

# Marine Archaeology in India

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## Abstract

Marine archaeology, also known as maritime, nautical or underwater archaeology deals with the 'scientific study of the material remains of man and his past activities on the sea'. Marine archaeology has made tremendous progress in India. Over the years, the National Institute of Oceanography, Goa, in collaboration with other Government agencies has undertaken the exploration and excavation of submerged ports and shipwrecks at Dwarka, Bet Dwarka, Somnath, Vijaydurg, Goa and Lakshadweep on the west coast; and Poompohar and Mahabalipuram on the east coast of India. Further, onshore explorations have also been carried out at various places along both coasts of India to locate ports, trading centres and structures related to maritime activities. These findings from various sites in India, confirm her rich submerged cultural heritage, conservation of which is a prime necessity. A modest beginning has been made in this direction and more thrust is required before this submerged heritage is destroyed owing to intense activity along the coast, resulting from globalisation and rapid industrialisation. This article provides an overview of developments in Indian marine archaeology, and describes a few important sites and their archaeological significance.

## Introduction

Marine or maritime archaeology, otherwise known as nautical and underwater archaeology; is a distinct and emerging field within the broader discipline of archaeology. Marine archaeology is primarily concerned with the documentation, investigation and recovery of material remains and physical traces of maritime communities, technologies and practices. The material remains of the activities of men can be traced in and alongside seas, lakes and rivers. Sunken ships, cargo, tools and anchors lost in voyages are important sources of information. Maritime archaeology is defined as "the scientific study of the material remains of man and his activities on the sea". (Mucklroy 1978). The main objective of 'nautical archaeology' is to study different types of seagoing vessels, their construction techniques and various kinds of usages; whereas 'maritime archaeology' encompasses all kinds of maritime activities, which includes trade, commerce, exchange, water transport technology, seafaring, coastal settlement, ports and harbours. Much of the work of maritime archaeologists is not related to excavation but involves surveying maritime sites, assessing their archaeological potential, making management recommendations and interpreting these sites to the wider community. All underwater antiquities, port installations and ships must be explored, preserved and analysed in order to reconstruct the maritime history of mankind.

## Origins of Marine Archaeology in India

The underwater heritage of India, in the form of submerged cities and sunken ships spans a period of around 4000 years or more. The best efforts of S.R. Rao helped initiate this interdisciplinary subject in NIO (National Institute of Oceanography) in 1981. Since then, various government and private organisations have extended financial support for this research. In a span of two decades, marine archaeological explorations and excavations have been carried out in Dwarka, Bet Dwarka, Somnath, Vijaydurg, Malwan, Goa, Lakshadweep Islands, Poompohar and Mahabalipuram waters (Fig. 1). Onshore and near-shore explorations have been carried out at various ancient port sites such as Chilika and adjoining regions, Kalingapatnam, Machilipatnam, along the Rameswaram coast, Calicut, Beypore, Mangalore, Honavar, Bhatkal, Ratnagiri, Dhobal, Chaul, Janjira amongst other sites prior to undertaking offshore explorations. Although a late development, marine archaeology is a fast developing discipline in India. The University Grants Commission established the Centre for Underwater Archaeology in Mandela Camp, Tamil University, Thanjavur in 1983. However, the centre concentrated to a greater extent on traditional navigation and shipbuilding technology of peninsular India. The centre also retrieved iron and stone anchors from along the Tamil Nadu coast (Rajamanickam 1992). The marine archaeology centre of

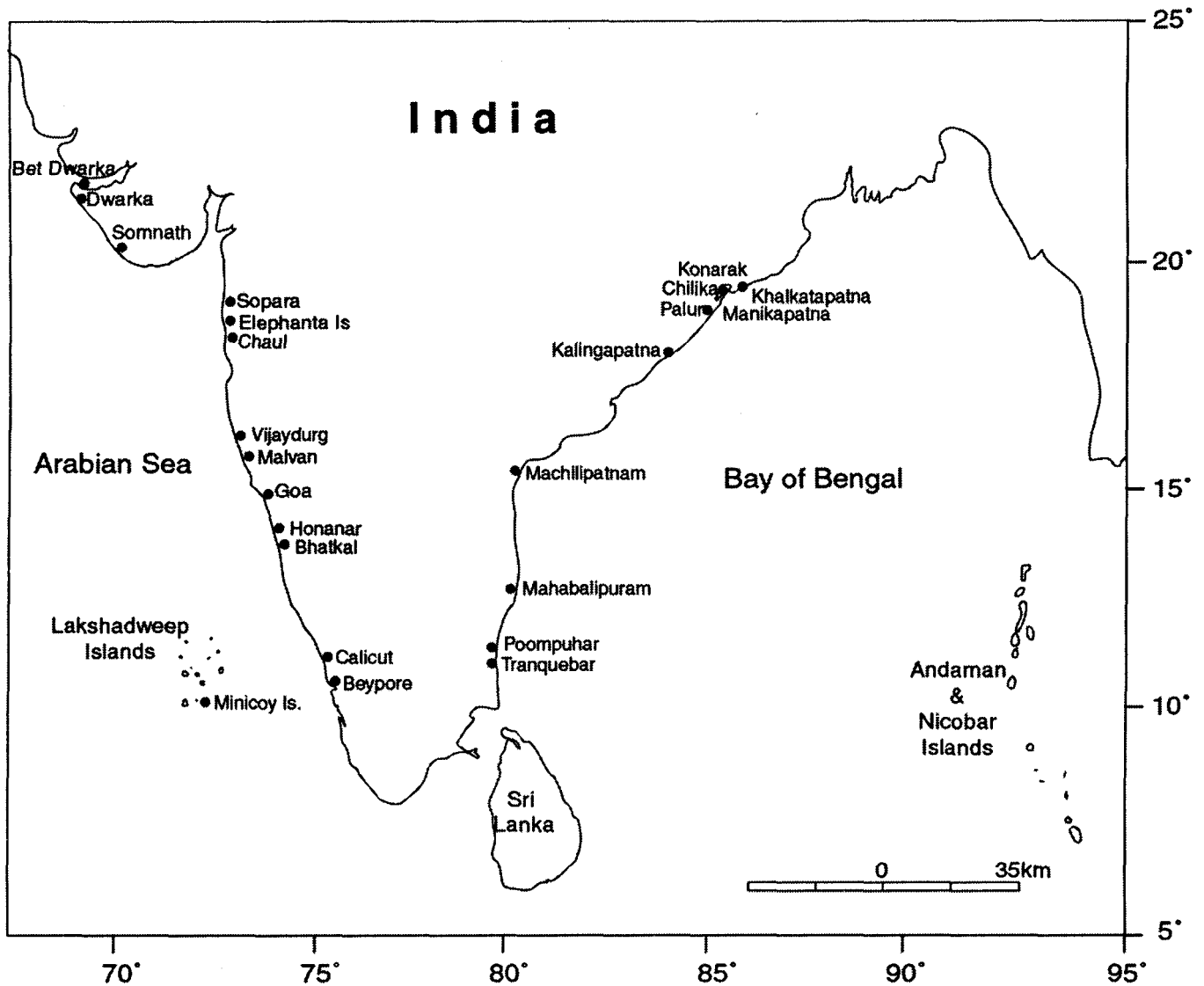


Fig. 1: Map showing the location of sites mentioned in the text

Andhra University, Visakhapatnam carried out work off the coast of Visakhapatnam, Andhra Pradesh, in order to investigate a 11th century Shiva temple which was presumed to be submerged here. Preliminary explorations were carried out in 1989 (Gangadharam 1991). Recently, the Archaeological Survey of India established a marine archaeology wing, and the exploration of shipwrecks was carried out in Lakshadweep and Mahabalipuram waters (Tripathi 2001-02). Similarly, the National Institute of Ocean and Technology (NIOT), Chennai carried out geophysical surveys off the Gulf of Khambat and discovered remains of an early civilisation. NIO has carried out both onshore and offshore explorations along the East and West Coast of India in order to locate submerged ports, coastal cities and shipwrecks.

