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A study of Traditional Boats and Navigational History of Odisha, East coast of India

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Abstract

It is generally believed that there were seafarers before there were farmers and potters. Man must have used some kind of craft to cross the rivers, seas, bays for collection of food during prehistoric time onwards if not earlier. With regard to the earliest voyages, it is believed that these were made around 60,000 years ago when the sea level was lower and people would have used floats or rafts for the purpose. After many centuries different types of traditional boats were constructed and used for maritime trade, fishing, warfare, etc. Indian epics and regional literature mention different types of vessels and their use and the vessels used in the seas, rivers and lakes are different in their construction, shape and size. Like other littoral states of India, references to a good number of traditional boats of Odisha are found in the contemporary literature namely *Pota* (dug out), *Nauka, Bhela, Chapa* and *Padhua*. There are some traditional boats, for instance teppa, padhua, nauka and patia, which are still in use and built along the Odisha Coast. The present paper details construction techniques of traditional boats of Odisha, their usages, difference between the traditional boats of Odisha and those on other parts of the east coast of India and navigational technology.

Keywords: Traditional boats, Navigation, Maritime trade, Odisha, East coast of India

Introduction

The history of boatbuilding is as old as the relationship between man and the sea. Across the length and breadth of the Indian subcontinent, along the coastal region, various types of traditional boats existed. The depiction of varieties of water crafts on rock paintings of Kaimur Hills, Uttar Pradesh suggest their use from the Stone Age onwards and they were probably used for fishing, crossing rivers, etc., but their construction patterns and endurance is unknown (Fig. 1) (Personal communication: Erwin Neumayer and Vibha Tripathi). The geographical position of India is significant because it covers the Arabian Sea, Bay of Bengal, and numerous rivers and their tributaries which were suitable for shipping and helped in attaining maritime dominance. And in the maritime trade different kinds of boats were used according to the topography of the seabed, sea conditions and water depth both in the open seas, estuaries and inland rivers. It is well evident that the Harappans were the first mariners of the Indian subcontinent, had trade contacts with Sumerians and Mesopotamians and followed the coastal route. The depiction of boats on seals, potsherds and terracotta affirms that the Harappans used flat bottomed and sharp upturned prow and stern type of boats. In addition, seafarers of India had knowledge of the sea pertaining to currents, tides, waves, weather, and winds from the Harappan period, if not earlier. Abundant evidence of the shipbuilding, navigation and maritime history is available from the Early Historical Period onwards. Similarly, the representation of various types of crafts on seals (Ratnagar 2004; Deloche 1996) coins (Sarma 1980), graffiti on potsherds (Sridhar 2005), terracotta seals (Mukherjee 1989), temple walls (Deloche 1991 and 1996), stupas (Mookerji 1912) caves (Schlingloff 1988) and rock paintings (Sonawane 1997) suggest that these were used for maritime trade, warfare, fishing, ferrying, etc., both in rivers, lakes and seas in different periods of history (Fig. 2). There were mainly two groups of vessels, namely river going and sea going. Each again had various types depending on dimension, capacity and height. The river going vessels were mostly oval at the bottom, smaller in size, required less draught for easy movement and were fast moving. The sea going vessels were bigger in size, sharp cutting from both sides, strongly built and technically suited to operation in high tides and against currents and strong winds. In any coastal environment, the nature of the sea craft is conditioned by the physical characteristics of the coastline and associated with cultural history of the seafaring community. Along the Indian coast different types of traditional crafts have been recorded (Fig. 3) probably because of seabed features, depth, flow of current and wind directions. For several centuries the structure and design of traditional crafts seem to have survived in their present form with some minor changes. But strictly speaking the technical details of ship and boatbuilding from construction stage to navigation stage are few and far between.

Sources for study of traditional boats of India and Odisha

Before going into details of ‘traditional boats’ it is essential to understand the meaning of traditional boats. In this perspective, McGrail (2014) suggests that “traditional boats” denote that the boats are

built manually following an inherited design, using natural materials and traditional tools; moreover these boats are propelled by human muscles or by wind, currents and tidal flows.

