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ON THE *DOL* NET OPERATION AT VERSOVA, BOMBAY

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ABSTRACT

Mechanisation of the crafts and use of synthetic materials for net fabrication have brought considerable changes in the structure and operation of *dol* net at Versova, Bombay. The structure of the *dol* net, its setting and hauling procedures as practised at Versova are described. The important procedure of spike-driving and use of various ropes for the construction of sus are described. The fishermen at Versova use three different cod ends according to availability of the different fishes and have co-operative practice of sharing a boat for transporting their catches to the landing centres.

iNTROUCnON

One of the most important fishing gears used traditionally for capturing Bombay duck along the Bombay-Saurashtra region is the *dol* net. Various workers (Pillai, 1948; Setna, 1949; Hornell, 1950;Gokhale, 1957;Ramamurthy and Muthu, 1969) have described the structure and operation of this net. Although Setna (1949) first recognized the ingenuity of the Bombay fishermen in setting and operating the net in the waters of Bombay and described some details of setting, operating and pile driving of both *sus* and *khunt* types, there have been quite a few changes in the operation and setting of the net over the past 35 years particularly at Versova. Mechanization of the fishing craft and use of synthetic fibres for the nets and ropes were mainly responsible for these changes.

Prior to mechanisation of the traditional craft (Versova type boat -FAO), which began in 1957 at versova, the *dol* nets were operated at a maximum depth of 20-24 metres within the visible limits from the shore. With mechanization of the crafts the fishermen have been setting their nets at greater depths as much as 40 metres, off Versova. The synthetic material polythelene, for net fabrication was first introduced in Versova in 1965 and due to its durability, light weight and easy manoeuverability, it has almost replaced the earlier cotton twine nets, which were heavy, cumbersome and required time-consuming tanning procedures. Similarly earlier coir ropes have been largely replaced by the polythelene ropes for the construction of *sus* and the net. The operation of the net in deeper waters, made possible by mechanization, the use of synthetic fibres for nets and ropes which are more buoyant due to their low density, have brought about changes in operation and setting of the *dol* net. The present paper thus describes this changed pattern, giving the details of the net, operation and setting procedures of the net as practiced at Versova, a major fish landing centre of Bombay.

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THE FISHING GROUND

The fishing ground at Versova is not a single uniform area and the fishermen set their nets at various depths in parallel rows. Broadly, there are three fishing areas depending on the depth. These are considered traditional, and outsiders are generally prevented from operating their nets. The fishermen select the depth of operation according to the sea-going capacity of their craft and the number of nets to be operated. The details are given in Table 1.

Generally, at the beginning of the fishing season which starts in the middle of September, most of the boats operate their nets at shallower depth as the catch include sizeable; quantity of penaeid prawns (Ra jan *el* a/.,1982). But as the prawn catches decline the fishermen go to their respective *sus* for the operation till the end of the season in late May or early June when monsoon begins and fishing activity is called off.

FISHING FROM SUS

At Versova the *dol* nets are tied in the sea to the fixed structure made from the ropes called *sus* unlike the *pylons* as described by Setna (1949) in Karanja-Revdanda region, where the nets are tied to long wooden poles. Th *sus* is fixed by means of ropes to spikes driven into the bottom of the sea and not to heaps of stones as described by Gokhale (1957) in Saurashtra region.

TABU 1. Details *of size of boat, depth of operation, number of nets and crew strength*

Overall length of boat	Engine power (H.P)	Depth of net operation (m)	No. of nets used	No. of crew required
6.5-8	5-25	10-20	2	3-4
10-13	30-35	10-32	2-3	5-6
13-17	50-100	30-40	3	7

Before the introduction of synthetic fibres, the spikes were fixed and *sus* were constructed every year at the beginning of the fishing season and cut off by a special device called *dateri* as described by Gokhale (1957). Since the synthetic ropes are durable, now fishermen retain at least two ropes attached to the spikes and use the same sus for 6-8 seasons.