### Objectives and Sources of Marine Archaeology

The foremost objectives of marine archaeology are: (i) to discover, excavate, interpret and preserve for posterity the underwater cultural heritage of our country, (ii) to reconstruct the history of maritime trade and maritime structures such as docks, wharves, warehouses, ship repairing yards, etc., (iii) to trace the development of boat building and navigational technology by excavating submerged ports and sunken ships, (iv) to preserve antiquities for scientific and educational purposes, (v) to study shoreline changes, coastal erosion, sedimentation, and the like through a study of habitational remains in areas adjoining the sea, and (vi) to study the effect of marine environments on metal and wooden objects and on other perishable materials.

Information on sea voyages, maritime contacts, navigation, shipbuilding, trade and commerce, and shipwrecks are found in ancient Indian literature and in travellers' accounts. However, the location of, and detailed, information on shipwrecks, are rarely mentioned. Indian art, archaeological finds, sculptures, coins, seals, sealing and the paintings of Ajanta indicate type of boats used in rivers, lakes and ships for purposes of overseas trade and commerce, ferrying people, etc. The Portuguese, Dutch, French and English marine records housed in various archives of India and other countries, provide information on trade, commerce and shipwrecks.

### **Tools and Methodology**

Diving (visual survey) plays a vital role in marine archaeological research. Diving helps in determining the distribution of sites, state of artefacts, their probable age, provenance, etc. Underwater documentation such as photography, videography and drawings are possible only by diving. Prior to the invention of Scuba (Self contained underwater breathing apparatus); the SDDE (Surface Demand Diving System) was used for diving. The Scuba system mounted on the diver's back enables him to dive without any hindrance. This system is useful for underwater surveys, especially while operating underwater scooters, cameras, etc. The SDDE system permits divers to complete long schedules underwater, particularly in shallow waters without running short of air and is also good for airlifting. Divers may also use the underwater scooter (Aquazep) to explore desired depths, more efficiently.

After the world wars, equipment such as side scan sonar, echo sounder, ORE mud profiler and magnetometer developed; and these are now deployed for marine archaeological research. Equipment of this nature, are essential to locate submerged and buried objects such as structures, shipwrecks, anchors, port installation remains and are capable of covering a relatively larger area in less time, without endangering life. The side scan sonar serves as a tool to search for artefacts lying on the seabed, at a distance of 50 to 500 m on either side; and provides a plan view of artefacts on the seabed. This system is capable of identifying shipwrecks, anchors and structures. The echo sounder is helpful in determining the water depth and to record the bathymetry. When the echo sounder passes over an object, the echogram records a pinnacle. It is possible to interpret archaeological objects based on echograms. The echo sounder locates objects lying on the seabed, whereas a mud profiler has a great potential for finding and surveying sites and objects buried underwater. The profiler provides an on-line recording of features of the sub-bottom of the seabed, which enables one to distinguish features of geological or archaeological interest. The magnetometer survey helps in identifying the content of iron in the form

of hull fastening and fittings, ballast, cannons, anchors, etc. from shipwreck sites. The shape and size of magnetic anomalies, enables one to identify artefacts, which may be subsequently confirmed by visual surveys. Archaeologists also use metal detectors to detect buried metal objects. This has the capacity to detect any kind of metal of the size up to 0.20 m and may be used at water depths of up to 60 m. Earlier, the sextant and mini ranger were used to obtain positions of sites and findings. At present, the GPS (Global Positioning System) is used to obtain the positions of the working sites. The GPS takes about 12 to 30 seconds to collect data on the location of a site or find.

Underwater archaeological findings can be documented by using underwater cameras with a 15 mm wide-angle lens for still photography and video cameras for videography. The airlift enables one to judge the stratigraphy of the seabed and reveals buried antiquities. The airlift may be used to dig the seabed, and it also sucks out sediment along with archaeological artefacts. Buoyancy is created owing to the air-water mixture, which helps in lifting sediments along with artefacts from the seabed through a main pipe. This water and sediment mixture is collected in a container on board, and this is passed through a sieve to recover sediments and other material. The water is allowed to drain out into the sea.

### **Search Techniques**

An efficient way to survey under water is that two divers (each termed buddy), hold onto a rope, 25 to 50 m long. While one diver holds one end and remains still, the other traces circular paths with a gradually increasing radius. Alternately, both divers swim, while maintaining a minimum distance between each other, in such a way as to maintain a good visual overlap of the seabed. This preliminary seabed survey is carried out in order to assess its nature without disturbing any objects. Divers move from a known to an unknown area. The entire area is surveyed in order to understand the distribution and extension of the site. During survey, attention is paid to natural features like rock outcrops, movement of sediments, seabed topography, water depth, current direction and archaeological artefacts. Subsequently, wherever new artefacts are found, marker buoys are tied to them and their positions are obtained. Small artefacts are generally lifted by hand whereas larger ones can be hauled by means of air bags or winches on boats.

### **Important Sites**

#### *Dwarka*

In 1963 the Deccan College, Pune, excavated Dwarka (inland excavations); and brought to light Early Historical (1st century A.D.) and Medieval pottery. The work was of a limited nature, and the excavators believed that further excavations might reveal earlier settlements (Ansari and

Mate 1966). Further excavations in the forecourt of the present Dwarkadhish temple in 1979-80 by the Archaeological Survey of India yielded the remains of a Vishnu temple of the 9th century A.D., two more phases of the temple datable to the 1st century B.C./A.D.; and evidence of the destruction of a settlement belonging to the Protohistoric and Early Historic Period (Rao 1988). Subsequent offshore explorations off Dwarka by the Marine Archaeology Centre of NIO, brought to light the remains of port installations, and a large number of stone anchors of various shapes and sizes (Rao 1990). The Geophysical survey traced the ancient channel of the River Gomati over a length of 1.2 km seaward at 8 to 10 m water-depth (Vora *et al.* 1991).

Further underwater explorations carried out from 1997 to 2001 covered a larger area, and up to 25 m water-depth off Dwarka, and aimed at locating the remains of settlements of the Protohistoric period (Fig. 2). However, the findings include a number of semicircular and rectangular stone blocks scattered over a large area, a few semicircular structures having 2-3 courses, various types and sizes of stone anchors belonging to the historical and medieval period, and a rectangular stone block engraved with Gujarati script, probably of a later period. Thus these remains confirm that they belong to a jetty, which might have collapsed over the years. Moreover, both nearshore and offshore investigations have not revealed any pottery and artefacts belonging to the Protohistoric period

