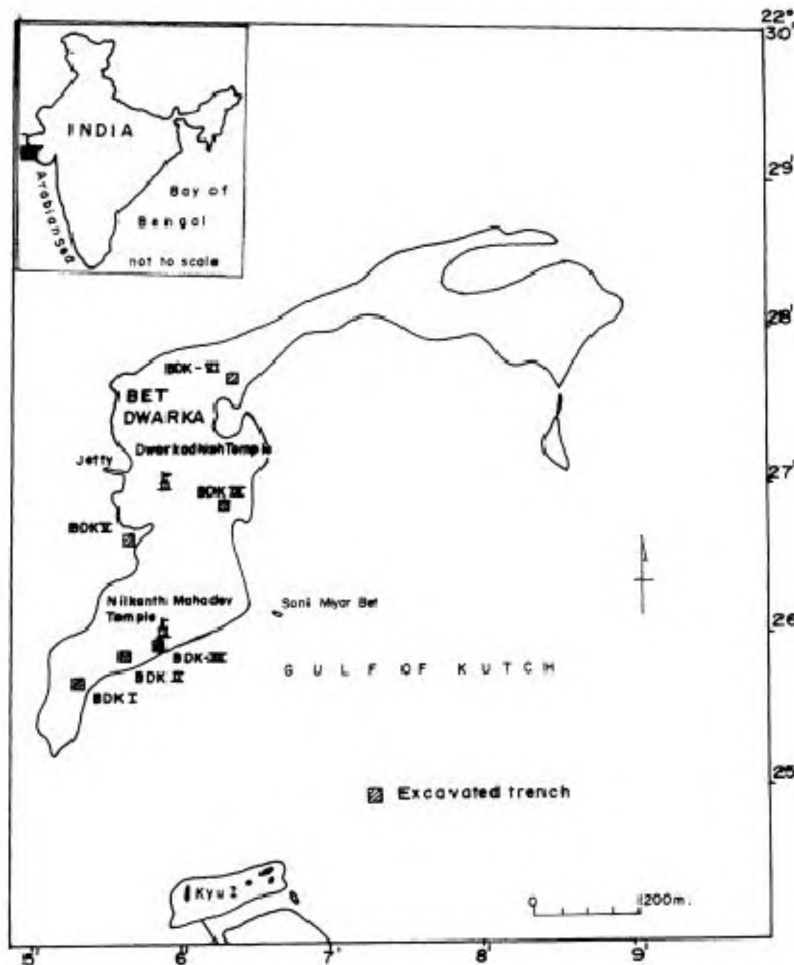


Figure 1. Location of trenches in Bet Dwarka Island.



Figure 2. Excavated trench BDK-VI from where the fish-hook was recovered.

excavation has yielded a large number of pottery of the Late Harappan period. The important pottery include red ware, painted red ware, buff ware and grey ware. The important shapes include jars, carinated dishes, bowl with featureless and sharpened rim. A sherd of stud handle bowl is also noticed, a characteristic feature of Saurashtra and Kachchh Harappans. Paintings include vertical, horizontal

wavy lines, thick lines and roundels with black colour. Varieties of shell have been encountered. The important ones are conch and dentalium shells. Fish-bone beads, shell beads are also amongst the important finds. The most important findings however, were of a copper fish-hook along with a small copper rod.

The fish-hook has been found about 50 cm below the surface in layer 2. It is well preserved and is one of the biggest hooks of the Late Harappan period reported so far. It is 7 cm long and weighs 9 g. The diameter of the shank is 0.3 cm. A layer of thick encrustation over the hook was removed by chemical treatment. It has a sharp barbed point, straight shank without forming any curve or eye. However, the top is beaten up and made wide and thin, perhaps for holding the thread (Figure 3a and b). Some of the Mesopotamian sites like Ur have yielded similar type of fish-hooks. Several Harappan sites have yielded fish-hooks which are