SPIKE DRIVING

The spike-driving operation requires spikes, iron chains, wooden barrels, plastic jerry cans as floats, anchors, wooden logs (for *musal, gorkhan* and *chova)* and ropes of various diameters and lengths cut appropriately according to the depth of the water at spike-driving site in the sea. Although only two boats are required for actual spike driving operations, generally three to four boats carry this material with a crew of 7 members on each boat including the expert spike-drivers.

Spike: Spike is a wooden log of coconut or palm tree 2.75 to 3.75 m. in length with shape as shown in Figure 1 or 3. The upper part of it is cyclindrical with a diameter of 15 cm and roughly 40-45 cm in length. This part should fit in the iron socket of *musal* The lower part is flat with tapering pointed end. Between the upper cyclindrical part and lower tapering end lies a deep groove in which the ropes are tied. Prior to 1975 the spikes were not grooved but had a hole through which a wooden crossbar was passed. Locally, the spike is known as *phata.*

Musal: It is a long wooden pole formed by joining several wooden units by bolts and ropes. The lowermost log is of strong heavy wood and bears an iron socket which is about 1 m in length and with inner diameter of 15 cm. This socket fits over the cyclindrical part of the spike. The total length of *musal* is adjusted in such a way as to maintain a ratio

of 1:1.25 with the depth of water where the spike is to be fixed. The *musal* is generally hired as this is used only in driving the spikes.

Chova: This is a single piece of wooden log 6-8 m in length and 25-40 cm in diameter. This strong log is tied across the two boats which participate in spike driving, leaving a gap of 1 metre between the gunwales.

Gorkham: It is a small peice of wood 1.75 m to 2 m in length attached to the boat, around which the iron chain is wound during spike driving.

Iron chains: Two iron chains are used; one is 4.5-5 m in length and 7-8 cm in diameter, at one end of which is a strong iron ring 12-15 cm in diameter. This chain and the ring are strong enough to bear the entire weight of the two boats. The other chain which weighs about 100 kg, merely acts as a sinker for the *musal.* It is wound round the lower-most part, just above the iron socket of the *musal.*

Anchors: Four grapnel type anchors are used each weighing 60-70 kg. Anchors are tied to anchor-ropes called *adkai* which are 200-300m in length.

ROPES USED IN SPIKE DRIVING

Dupota: It is a strong rope 16-20 mm in diameter, sometimes made from the old net webbings. There are two *dupotas* each passing around from the bottom of boats and tied to *chova.*

Samai: These are two ropes tied to the top of *musal.* They are used in lifting the *musal* upright before it is lowered to the bottom.

Budya: These are also two ropes tied to the lower end of *musal* near the heavy iron chain. These help in lowering the *musal* and also lifting it when the spike has been driven. In case of accidental breakage of *musal* it helps in recovering it.

Patta: This is loosely tied around *chova* and *musal* and steadies the *musal* in relation to the boat's movements.

THE SPIKE DRMNG PROCESS

The spikes are driven into the muddy bottom of the sea at neap tides when currents are generally weak. After reaching the place for spike driving, correct depth of water is measured and one boat casts 4 anchors in 4 directions at about 200-300 m distance. The position of each anchor is indicated by a plastic jerry can attached to the anchor by a long rope. The two boats are linked by *chova* tied across them leaving a distance of 1 metre. The 2 ropes *samai* are tied around the *musal* at upper end of the other two *budya* to the lower end. Now the upper cyclindrical part of the spike is inserted into the iron socket and a strong rope is doubled around itself and fixed in the groove of the spike by clove