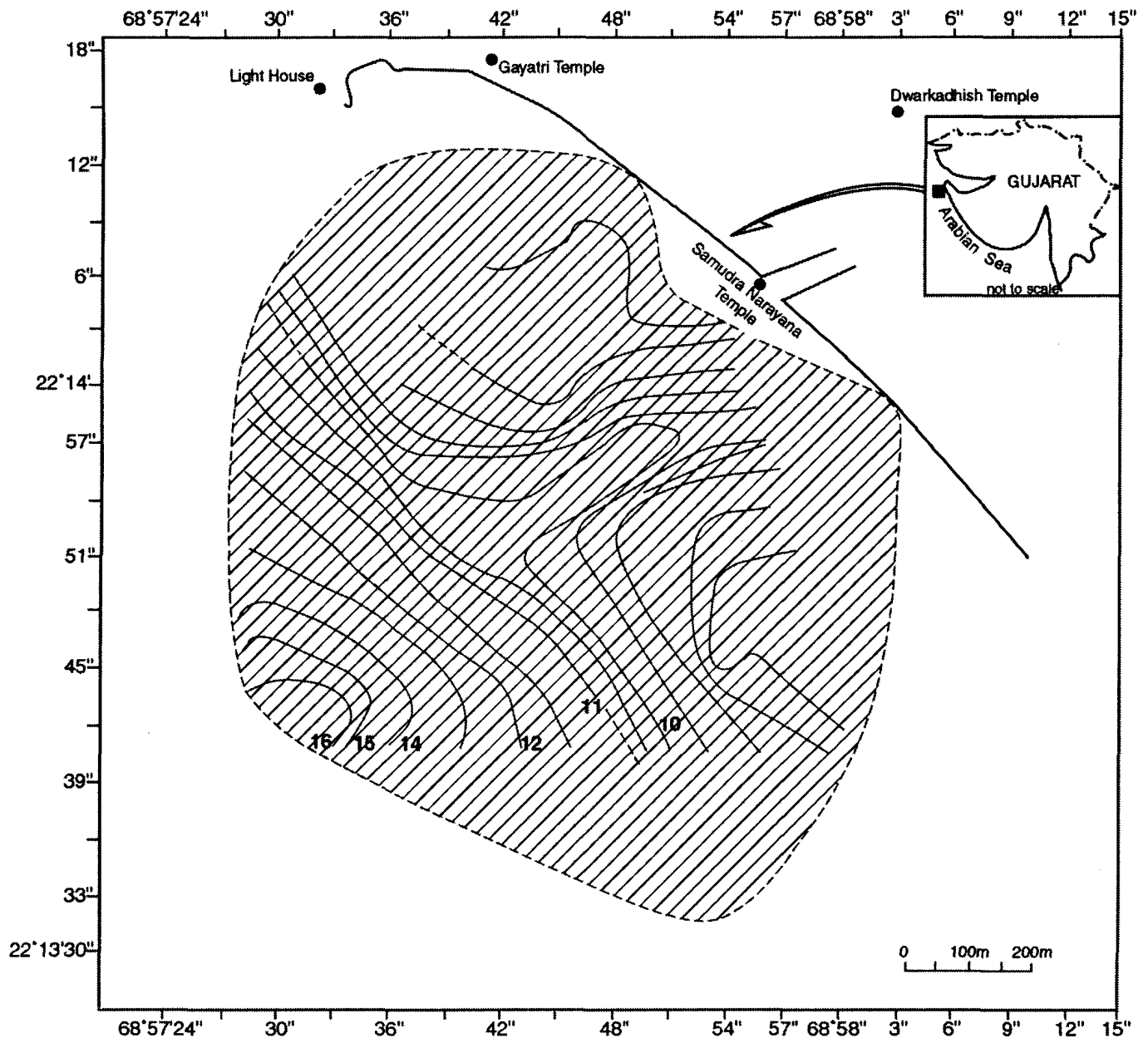


Fig. 2: Area of underwater exploration in Dwarka waters

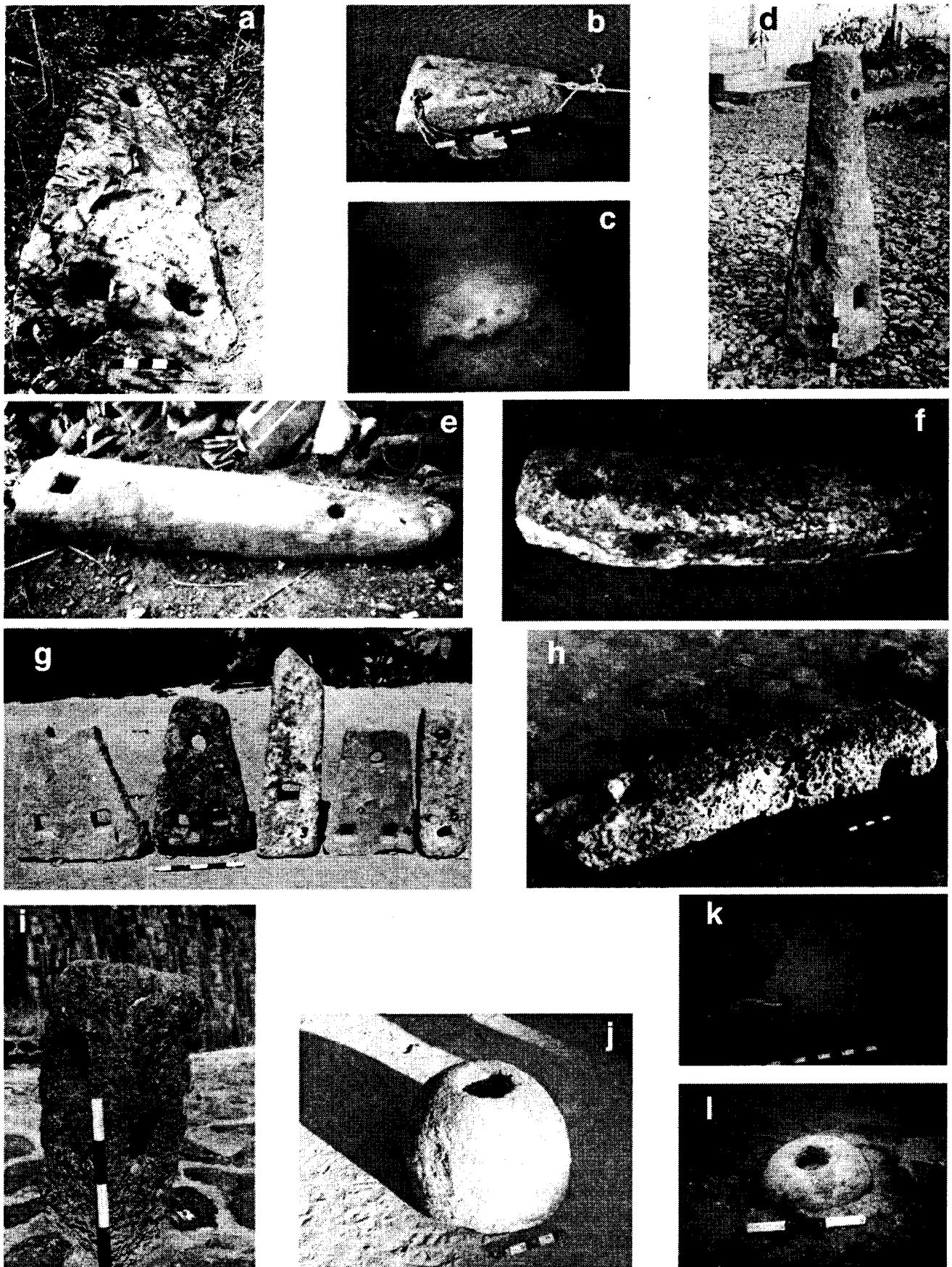


Fig. 3: Various types of stone anchors retrieved from Indian waters

(3500 years BP) off Dwarka. The structures, which were located off Dwarka have also been noticed in the intertidal zone. Further, similar kinds of circular, semicircular stone structures and stone blocks belonging to a century old jetty, have also been noticed during low tide at Rupen Bandar, 3 km north of Dwarka. These are younger in age than those at Dwarka, and the site also lacks stone anchors. The study of stone anchors of the Indian Ocean region, suggests that anchors from Dwarka fall between the 9th and 14th century A.D.. Moreover these stone anchors also indicate that Dwarka was one of the active ports of India during Early to Late Medieval times (Gaur *et al.* 2000). Stone anchors similar to Dwarka (Fig. 3 g, j, k) have also been reported from Bet Dwarka (Fig. 3 c, f), Somnath (Fig. 3 1),

Aramada (Fig. 3 b), Vijaydurg (Fig. 3 a, h), Sindhudurg (Fig. 3 i), Lakshadweep (Fig. 3 e), and Goa waters (Fig. 3d) (Sila Tripathi *et al.* 2003b).

**Bet Dwarka**

Onshore and offshore explorations have also been carried out at Bet Dwarka Island (Fig. 4). The findings confirm that Bet Dwarka was occupied for human settlement from the Protohistoric period (4000 years BP) till today. The findings include a seal, graffiti on three potsherds, pottery and shell bangles belonging to the late Harappan period, Kushana coins and pottery of the historical and medieval period, iron guns and Mughal coins. A historical period site was noticed near *Khuda Dargha*, which is submerged