The *Periplus of the Erythrean Sea* (60-100 AD) outlines the crafts made of logs with plank sides, outriggers, two canoes joined together and *masula* boats along the Coromandel Coast (Schoff 1974: 243-44). Pliny (23-79 AD) also mentioned about log boats of India which are even used today in peninsular India (Blue 2009; Greenhill 1971). Mookerji (1912) believed that the earliest depiction of planked craft is represented on the east gateway of Sanchi Stupa datable to the 2nd century BC. Except this no evidence for sewn planked boats was recorded until the early 16th century. However, Duarte Barbosa (1480-1521) mentioned that sewn boats voyaged from the Malabar Coast to the Red Sea. Balbi mentioned some of the boats of the Coromandel Coast which are used in surf zone carrying merchandise and passengers from mother boat to shore and back (Lane Fox 1875; Hill 1958; McGrail 1981) are sewn.

Thomas Bowery (1669-1679), sailing master and pepper trader mentions catamarans in his account, stating that catamarans are made of four to six logs which are tied together (Temple 1905: 42-44). The middle log is longer than other logs and catamarans are propelled by paddles. Similarly, he has left a good description of the *masula* (*massoolas*, *masula*), the flat bottomed boat which was most suitable for the surf zone off the Coromandel Coast. “The boats they [of the Coromandel Coast] doe lade and unlade ships or vessels with are built very sleight, haveing no timber in them, save the thafts [thwarts] to hold their sides together. Their planks are very broad and thinne, sowed together with cayre [coir] being flat bottomed and every way much deformed …… They are so sleightly built for conveniences sake, and realy are most proper for this coast” (Temple 1905: 42-44; McGrail 1981: 54; McGrail 2001: 269-272). *Masula* boats had broad and thin planking sewn with coir, and thwarts but no floor timber. Further, John Fryer, a (17th century traveller, contemporary of Thomas Bowery, with regards to the *Masula* of the east coast of India, mentions that these crafts were sewn with coco yarn and dammar resin was used for caulking (Hill 1958; McGrail 1981: 54). Moreover Greenhill (1971) has recorded other sewn boats of the Indian coast.

In addition to the above evidence regarding the sewn boats, the *Yuktikalpataru* otherwise known as *Vrksayurveda* (the Science of plant life), the early medieval period text of the 11th century AD compiled by the King Bhoja of Dhar, Central India,

(Mookerji, 1912; Gopal, 1970, 1999; Chaudhary, 1976) mentions that sea going vessels are sewn with fibres and ropes and no iron nails are used, because there is an apprehension that submerged magnetic rocks in the sea would attract the iron nails. No iron at all is used in the construction of *masula*. An interesting sidelight on the use of sewn planks in these eastern waters is the widespread myth, first recorded by King Bhoja, that iron nails would be drawn out of any ship that passed near a certain magnetic mountain (Mookerji 1912). Al-Masudi noticed that since early

medieval times, sewn ships were being plied on the Indian coasts (Hourani 1975). Planks seem to have been joined by ropes and coconut fibres. *Tilakamanjari* mentions that the broken planks were fastened together tightly and the chief sailor's duty was to examine all joints before the ship set sail. The holes used to be caulked by wax and wool (Gopal 1962).

Other than these sources, references to construction of boats are found in Odia literature, for instance the *Datha Dhatu Vamsa* mentions that the tooth relic was transferred from Dantapura of Kalinga to Sri Lanka in a well plank built ship, sewn together with ropes, having a well rigged, lofty mast with a spacious sail and manned by skilful navigators (Das 1977). In the lexicon *Trikandasesha* Purushottamadeva provides different names of boats plying in the rivers of Odisha and their use in coastal navigation (Sah 1976). The *Prastabasindhu* text of Dinakrushna Das describes construction of various types of boats and their carrying capacity. *Prem Sudhanidhi* of Kabisamrat Upendra Bhanja describes the different types of boats intended for pleasure and amusement trips (Tripathy 1986; Sila Tripati 2000). The Jayadev Museum, Bhubaneswar has a rich collection of palm leaf manuscripts in which four manuscripts contain illustrations of boats. The illustrations are in the *Ushavilasha* of Sisushankar, Siva Parvati, Usha and Chitralekha. A close observation of the boats shows the differences. The prows of the boats are in different shapes and sailors are also depicted. Among eight boats, prows of six boats are of same type; faces of a bird on one and an elephant on the other have been depicted on the prows of the other two boats. The construction of five boats is identical but the remaining three are different from each other (Behera 1993). Out of eight boats four boats were sailed by women, which is highly significant. Similarly, boats depicted on sculptures of Odisha indicate the existence of reverse and clinker construction. One specimen was found at the *Bhogamandapa* of Jaganath temple, Puri, and of the two other sculptures depicting the same type of boats, one is in the Indian Museum, Kolkata (Fig. 4), and other in the Victoria and Albert Museum (Fig. 5), London, datable to the 11th to 12th centuries AD (McGrail 2003; Guy 1999). Reversed clinker technique continues till date; proved by a drawing of *Patua* (Patia) made by B. Solvyris in the early part of the 19th century. *Patia* boats are found between the Rivers Dhamra and Suvarnarekha on the northern coast of Odisha. The survival of clinker construction, both ordinary and reversed type, is significant as clinker constructions of boats are not available in southern and western coast of India. Of course such types are found in present West Bengal and Bangladesh (McGrail 2003).