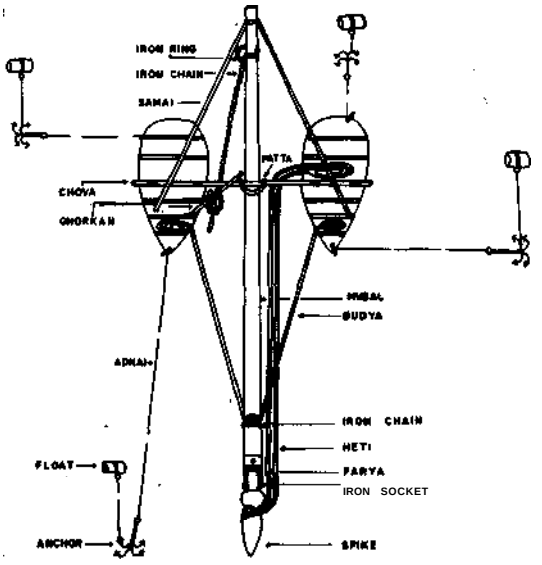
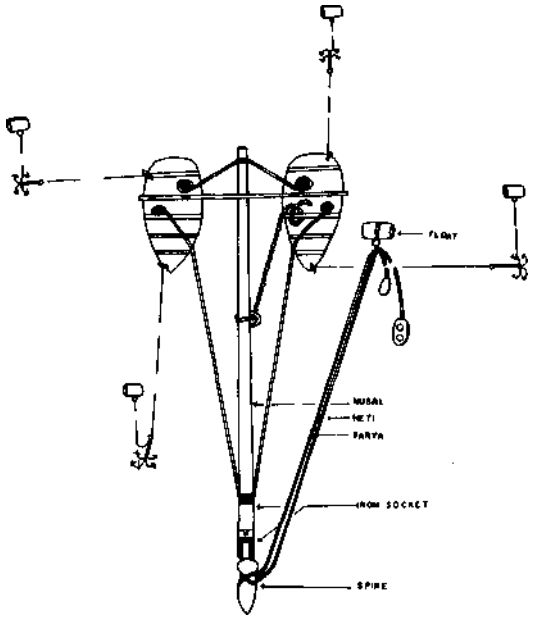


FIG. 1. Method of spike driving.

hitch. The length of this rope is maintained in such a way as to have a ratio of 1.8:1 with the depth of water. The two ends of this rope now called *farya* and *heti,* are temporarily tied by a small weak rope to the *musal* so as to prevent interference of these ropes while the spike is being driven. These ropes also secure the spike. Before the *musal* is made upright, few metres of *heti* and *farya* are paid into the water in such a way that if the *musal* is made upright it should remain at least 5-6 metres above the sea bottom. Now *heti* and *farya* are tightly secured to the beam of the boat and they are attended by one of the crew members. The rest of the crew now lifts the *musal* with the help of *samai* and makes it upright. It is loosely tied to *chova* by a small rope *patta.* Now the entire weight of *musal* lies on *heti* and *farya,* and *samai* and *budya* only keep it upright. When the expert is satisfied about the exact uprightness of the *musal* he orders the crew attending the *heti* and *farya* to release these ropes. Due to sheer weight of *musal,* iron chain and the iron socket the spike gets driven at least 1-2 metres into the bottom mud. Now one end of 5 metre long iron chain with the ring is slipped round and fixed at the top of the *musal.* The lower end of the chain is passed below the *chova* and looped 2-3 times around a small wooden bar, the *gorkhan.* The *gorkhan* is free at one end whereas the other end is tied firmly to one of the boats. The arrangement of these wooden logs and the chain is shown in figures 1 and 2.

As the boats ride over the crest of a wave the chain loosens and instantaneously the crew attending to *gorkhan* further winds the chain around the *gorkhan* so as to make the chain taut. Immediately when the boat goes into the trough after the wave, the tautness of chain coupled with fall of the two boats exerts a powerful downward thrust to *musal* which pushes the spike deeper. This process continues until the spike goes 5-6 metres deep into the bottom mud. The process of rolling of the chain is sometimes hazardous, as a careless worker could loose his fingers between the chain and the wooden *gorkhan* on which the entire weight of the boat falls. The operation of spike driving, although basically similar to the *pyale* - driving described by Setna (1949) differs in the elimination of pulley and the substitution of ropes by the iron chain.



Fic. 2. Method of detaching *musal* from spike.