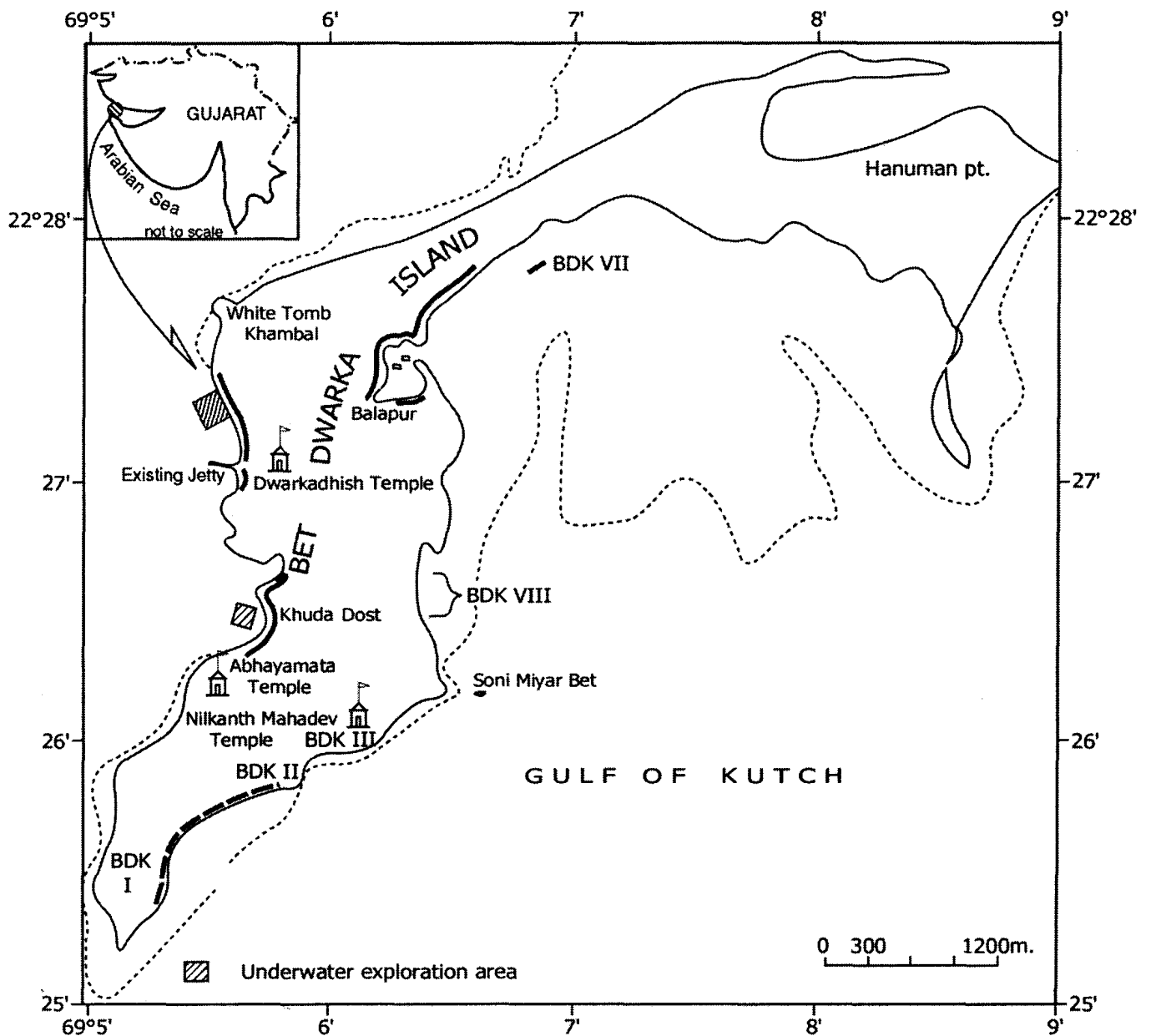


Fig. 4: Area of exploration on Bet Dwarka Island

during high tide. This suggests changes in sea level at least after the Christian era. Underwater investigations off Bet Dwarka have brought to light various types of stone anchors, amphorae sherds and lead ingots (Sundaresh *et al.* 2002). The occurrence of amphorae sherds and lead ingots in Bet Dwarka waters, indicate the presence of a shipwreck belonging to the Roman period. The results of the exploration indicate that Okha Mandal region was occupied in order to exploit the rich marine resources available. It is interesting to note that Harappans of Nageshwar and Bet Dwarka of Okha Mandal had direct contact with Harappans of the Gulf of Kachchh, rather than with Saurashtra, as is evident from ceramic studies.

### **Somnath**

Prabhasa, which seems to have extended up to Somnath, was a flourishing port during Protohistoric times. Excavations at Prabhasa brought to light a warehouse on the banks of the river Hiranya, which is similar to one at Tepe Yahya, West Asia. Near shore exploration between Veraval and the mouth of the river Saraswati during ebb tide brought to light six lingas, a few of which are still worshipped. The offshore explorations off Somnath, brought to light three ring stone anchors, triangular and Indo-Arabian type stone anchors (similar to the Dwarka anchors), dressed stone blocks and a rock cut channel (Rao *et al.* 1992). The subsequent underwater exploration brought to light a large number of ring stones, and triangular and Indo-Arabian type of stone anchors which are similar to those found at Dwarka and Bet Dwarka. The ring stone anchors lie in rock cut channels. Somnath has yielded a greater number of ring stone anchors than any other site in India (Gaur *et al.* 2002a,b). However, explorations in Somnath waters did not yield any submerged habitational remains either of the Protohistoric or of the historical period.

### **Vijaydurg**

Historical records indicate that frequent naval battles between Europeans and Maratha kings occurred at Vijaydurg, as a result of which a number of ships were either sunk or burnt in these water (Apte 1973). The main objective of underwater exploration and excavation off Vijaydurg waters was to locate shipwrecks. Diving, airlift and metal detector surveys were undertaken in Vaghotan creek and on the western side of the Vijaydurg fort at 8 to 10 m water-depth. The underwater exploration revealed a huge linear stone structure (122 m length, 7 m width and 3 m height) built of irregular stone blocks on the western side of the Vijaydurg fort. It is believed that the structure could be of the Maratha period. The structure may have been constructed in order to damage enemy ships and to protect the fort from wave and current action. The airlift revealed coal, shale, slag and pottery of the medieval period from 2.5 to 3 m below the subsurface (Sila Tripathi

*et al.* 1998a). In addition, a number of Indo-Arabian types of stone anchors, and a triangular stone anchor, were also located in the adjoining area of the dockyard. It appears that these anchors were used as mooring bits when the dock was in use. Besides, eight Indo-Arabian types of stone anchors were discovered which served as a lintel in the parapet wall of the second fortification of Vijaydurg fort. Both ends of the Indo-Arabian anchors are embedded in the wall and only the centre portions are visible. Alternative uses of stone anchors have been noticed for the first time along the Maharashtra coast (Sila Tripathi *et al.* 1998b).

### **Malwan**

Exploration revealed three triangular and five Indo-Arabian stone anchors at Sindhudurg fort, Malwan. These stone anchors were embedded on the platform of the jetty of the fort, and two Indo-Arabian stone anchors were used as mooring bits for canoes. Another Indo-Arabian stone anchor was noticed at the entrance, used as a lintel of the Padamgad fort, which served as the shipyard of Shivaji (Apte 1973). All these anchors are made of locally available laterite and sandstone and are highly weathered. It appears that these anchors had been in use prior to the construction of the fort by Shivaji, the Maratha king. During the 17th century, iron anchors were used extensively and stone anchors were abandoned. As the shape and size of these anchors are suitable for use in construction, they were used for paving and mooring. Satavahana coins have been reported from Kolhapur, closer to Malwan. Periplus has identified Malwan as Aurannoboas, and the earliest date for the maritime history of the Malwan region is of the Early Historic period. On this basis it is suggested that these stone anchors belong to a period ranging from the 3rd century B.C. to the 2nd century A.D. (Sila Tripathi and Gaur 1997).

### **Goa**

Underwater exploration in Goa waters has brought to light two shipwrecks at Sunchi Reef and St George's Reef (Fig. 5). The exploration at Sunchi Reef, around 2 km away from Mormugao port, yielded Martaban pottery (Fig. 6 a, b), brass barrel of a handgun, Chinese ceramics (Fig. 6 c), eight elephant tusks of different sizes (58-36 cm in length) (Fig. 6 d), nine hippopotamus teeth (Fig. 6 e), lead pipe and pieces, metal handle (Fig. 6 f), 2 m long four iron guns datable to the 17th-18th century (Fig. 6 g), a 1.218 kg cast iron gun shot, an Admiralty type of iron anchor, stone bricks, a number of well dressed granite blocks and square and round bases of glass bottles (Fig. 6 h, i) in 3 to 6 m water depth. The thermoluminescence dating of pottery shows that the Martaban pottery is 360+ 40 years old. The measured Carbon 14 age of the elephant tusks is 740 ± 130 years; the calibrated age range being 740-560 years BP.