Traditional boats of Odisha

Odisha is situated along the eastern part of the country with a 480 km long coastline; a number of rivers flow through Odisha which have originated from Odisha and neighbouring provinces. Among them some rivers are navigable in the estuarine region, but traditional crafts can be seen both in estuarine as well coastal regions. The boats of Odisha can be classified into three types which ply in rivers, lake and sea. As with traditional boats of other Indian coastal regions, different types of traditional boats have been recorded along the Odisha coast (Fig. 6). The boats of the northern

coast are different from the southern coast because of varied seabed morphology, wide shelf, tidal range, etc. To trace their history, construction pattern, and navigation technology of Odisha, the local traditions as well as existing literary works have been consulted. *Bhela*, *Pota* (dugout), *Padhua* or *Kosala danga*, *Chapa*, etc. are the traditional boats of Odisha referred to in the contemporary literature of Odisha and were used in maritime ferrying, transportation of cargo, fishing activities, etc. Among these types, some still exist and are used in estuarine and coastal waters.

Bhela

In some parts of Odisha, *Bhela*, which are similar to the catamaran, were used. *Bhela* is used in coastal and shallow waters and more importantly in confined water. The middle log of *bhela* is fixed low and all other logs are tied slightly above the middle log. This gives little slope to the craft from fore and aft side. Hence the fore and aft side remain a little higher, which helps to cut waves smoothly. It was rowed by oars and never sank because of its light weight. The logs were tied in such a way that if water got into the *bhela*, it would automatically be released through the gaps so the craft is not damaged by sea water.

Chapa

In comparison with other boats, *chapa* are large in size. The construction of *chapa* provides an indirect evidence of the boatbuilding technology of Odisha. The lower part of *chapa* looks like the English letter 'U' and wooden ribs named *pankhi* were joined on both sides of the lower part of the boat. Planks are joined by stitching. In Odisha similar boats were used in the *Chandan Yatra* festival in the month of Baisakha (April-May). The *Madala Panji* describes how Lord Jagannath was taken to Chilika in *chapa* to keep away from the attack of Muslims. These were used for transportation of cargo and sea voyages.

Padhua* and *Kosala danga

Padhua or Kosala *danga* is the traditional craft which are still prevalent along the Odisha coast. Kosala is in the upper valley of River Mahanadi region and the name of the boat comes from the fact that in ancient times the people of this region used these boats. Even now these crafts are used in the Rivers Mahanadi, Brahmani and Baitarani. The planks of padhua or Kosala danga were fasten by sewing. Similar type of fastening was known as carvel built. Kosala danga was joined by wooden pegs known as fish joinery. Coir and ropes made of palm leaf were used for fastening. Long shafts or bamboos were provided for further strengthening on both sides of Kosala danga and the shafts were known as pakhi. In shallow water bamboos and in deep waters oars were used for riding the craft. In the 17th century masts were added and it was then *sulupa*. In *Samar Tarangana,* Brajnath Badajena (Das 1993) has referred to this craft as *solapa*. These crafts were used in ancient Odisha for trade and commerce.

Pota (dugout)

Pota was directly scooped out from the log. As it was scooped out from the log, its durability is much greater than other traditional crafts. Its shape is like a long tub and its lower portion looks like a half circle. Pota is suitable to use in calm and shallow water. The local names of pota are Kathua, Nauka, Sapeidanga and Dengi. Generally pota is used in Ansupa and Chilika Lake region. Pota was also used in marine trade.