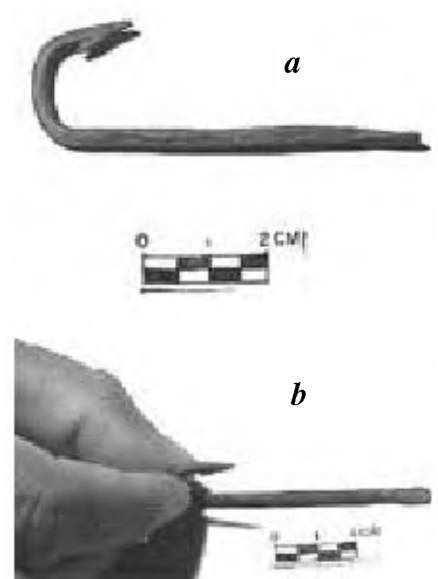


Figure 3. a, Late Bronze Age copper fish-hook from Bet Dwarka. b, Upper portion of hook beaten for holding thread.

barbed and range in length from 1.25 to 7 cm⁷. The fish-hook from Bet Dwarka is one of the biggest and well-preserved fish hooks from the Late Harappan sites. However, the biggest copper fish-hook has been reported from Harappan level at Padari¹¹.

Copper fish-hooks from Harappan sites can be broadly divided into two categories, i.e. barbed and unbarbed. Shinde and Thomas¹¹ have suggested that barbed fish-hooks are generally used to catch large marine fish, whereas the unbarbed variety is used for catching small riverine fish. A number of barbed fish-hooks have been reported from Mohenjodaro. Unbarbed fish-hooks have come mainly from Chanhudaro and Harappa. A number of sites in Gujarat like Kuntasi, Rojdi, Dholavira and Lothal have yielded copper fish-hooks of both varieties. Fish-hooks reported from Lothal are with tiny barbs and the loops touch the shaft of the hook⁶.

Fish-hooks have been divided into three varieties based on the shanks: (i) hooks consisting of a straight shank without forming any curve or eye; (ii) hooks with straight shanks but turned outward, the bent loop does not touch the shank, and (iii) hooks consisting of a straight shank but curved out to form a small eye, which is either connected with the shank or only slightly separated from it. The fish-hook under discussion falls into the first category. Sites like Ur have

Table 1. C₁₄ dates from Bet Dwarka (BDK-VI)

Site	Sample no.	Layer	Depth	Lab no.	C ₁₄ date year in BP	Cal. date
BDK-VI	2001/26	1	20	2000	3140 ± 100	3470–3260
BDK-VI	2001/27	2	50	1993	3470 ± 80	3830–3640

yielded specimens similar to the one at Bet Dwarka. The best metallic fish-hooks were probably developed by the Harappans, and were certainly superior to those from contemporary sites in Egypt and Mesopotamia¹¹.

It is well known that the Harappan period witnessed a significant development in copper metallurgy. It is believed that the copper requirement of Harappans of Punjab, Haryana, Rajasthan and Gujarat was met by the Sikar–Jhunjhunu area of the Khetri belt¹². Archaeological evidence also suggests that Ganeshwar, located roughly 75 km away from the Khetri copper mines and dated to ca. 3000–2000 BC, was the main supplier of copper during the Harappan period¹³.

Earlier explorations and excavation near this site indicated the site to be of Late Harappan period. TL dating of potsherds collected during surface exploration¹⁴ suggested a date ranging from 16th to 14th century BC. Two worked shell samples from stratified layers 1 and 2 were collected during the present excavation and the same were dated by Birbal Sahni Institute for Palaeobotany, Lucknow. This has provided a time bracket for Bet Dwarka Late Harappan settlement between 18th and 14th Century BC. The fish-hook was recovered from layer 2, therefore a precise time bracket for this layer is 18th to 16th century BC (Table 1).

The excavation in Bet Dwarka Island has confirmed the oldest settlement dating back to the Late Harappan period.

They have exploited marine resources available around the island. They had extraordinary technology for fishing, which has continued for thousands of years. The discovery of a copper fish-hook suggests that large-scale fishing activity continued around Bet Dwarka Island even after the Harappan period. Chronology has been verified with findings from Saurashtra as well as with absolute dating method.

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