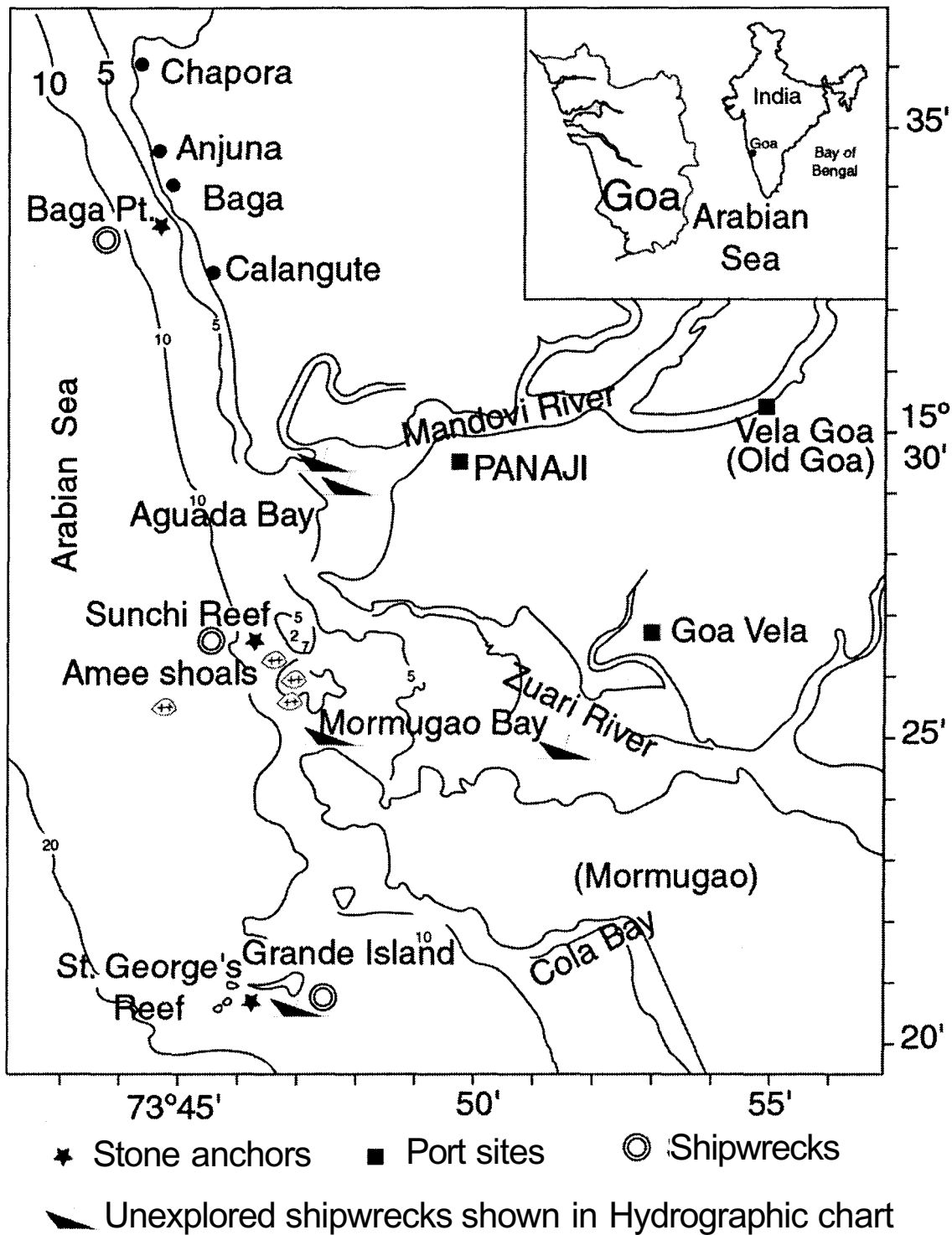


Fig. 5: Area of exploration and location of shipwrecks in Goa waters



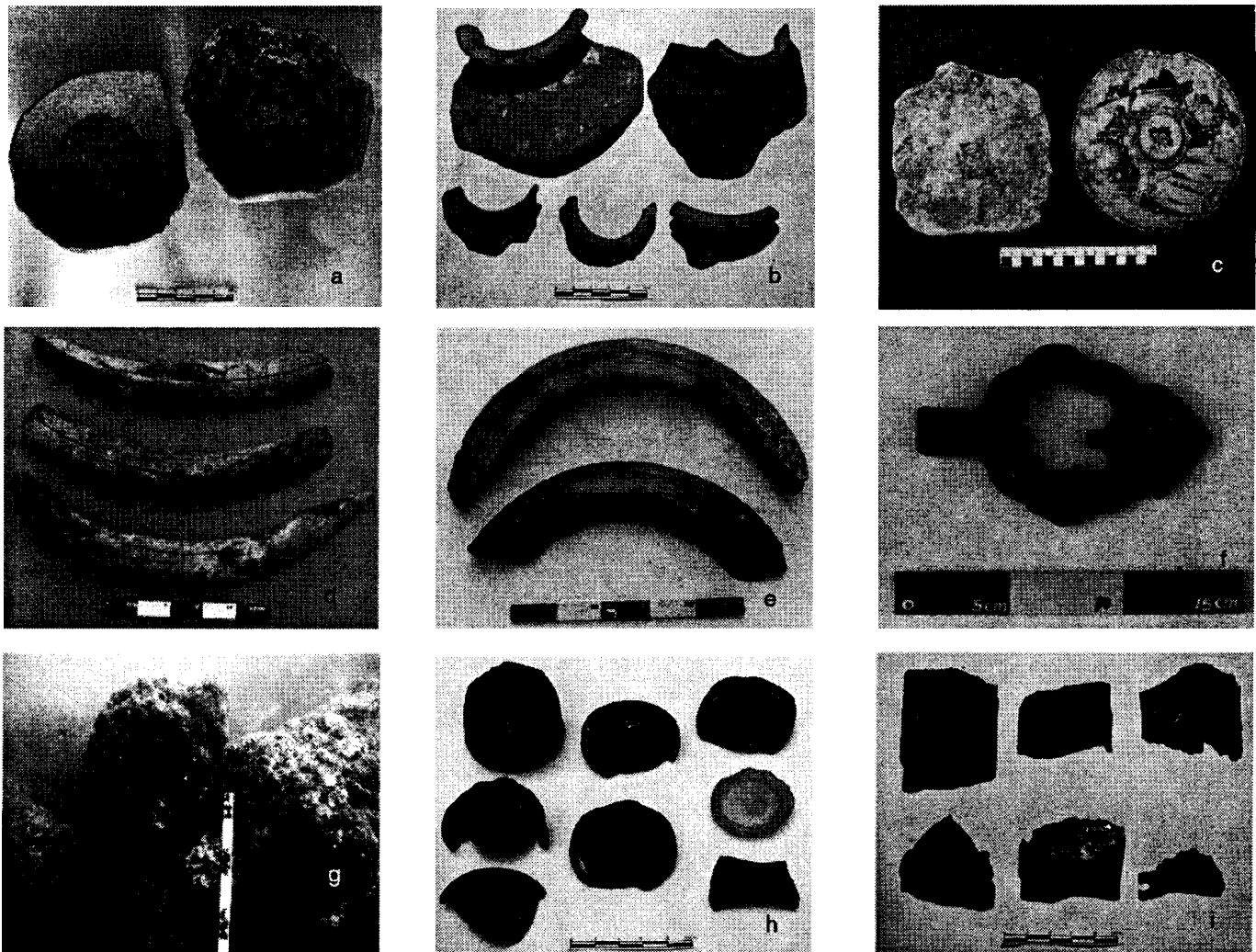


Fig. 6: Artefacts recovered from shipwreck off Sunchi Reef

The Martaban pottery collected from Sunchi Reef is similar to that found in the wrecks of *Nossa Senhora dos Martires* 1606 off Lisbon, and *Santo Antonio de Tanna* 1697 off Mombasa. Evidence suggests that the Sunchi Reef wreck belongs to the Portuguese period of the early seventeenth century A.D. (Tripathi *et al.* 2001). The shipwreck findings in Sunchi Reef add to the picture of Indo-Portuguese trade and commerce.