Other than seagoing boats, boats such as *Kusli* and *Patua* are found in the rivers of central and western Odisha. *Patua* is used for transporting cargo and *Kusli* for carrying cargo and ferrying. They differ in size but construction pattern is parallel. *Patua* is provided with a roof to shelter the cargo and the crew whereas the *Kusli* does not have the roof (Tripathy 2000). In addition to these boats mentioned in Odia literature, the other traditional boats, namely cattamaran (teppa), Nauka, Padhua (Masula) Patia, Salti, Sabado, Kusli and Patua ply along the Odisha coast in Chilika Lake, Bay of Bengal and rivers.

Cattamaran

The log rafts of Odisha are known as *kattumaran* in southern and *teppa* in northern Odisha respectively (McGrail 2003). *Cattamaran* (*kattumaram*), are prevalent from southern coast up to Paradeep in the north. In general, cattamaran is widespread from the coast of Odisha to Cape Comorin, Sri Lanka and beyond to Travancore coast except Godavari and Krishna deltas (Deloche 1994). Cattamaran is a long and narrow raft made of variable number of logs which are fastened together, manoeuvred by paddles (Fig. 7) and sometimes a triangular sail used. The middle log used to be the longer than others. Generally, light timber is preferred for catamarans which are positive in buoyancy and never sink. Locally available timber known as *Alibizzia* stipulate and *Erithryna indica* are used. The length of the catamaran ranges from 4 to 5.5 m and 3 to 5 people are engaged in each catamaran. By and large, a triangular sail and bamboo mast is used in catamaran. Vertical wash strake and accessory stem pieces give the craft a sharp break point above the general level. During fair weather, generally, catamarans go up to 8 to 10 km away from the shore for fishing and they are best suited to the surf beaten beaches. There is no seasonal bar and they are able to draw away from the coast without any danger.

Nauka* or *Danga

The flat-bottomed keel-less craft known as *Nauka* or *Danga* (Fig. 8) is the only traditional craft found in Chilika Lake and found suitable for the environment of Chilika. These crafts are used for carrying passengers, cargo and fishing and have the capacity to carry five to six quintals of cargo. *Nauka* is a clinker type of craft without stem, stern, ribs and frame (Rajamanickam 2004). It is a plank built craft, both wooden dowels and iron nails are used in construction, cotton is used for caulking however, it is not a sewn boat like *padhua*. Nails are used at every 15 to 20 cm and in some cases at

10 cm. Its maximum length, width and depth are 14.30 x 2 x 0. 75 m. The dimensions of different parts of the *nauka* are in accordance with the length of the lowermost plank. Local builders use traditional units of measurement such as hand, finger and feet. The planks are heated for certain time and care is taken to obtain the required shape, then they are fitted at the proper place. The method of planking of *nauka* is very simple. Planks are laid edge to edge and in some cases they are overlapped. In order to provide strength six thwarts are provided in the form of cross bars, and these thwarts pass through the gunwale planks. During sailing, masts and sail are used and oarsmen row the craft. Cabins cannot be mounted on these crafts because load makes it difficult to ply smoothly in the lake (Raut and Sila Tripati 1993). For centuries the traditional boat builders of Chilika Lake region have been involved in construction of *Nauka*.

Masula

The *Masula* traditional boat is also known as *Padagu, Salangu, Padava* and *Padua* in different coastal states. In Odisha *masula* boats are known as *padhua* or *padua* (Kentley 2003; Hornell 1920). This boat is easily distinguished from others because of its sewing methods. It is also different from others due to its building design and joining of wooden planks, zigzag pattern of stitching with coir and caulked with cotton, tar, etc. *Padhua* are the plank built boats ranges from 6 to 8 m or a little longer (Fig. 9). These are flat bottomed craft, without keel, and frame, stem and stern are more or less vertical. *Padhua* has neither mast nor sail and is rowed by rounded paddles while the helmsman steers the boat with a large oar attached to stern post. *Masula* are prevalent between the Odisha coast and Karaikkal (Deloche 1994). The general dimension of *padhua* is 8 m in length, 2.5 m in breadth and 1.5 m deep. The thickness of each plank is 5 cm. The dimension of different parts of *padhua* had to be in proportion to the length of the lower most plank. All the planks and the wooden shaft are stitched both on the interior and exterior. The *padhua* of Coromandal coast is similar to that of Sunapur (Hornell 1920). These boats are used for beach seining along the southern coastline up to Odisha coast and used during fair weather season. The builders of *padhua* are supplied with wood, preferably teak, by the local forest department. But due to scarcity and high cost of teak the builders prefer mango (*Mangifera indica*) and sal (*terminalia tomentosa*) which are strong and durable in sea water. Jamun (*syzyquim cumini*), nilgiri (*eucalyptus sp*), tamarind (*tamarindus indicus*), berry (*zizupus zizuba*) and casurina (*casurina sp*) are other types use for planking (Sila Tripati 1999).

The building activity of *Padhua* starts with the laying of the lower most plank. Two other planks are then sewed on to the central log. These planks are narrower at the fore and aft side. The construction of the bottom part is completed after sewing the three logs together. Afterwards, the stem post and stern post are stitched with the central log. Occasionally wooden chips are provided for further strengthening of the bottom. Planks are fastened edge to edge beginning from the bottom. There are no ribs or frame to reinforce the hull. Three planks are sewn with the hull on each

side. The lower most side plank is extended up to stem and stern posts, and bent near the stem to form the bow. The second side plank is sewed with the lower most planks, and the third plank joined with the second plank to reinforce the body of the *padhua*. Seven horizontal casuarina shafts of different sizes are tied across to the third plank to provide additional strength to the *padhua*. Four wooden pegs are tied to these casuarina shafts at four places where oars are tied for rowing. Another plank, tied to the horizontal shaft, is used for sitting. The deck consists of three planks stitched to the top plank of the stern which is meant for keeping cargo. During the European rule *padhua* carried man and cargo from the harbour to mother ship. Its carrying capacity is eight to ten quintals in terms of fish load. It is operated within 15 to 20 fathoms depth (Mohapatra 1986).

Patia

Patia (Fig. 10), the reverse clinker sailing boat, is found between Balasore, Bhadrak and River Subarnarekha, close to the border of West Bengal. Reverse clinker boats are also named variously such as *botala* and *danga,* based on their size, carrying capacity, etc. However, (Rajamanickam 2004) has suggested that *patia* and *botala* are identical. Generally, *Patia* are of three types, propelled by sail or oar used in the estuary; oared *patia* are used for beach seine-net fishing, and motorised ones for offshore fishing. Mostly, *patia* are built of sal wood and a thick coat of tar is applied on both, the inboard and outboard to protect them from worms. Because of cost and unavailability of sal wood, *patia* owners use other timber namely *babla*. *Patia* has been used along the coast of Odisha and West Bengal for centuries. The features of *patia* are not comparable with European boatbuilding, even the terms are different. The stern and stem are almost vertical. The length, width and depth of *patia* differ according to the size of the boat and these boats are seaworthy. Rectangular sails are used. Building of *patia* begins with lying of plank keel, and then a series of planks joined together, forming a hog. The hog runs beyond the keel and sweeps up to form stem and stern. The process of planking up continues until the eighth strake is fitted and fastened. Each *Patia* is made of 16 to 18 numbers of planks with varied thickness and dimensions. The width of the plank decreases as it moves to the stem and stern. Moreover, the planks are so shaped that planks are inclined upwards so that each plank overlaps the preceding one. Of 16 planked *Patia*, 12 lower planks are coupled and added in such a manner to get a close clinker structure with reducing width of plank at each joint while the remaining planks form sides of the last two at gunwales which are joined in carvel pattern. It is very difficult to ascertain since how long patia is being used in Odisha coast, the stone relief sculpture in the Jagannath Temple at Puri depicts a reverse-clinker boat; this suggests that the earliest evidence of reverse-clinker *patia* goes back to the 12th century AD in Odisha.

The *Chooat, Dinghy, Salti* and *Sabado* are carvel (Fig. 11); nailed plank built traditional boats used in northern Odisha. All these boats are propelled by sails, and dimension of these boats depends upon the size of boat which is generally made of sal wood. Rectangular sails are used for *Chooat*

and Dinghy and lug sail are used for *Salti* and *Sabado*. The *Chooat* and *Dinghy* are seaworthy and widely used 20 to 30 km from the shore during fair weather, whereas *Salti* and *Sabado* are also used in the sea during certain seasons, particularly between October and February when the weather is calm. During other seasons *Salti* and *Sabado* are used in estuarine regions (Rajamanickam 2004). All the traditional vessels of Odisha are driven by sails (triangular, rectangular and lug) oars and peddles. All these crafts are used between coastal zones to 15 to 18 fathoms of water depth. The other flat bottomed boats are *patilla*, *purgoa, malangi* and *holah*. These were used for loading and unloading cargo from mother boats anchored in the sea. Sometimes these were also used for inland waters. With the increase of trade and commerce in the 16th century, shipbuilding industry expanded and timber brought from the forests of Sambalpur, Cuttack, Ganjam and Balasore to meet the demand for boat construction.