Underwater exploration off St George's Reef has brought to light the remains of a shipwreck in 15 m water depth. The wreck contains various types of terracotta artefacts such as a Corinthian column capital, a hollow column drum, drainage pipes, vases, ridge, roof and floor tiles and chimney bricks (Fig. 7), which were intended for house construction. The legend *Basel Mission Tile works 1865* is impressed on chimney bricks and tiles. The study shows that the *Basel Mission Company* established the first tile factory at Jeppo, Mangalore in 1865 and was active in manufacturing terracotta artefacts. Tile factories were also

established at Malpe, Palghat and Calicut. Products were exported to Africa, Australia, Borneo and Sumatra. The radiocarbon dating of timber in the shipwreck suggests that it is  $(114.3 \pm 1.5\%)$  115 years old. The anatomical analysis of timber shows that it belongs to *Lagerstroemia lanceolata* species, for which the trade name is "benteak". These findings suggest that the St. George's Reef wreck is assignable to the 19th century A.D. This is the first wreck of the *Basel Mission Company* located during underwater excavations and dates to its period of expansion in the mid-19th century (Sila Tripathi *et al.* 2003a). Further underwater explorations in Goa waters led to the recovery of four stone anchors from Sunchi Reef, Grande Island and off Baga. Three belong to the Indo-Arabian type of stone anchors and one, which has been retrieved from Baga, appears to be a pyramidal stone anchor. Similarly, a number of 'Admiralty Long Shanked' and 'Pering's improved' type of iron anchors have also been retrieved from various places off Goa (Sila Tripathi *et al.* 2003b).

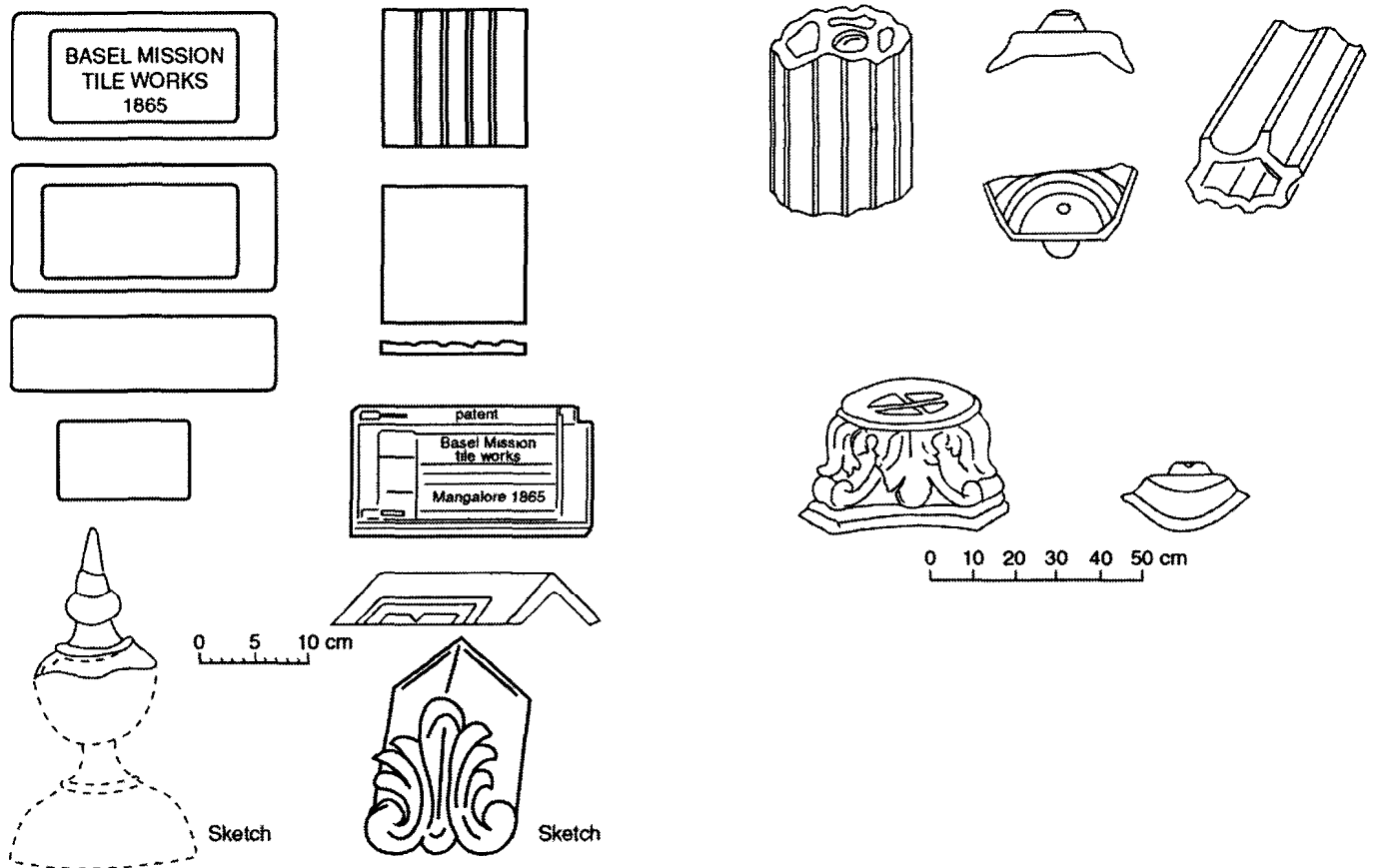


Fig. 7: Terracotta artefacts recovered from shipwreck off St. George's Reef

### Lakshadweep

Lakshadweep Islands lie on the sea route between West Asia and North Africa on one side and South Asia and the Far East on the other. Archaeological explorations carried out by the Archaeological Survey of India brought to light Roman gold coins from Kadmat, and Buddha heads from Androth and Minicoy (Sharma and Khan 1994). These coins and Buddha heads provide evidence for early settlement in the islands. Onshore explorations were carried out by NIO at Kavaratti, Androth, Agatti and Amini. Red Polished Ware (RPW), red ware, dull red ware, and buff ware were noticed at these islands. The scraping near the Ujira Habiwulla Mosque mound of Kavaratti brought to light a number of potsherds, the majority of them belonging to red ware, black ware and PRW. Large quantity of red ware, dull red ware and black ware were found in the habitational mound of Androth. Medieval pottery was found in the Jama Masjid, Majar and Waliullah Majar of Agatti. Red ware and coarse grey ware belonging to the Medieval and Early Historical Period were noticed in the foundation trench excavated for a public building at Amini (Sila Tripathi 1999).

Offshore explorations in the Suheli Par Reef brought to light the remains of a shipwreck in the 6 to 15 m water-depth. According to local information, three to four ships have wrecked here. A number of armoured vehicles, tyres, trucks, cars and cannons were also found lying in this lagoon. Owing to choppy seas, it was not possible to dive nearer the reef for a close examination of the wreck. The remains of a Greek ship carrying Second World War surplus stores from Burma, was noted; grounded at night in December 1955 (Sila Tripathi and Gudigar 2001). Two shipwrecks were surveyed in 4 to 10 m water-depth, about 200 m seaward off Minicoy Island. The first wreck is oriented north-south and is parallel to the shore. The exploration revealed a well-preserved frame, beams, engine, flywheel and steam pipes of the ill-fated steam ship; however the hull plates are corroded. The shaft attached to the wheel is traced up to 27 m, the diameter of the wheel is 4.5 m and both are in good condition. The anchor chain is in good condition and noticed up to 150 m. The other wreck lies to the north of this. The shaft attached to the engine is in good condition and steam boilers were noticed (Gaur *et al.* 1988; Rao *et al.* 1995-96b). Some parts of these wrecks lie in deep waters. They are well preserved and belong to the transition phase between wood

and iron and sail and steam. Explorations of steam engine wrecks are rare, hence it is important to explore these wrecks of Lakshadweep for marine archaeological research.