Navigation Technology

The Indian Ocean has been the scene of varied activities of ancient explorers and maritime traders from the very beginning of recorded history. The experienced seafarers had much information about the sea pertaining to weather, winds, currents, waves and tides. The principal sources, which contain this information, are Sanskrit, Pali and Tamil literatures and archaeological excavations, numismatics and paintings.

Coastal Navigation

Small coastal vessels were put to sea only when conditions were favourable. Hence these vessels cast anchor at night and in dangerous circumstances. They were beached or sought refuge in the mouth of a river. If they were not aware of the features of the coast line or land marks, they did not set sail near the coast line. They were often threatened by the hidden reefs, sandbars and pirates. The ship's crew were dependent upon the captain's sense of orientation and knowledge of the coastline which enabled him to determine the boat's position in relation to a number of fixed points such as topographic features and identifiable land marks. These were often noted on old maps of India's coast. Buildings having conspicuous features served also as orientation point for example, the Konark and Puri temples on Orissa coast (Horsburgh 1836).

Open Sea Navigation

Sailing within territorial areas was possible through direct observation, without any instruments. But open sea navigation without the supporting orientation of landmarks, necessitated the use of specific procedures and instruments. It is likely that sailors in ancient period possessed precise astronomical knowledge and they navigated with an approximation in relation to the Sun's azimuth or the stars according to time and season. The position of ship was estimated with its average speed on the basis of experience and velocity of wind or the prevailing conditions of the sea. Tamed birds were kept on deck as land finders to indicate the coast. Ancient texts emphasise the skill of the pilots, their nautical

experience and knowledge of the conditions of the sea and the changes in the behaviour of wind and water. It seems that in ancient times there was significant progress in nautical science (Mookerji 1912).

Ancient knowledge of currents

The *Satapatha Brahmana*, (Eggeling 1982-1900) of the later Vedic period, provides some ideas about the circulation of oceanic water. The text mentions, 'The Ocean flows round this world on all sides'. Eggeling comments about turning to the right i.e.; from east to south following the course of the Sun. An examination of the above passage reveals that it refers to the southwest monsoon, which lasts from May to September. During this period the general flow of the current is from east to south. *Aryasura* in the Jatakamala of 4th century AD differentiates waves from currents and terms the latter as *salila*. It is interesting that seafarers were aware that there are three physical phenomena in the ocean: tides, currents and waves. By observing fish, the colour of water, birds and rocks the mariners knew how to determine in which area of sea they were sailing. If a sailor threw a handful of sand or shell and feathers into the calm sea, the drift of the feathers on the surface and the sinking of sand or shell in the sea would provide an estimate of the speed of the current. On the basis of speed of current sailors decided their anchorage off the coast. Many early practices are still surviving on the eastern coast of India.

Ancient knowledge of wind

The *Buddhist Jatakas* and *Jain Canonical* literature (Jain 1984) refer to ships moving by force of wind *Pavanabalasamahaya*. The masts of ships depicted on the Satavahana coins testify to the use of wind in oceanic navigation during the early centuries of the Christian era. As ships could set sail only with a favourable wind, ancient voyages had necessarily to be timed according to season. For the Bay of Bengal, the force of the wind is a predominant factor. The seasonally reversing winds are almost consistent during the monsoon period. However, a number of weather disturbances occur during the pre-monsoon, monsoon and post-monsoon periods. The problem of studies related to the circulation is whether the large scale mean wind field remains as the factor controlling the circulation or the local dynamics control and affect the whole system during such weather disturbances (Leemaa and Bunker 1978).

Sailing seasons

The seafarers had a fair amount of knowledge of the monsoons. The ports of the East Coast of India were exposed to the Bay of Bengal and the climatic conditions of the Bay are crucial in determining sailing in and out of these ports. Sailing was carried out north and south along the coast and eastwards across the Bay. Communities of mariners, pilots and merchants acquired a vast knowledge by generations of sailing.

The people of the east coast of India took a route along the coastline and went up to Sri Lanka. Subsequently, with the help of the equatorial current, they proceeded towards Java. Hiuen Tsang took this route for his return journey to China. The timing of the journey was also related to the route. While returning through the same route the seafarers of the east coast of India had to consider two factors, viz. the direction of the wind and the movement of the water for their journey. During the period from June to September, the southwest monsoon wind blowing from southwest naturally helped a ship to return from Sri Lanka to Tamil Nadu, Andhra, Orissa and Bengal. Similarly, from November to February, the monsoon winds blowing from the northeast helped the ships to sail from the East Coast to Sri Lanka for overseas trade. Just as the Arabs had a thorough knowledge of the winds and currents of the Arabian Sea, the sailors of the East Coast of India had expert knowledge of the Bay of Bengal. To sum up, the knowledge of sailing, wind, current, seasonal monsoons, etc. helped the mariners of India to nurture a rich maritime heritage for centuries together.

Navigation and fishing methods depend upon the physical structure of the coast. The East Coast of India has wide surf beaten shores and sandy beaches while the West Coast is full of rocks, reefs and sandbars. The navigators possessed sound knowledge of wind, wave, current and tides. The mariners of India had knowledge of eight types of winds, which are seasonal. The influence of the moon on the tides was known to most of the fisher folk. Current is known by various names in different parts of India by the fisher folk. Fishermen predict a cyclone a day or two in advance if dark clouds are seen in the northeast or in the northwest. Particularly, cyclones are expected if jellyfish are entangled in the nets. The sound of breaking waves in the near shore region is also an indicator of a cyclone. Cyclones are also predicted if crabs or tortoises float and heads of fish are seen on the surface of the water (Per. Comm. with fisher folk of east and west coast of India).

Small coastal vessels were put to sea only when conditions were favourable. They cast anchor at night and in dangerous circumstances, they were beached or sought refuge in the mouth of a river. If they were not aware of the features of the coastline or landmarks, they did not set sail near the coastline. The hidden reefs, sandbars and pirates often threatened them. The ship's crew was dependent upon the captain's sense of orientation and knowledge of the coastline, which enabled him to determine the boat's position in relation to a number of fixed points such as topographic features and identifiable landmarks. These were often noted on old maps of India's coast. Buildings having conspicuous features served also as orientation points, for example, the Konark and Puri temples on Orissa coast, the shore temple of Mahabalipuram and Vivekananda Rock in Tamil Nadu, Girnar Mountain on Gujarat coast, etc (Balakrishnan *et al*. 2002).

Sailing within the territorial area was possible through direct observation, without any instruments. But open sea navigation without the supporting orientation of landmarks, necessitated the use of specific procedures and instruments. It is likely that sailors in ancient times possessed precise astronomical knowledge and they navigated with an approximation in relation to the Sun's azimuth

or the stars, according to time and season. The position of the ship was estimated from its average speed on the basis of experience and velocity of wind or the prevailing conditions of the sea. Tamed birds '*Disha Kaka*' was kept on deck as land finders to indicate the coast. '*Disha Kaka'* is also seen on Mohenjo-Daro seals. Ancient texts emphasise the skill of the pilots and their nautical experiences to know the conditions of the sea and the changes in the behaviour of the wind. Boats were not only engaged for transportation of cargo, crossing rivers, lakes and pleasure trips for noble people but also for warfare. The art of employing boats and ships for military purposes was known in India since the Early Historical Period.