### Poompuhar

Poompuhar, a port town (3rd century B.C.-3rd century A.D.) is situated at the confluence of the River Kaveri and the Bay of Bengal on the east coast of India. Sangam texts describe the layout of the port city, harbour, warehouse, and the export and import of articles from this port. Excavations at Poompuhar and adjoining areas brought to light an T shaped brick wharf at Kilaiyur, a reservoir at Vanagiri and a Buddha Vihara near the Pallavaneswaram temple (Soundar Rajan, 1994). The Department of Archaeology, Government of Tamil Nadu and the National Institute of Oceanography, Goa carried out offshore explorations to locate the port installation remains in the sea, in 1981. The exploration revealed some conspicuous objects, which could not be identified since diving was not undertaken (Vora 1987). Marine archaeological explorations were also carried out in Poompuhar waters from 1989 onwards. Onshore explorations between Poompuhar and Tranquebar revealed ring wells, early historical pottery, brick structures, inscribed potsherds, Chola coins, semiprecious stones and terracotta beads; and red ware of the medieval period. A brick structure exposed in the intertidal zone, about 200 m south of the Kannagi statue, was excavated; and in order to obtain a cross section a trench of 1.20 m depth was laid down. The structure measures 4 m in length, 1.20 m in width and consists of 11 courses of bricks laid in natural soil. The bricks used are 36x 8x 6 cm in dimension. The structure is aligned parallel to the shore (Sila Tripati *et al.* 1996). Offshore exploration involved both visual and geophysical surveys. Airlifting was carried out extensively off Poompuhar at different water depths, and yielded brick bats, red ware, Black and Red ware, a sherd of amphora and some courses of dressed blocks, which are square and rectangular in shape. The blocks are highly eroded and no trace of binding material is noticed on them. Further diving in 7 m water depth, brought to light scattered stone blocks measuring 60 x 35 x 10 cm, 65 x 40 x 10 cm and 30 x 2 x 10 cm. Airlift yielded similar kinds of pottery 1 m below the sediment water interface (Rao *et al.* 1995-96a). A LP shaped stone structure (40 x 20 x 3 m) lying in a north-south direction and in two parts was noted at 23 m water depth. A depression of about 1 m was noted at the centre of the structure. A smaller structure was noticed about 40 m to the north. These structures are highly disturbed, broken in several pieces and covered with fishing nets. Many explanations have been suggested regarding the structure, none of which can be substantiated as yet:

### Shipwreck in Poompuhar Waters

A wooden hulled shipwreck was located at 19 m water depth around 3.5 km off Poompuhar (Gaur *et al.* 1997). The wreck is distributed in two parts and lies oriented northeast to southwest. A metal detector survey confirms that about 75% of the ship is buried within sediments; whereas echo sounder surveys indicate that the height of the wreck may be around 2.5 to 3 m. Other important findings at the site are a 2.1 m long gun and three gunpowder boxes on the eastern side. A large number of lead ingots bearing the inscription 'W: BLACKETT' on one side; and '1791-92' on the other, along with merchant marks, were lying on the southern side (Fig. 8). The gun is fixed on an iron platform, which makes it difficult to lift. Wooden planks and copper nails were also noticed on the wreck. Woodborer molluscs affected the upper wooden planks, while the lower planks were intact. The rudder gudgeon along with copper nails and a rudder pintle which were lying 10 m away, to the north of the wreck, were recovered along with 18 lead ingots of various types. Based on physical features, the ingots are classified into four categories based on their shapes, weight and markings. To know the provenance and quality of lead; isotopic and trace metal analyses were carried out. These indicate that W: Blackett used high purity lead for manufacturing ingots, and that the main source for lead ingots was the North Pennine ore fields of Britain. The wreck is well preserved and needs to be excavated thoroughly. The year stamped on the ingots, 1791 and 1792, indicate the dates of manufacturing and the vessel might have been wrecked some years later. The finding of lead ingots confirms that there was trade contact between the W: Blackett Company and India, but merchant marks suggest this was through middlemen and not direct. The Poompuhar wreck is the first wreck so far reported from the East Coast of India (Sila Tripati *et al.* 2003c).

### Mahabalipuram

Numerous references suggest that Mahabalipuram was a flourishing port in the early centuries of the Christian era and this situation continued till the Pallava period in the 8th century A.D. It is believed that out of seven temples constructed in Mahabalipuram, only one remains, with the remaining being submerged.

Preliminary underwater investigations off Mahabalipuram were carried out to locate the remains of submerged temples. The exploration yielded structures such as walls and scattered blocks in 5 to 8 m water-depths about 800 m away from the present shoreline. Some structures have 2 to 3 courses extending up to 15 to 20 m in length. The structures were badly damaged due to strong underwater currents, swells and thick marine growth. On the basis of archaeological evidence of the region around Mahabalipuram, the earliest possible date of

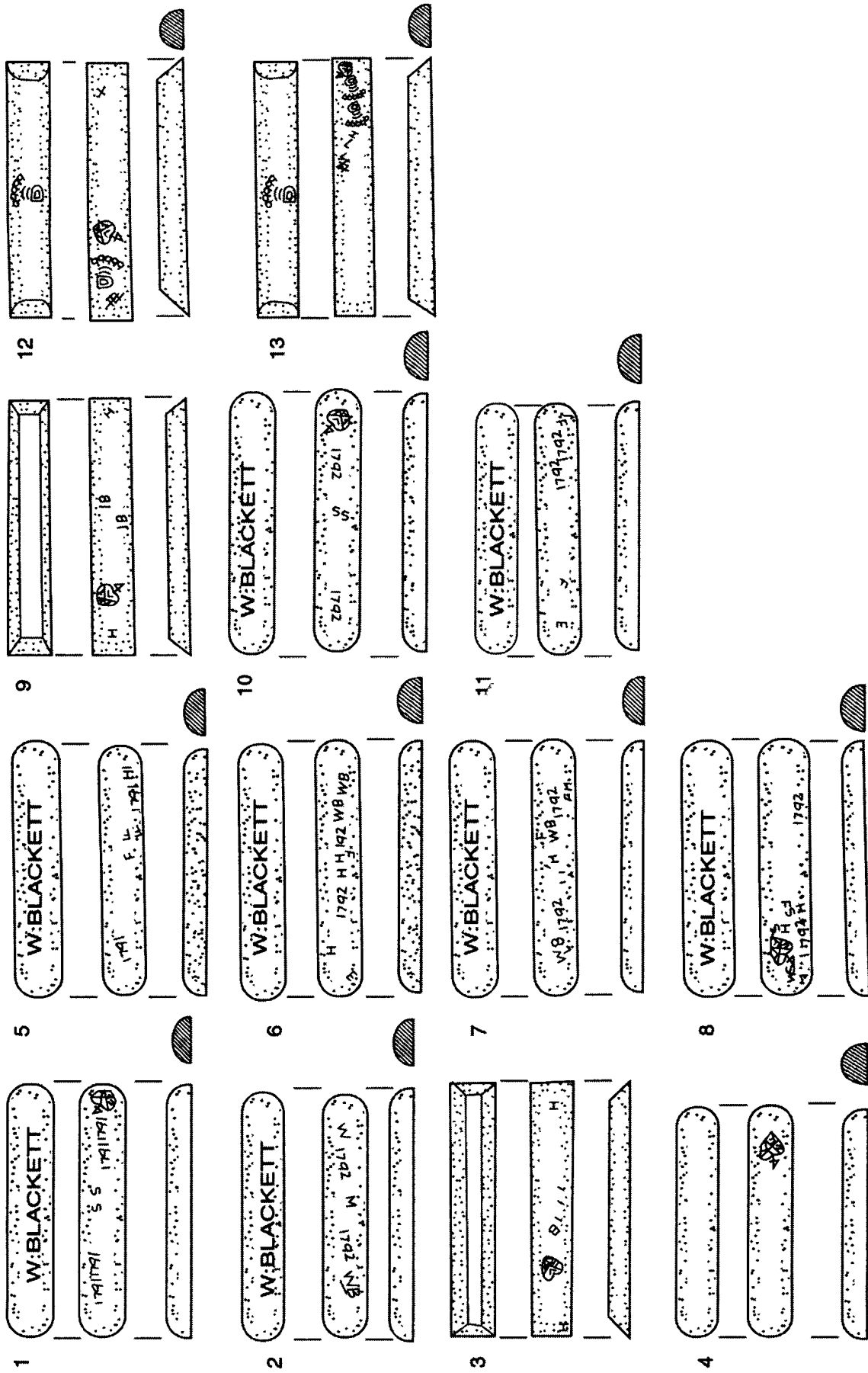


Fig. 8: Various types of lead ingots retrieved from Poompuhar wreck

these structures could be around 1500 years BR The major causes for the submergence of these structures include severe coastal erosion, and minor sea level fluctuations. Extensive excavation and removal of marine growth are required to understand the layout, plan, purpose and other details of these structures (Sundaresh 2003).