Discussion and Conclusions

The water transportation system is not only found within the rivers and channels, but also expands in the seas and oceans. Boatbuilding is as old as the maritime trade of a country. Evidences regarding the origin of traditional boats of India in general and Odisha in particular and their prototype are not available therefore it is crucial to trace the history. The structure and design of the traditional boats of Odisha as well of other parts of India seem to have been in existence in the present form for several centuries. Along the Indian coast different types of traditional boats have been recorded and those are because of nature of seabed topography, wind and current pattern, however, it appears to be more complex, therefore a systematic study and documentation is essential. To know exactly the differences among the traditional boats of a region boat builders should be interviewed. As a result, it is essential to study the ethnological details of traditional boats. However, in the recent past in the absence of availability of raw material and advancement of technology, wood is slowly being replaced by fiber or synthetic material and sail and oar replaced by outboard engines. Traditional boats of Odisha coast can be divided into two major geographical regions. Crafts of southern and northern coasts of Odisha signify variety of boats in different names. In northern Odisha coast the major boat types is reverse clinker *Patia* then the flat bottom boats. *Cattamaran* and *padua* are two major boat types in southern part of Odisha coast. The traditional boats of Odisha, Bengal, Andhra and Tamil Nadu coast look similar but sometimes their planking and caulking differ because of changes in seabed topography and environment. This phenomenon has been observed commonly all over the world. For example *masulas* are subdivided into groups, according to their function, strake sewing, wadding and sewing pattern. The traditional methods such as carvel joint, *vadhera* joint, caulking, etc. which have been practiced for centuries could be considered indigenous unless some new evidence comes to the fore. It is not only those traditional boats were featured in fishing, maritime trade, etc. but also in folklore, tales and social festivals varieties of boats are given prominence. For instance in the *Kartika Purnima* festival of Odisha different types of boats made of banana bark, paper, pith are set afloat, remembering the maritime past of the country. It is not that traditional boats plied only in the seas and lakes, but some boats also plied in the rivers and it is critical that the existing evidences should be studied to differentiate

between river and seagoing ships. The development of technology and Industrialisation led to desertion of some of the ancient ports, as a result of construction of traditional boats reduced; the use of fiber and synthetic products in construction and repairs and traditional materials and inherited knowledge is disappearing. However, very limited number of traditional boats is continued to be used in either estuary or in coastal waters. Before losing them completely, the remaining evidence and navigational skills should be documented. Similarly, the ports of Odisha as well as others along the east coast of India had trade and cultural contacts with Southeast Asian and other countries, so it is critical to understand and make a comparative study of the traditional boats of east coast of India and Southeast Asia. The study of traditional boats is highly imperative because it provides a baseline for historical research such as in the field of maritime archaeological, water transport and overseas contacts backwards from today.

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Fig. 1



Fig. 2

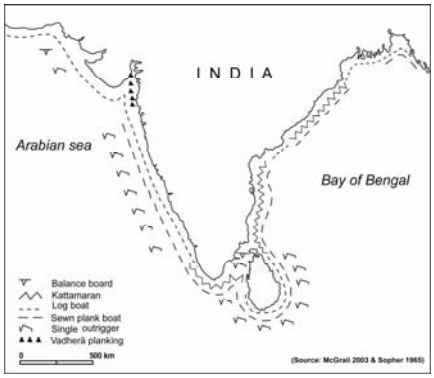


Fig. 3



Fig. 4



Fig. 5

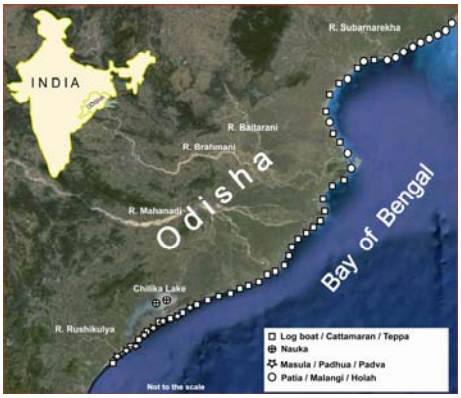


Fig. 6



Fig. 7



Fig. 8



Fig. 9



Fig. 10

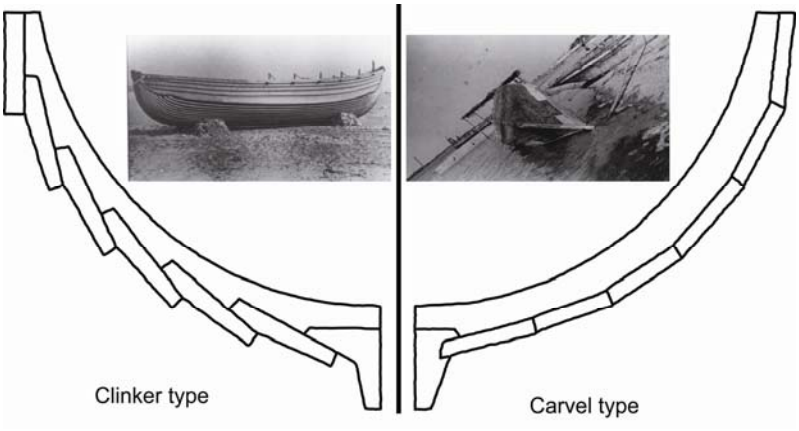


Fig. 11