### Conclusion

Submerged sites and sunken shipwrecks are our cultural heritage. It is critical for us to decipher these records and link the past with the present. Rampant developmental activities in coastal zones may destroy evidence of bygone civilizations forever. Therefore, it is imperative to make marine archaeological investigations mandatory in coastal zones, where any kind of developmental activities occur in the form of ports, harbours, industry, tourism, etc. In India, very few shipwrecks have been explored, although the rate of salvage of shipwrecks is higher. Unless this is stopped, evidence will be destroyed forever. Archaeological evidence, if found, must be reported to authorities to prevent its destruction. In addition to this, submerged port and shipwreck sites can be promoted for tourism.

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### References

Ansari, Z.D. and M.S. Mate 1966. *Excavations at Dwarka*. Pune: Deccan College.

Apte, B.K. 1973. *A History of the Maratha Navy and Merchant ships*. Mumbai: Government Central Press.

Gangadharam, E.V. 1991. The Lost Temple for Vaisakheswara off Visakhapatnam, Andhra Pradesh, India, (Abstract), in *Recent Advances in Marine Archaeology*, Proceedings of the Second Indian Conference on Marine Archaeology of Indian Ocean Countries, Bangalore-1990, (S.R. Rao Ed.), pp. 198. Goa: Society for Marine Archaeology.

Gaur, A.S., Sundaresh, M. Saxena, Sila Tripathi and P. Gudigar 1997. Preliminary Observations on an

18th-Century Wreck at Poompuhar (East coast of India), *International Journal of Nautical Archaeology* 26 (2): 118-126.

- Gaur, A.S., K.H.Vora, Sundaresh, Sila Tripathi, P. Gudigar and S.N. Bandodker 1998. Exploration of Steam Engine Wrecks off Minicoy Island, Lakshadweep, India, *International Journal of Nautical Archaeology* 27(3): 225-236.
- Gaur, A.S., Sundaresh, P. Gudigar, Sila Tripathi, K.H.Vora and S.N. Bandodker 2000. Recent Underwater Explorations at Dwarka and Surroundings of Okha Mandal, *Man and Environment* XXV(1): 67-74.
- Gaur, A.S., Sundaresh, Sila Tripathi, P. Gudigar and S.N. Bandodker 2002a. Saurashtra Stone Anchors (Ring Stones) from Dwarka and Somnath, West Coast of India, *Puratattava* 32: 131-145.
- Gaur, A.S., Sundaresh, Sila Tripathi and S.N. Bandodker 2002b. Ring Stone Anchors from Gujarat, West Coast of India, *The Mariner's Mirror* 88(4): 390-404.
- Mucklroy, K. 1978. *Maritime Archaeology*. New York: Cambridge University Press.
- Rajamanickam, V. 1992. Marine Archaeological Exploration Activities from the Centre of Tamil University, Tamil Nadu, in *Seminar on Marine Archaeology* (N. Kasinathan Ed.), pp. 34-44. Chennai: Department of State Archaeology.
- Rao, S.R. 1988. Excavation of Submerged Ports-Dwarka a Case Study, in *Marine Archaeology of Indian Ocean Countries, Proceedings of the First Indian Conference on Marine Archaeology of Indian Ocean Countries - Oct 1987* (S.R. Rao Ed.), pp.47-53. Goa: National Institute of Oceanography.
- Rao, S.R. 1990. Excavation of the Legendary City of Dvaraka the in Arabian sea, *Journal of Marine Archaeology* 1: 59-98.
- Rao, S.R. 1991. Further Excavations of the Submerged city of Dwarka, Recent Advances in Marine Archaeology, in *Proceedings of the Second Indian Conference on Marine Archaeology of Indian Ocean Countries*, Bangalore- 1990, (S.R. Rao Ed.), pp. 51-59. Goa: Society for Marine Archaeology.
- Rao, S.R., Sila Tripathi and A.S.Gaur 1992. A Preliminary Exploration of Prabhasa-Somnath, *Journal of Marine Archaeology* 3: 13-16.
- Rao, S.R., T.C.S. Rao, A.S. Gaur, Sila Tripathi, Sundaresh and P. Gudigar 1995-96a. Underwater Explorations off Poompuhar, *Journal of Marine Archaeology* 5-6: 7-22.

- Rao, S.R., K.H.Vora, A.S., Gaur, P. Gudigar, Sundaresh and Sila Tripathi 1995-96b. A Preliminary Shipwreck Exploration off Lakshadweep, *Journal of Marine Archaeology* 5-6: 23-32.
- Sharma, A.K. and M.F. Khan 1994. Buddha Heads and Some Graves Head Stones from Lakshadweep, in *Role of Universities and Research Institute in Marine Archaeology, Proceedings of the Third Indian Conference on Marine Archaeology of Indian Ocean Countries-1992* (S.R. Rao Ed.), pp. 129-131. Goa: Society for Marine Archaeology.
- Sila Tripathi, A.S. Gaur, Sundaresh and P. Gudigar 1996. Marine Archaeological Explorations in the Kaveripoompattinam region: Fresh Light on the Structural Remains, *Man and Environment* XXI (1): 86-90.
- Sila Tripathi and A.S.Gaur, 1997. Stone Anchors from Sindhudurg Fort on the West Coast of India, *International Journal of Nautical Archaeology* 26 (1): 51-57.
- Sila Tripathi, M.K. Saxena, Sundaresh, P. Gudigar and S.N. Bandodker 1998a. Marine Archaeological Exploration and Excavation of Vijaydurg - A Naval Base of Maratha Period, Maharashtra, West Coast of India, *International Journal of Nautical Archaeology* 27(1): 51-63.
- Sila Tripathi, A.S. Gaur, Sundaresh and S.N. Bandodker 1998b. Historical Period Stone Anchors from Vijaydurg on the West Coast of India, *Bulletins of the Western Australian Maritime Museum* 22: 1-8.
- Sila Tripathi 1999. Marine Investigations in the Lakshadweep Islands, India, *Antiquity* 73(282): 827-835.
- Sila Tripathi and P. Gudigar 2001. Shipwreck Archaeology of the Lakshadweep Islands, West Coast of India, *International Journal of Nautical Archaeology* 30(1): 37-47.
- Sila Tripathi, A.S. Gaur, Sundaresh and S.N. Bandodker 2001. Exploration for Shipwrecks off Sunchi Reef, Goa, West Coast of India, *World Archaeology (Shipwrecks)* 32(3): 355-367.
- Sila Tripathi, Sundaresh, A.S. Gaur, P. Gudigar and S.N. Bandodker 2003a. Exploration of Basel Mission Company Shipwreck Remains at St George's Reef off Goa, West Coast of India: Impact of the Basel Mission Co. on Society and Culture, *International Journal of Nautical Archaeology* 32(1): 111-120.
- Sila Tripathi, A.S. Gaur and Sundaresh 2003b. Anchors from Goa Waters, Central West Coast of India: Remains of Goa's Overseas Trade Contacts with Arabian Countries and Portugal. *Bulletin of the Australasian Institute for Maritime Archaeology*, Vol. 27: 97-106.
- Sila Tripathi, G. Parthiban, K.V.Vora, Sundaresh and S.N. Bandodker 2003c. Lead Ingots from a Shipwreck of Poompuhar off Tamil Nadu, East Coast of India: Evidence for Overseas Trade and their Significance, *International Journal of Nautical Archaeology* 32 (2): 225-237.
- Soundar Rajan, K.V. 1994. *Kaveripattinam Excavations 1963-73 (A Port City on the Tamil Nadu Coast)*. New Delhi: Archaeological Survey of India.
- Sundaresh, A.S. Gaur, Sila Tripathi, P. Gudigar and S.N. Bandodker 2002. Stone anchors from Bet Dwarka Island, Gujarat coast, India: Significance to historical period maritime activities, *Bulletin of the Australasian Institute for Maritime Archaeology* 26: 43-50.
- Sundaresh 2003. *Marine archaeological explorations off Mahabalipuram, Tamil Nadu, 2002-03, Technical Report No. NIO/TR-8/2003*, pp. 1-30.
- Tripathi, A. 2001-02. The Underwater Exploration of Mahabalipuram in Bay of Bengal, *Puratattava* 32, 93-100.
- Vora, K.H. 1987. A Note on Geophysical Explorations for Marine Archaeology off Tamil Nadu coast, India, *International Journal of Nautical Archaeology* 16 (2): 159-64.
- Vora, K.H, D.K. Naik, P. Ganesan and C.N. Moraes 1991. Offshore Extension of Gomati river, Dwarka, *Journal of Marine Archaeology* 2: 32- 38.