After the spike is driven to the desired depth, the *musal* is detached from the spike and brought aboard though not so effortlessly as mentioned by Setna (1949), by reversal of the procedure employed in driving the stake. The iron chain is now detached from the top end of the *musal* and tied to its lower part. The other end of iron chain is looped around the beam of the boat. The crew members in the two boats pull the

budyas, tied around lower end of the *musal* (Fig.2). Once again the advantage of the surge and recession of the waves is harnessed, but now for pulling the *musal* upward. During the pulling operation *heti* and *farya* are tied to wooden barrels with little leeway so that the float would indicate the exact location of the spike in the ground. Now the anchors are lifted and the boats go across the current direction and once again repeat the process of spike driving for the successive spikes. The spikers required for one *sus* and the distance (40-50m) between the spikes varies inversely with the depth, higher the depth lesser is the distance. Normally, six spikes are fixed in a row for the operation of three nets (Fig. 4). The distance between the spikes of the adjoining *sus* is 2-3 metres. The entire process of spike driving for three nets involves one day's full work.

ROPES AND KNOTS USED FOR SUS

Sus : This frame of ropes fixed to the spikes from which the net is operated is like a fixed station in the sea. The operation of *dol* net entirely depends on the size and thickness of various ropes. Fishermen take advantage of size and thickness of ropes to identify them during night as pulling of the right rope would enable them to set or haul the net. Each rope has a specific purpose and function and therefore each of them has an individual name such as *Farya, Heti, Khalya, Toran, Balan, So, Era, Vaool, Chalani* and *Dupota.* Cokhale (1957) rightly pointed out that although a number of ropes are used none of them is superfluous.

All these ropes are strong and knotless. The thickness and the length of them, however, may change according to the size of the

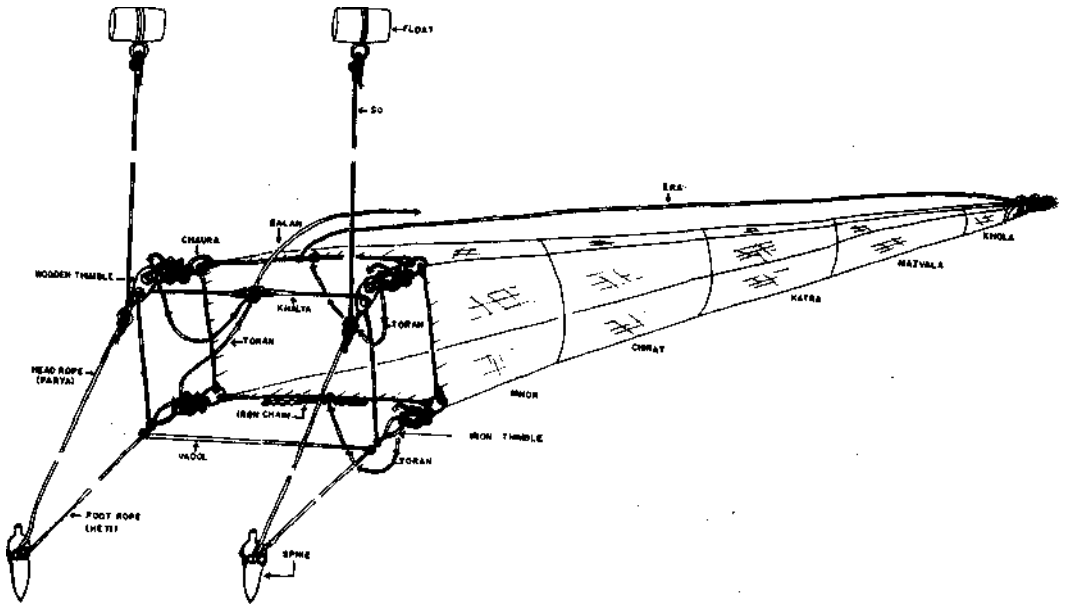


FIG. 3. *Dol* net with all its accessories in position.

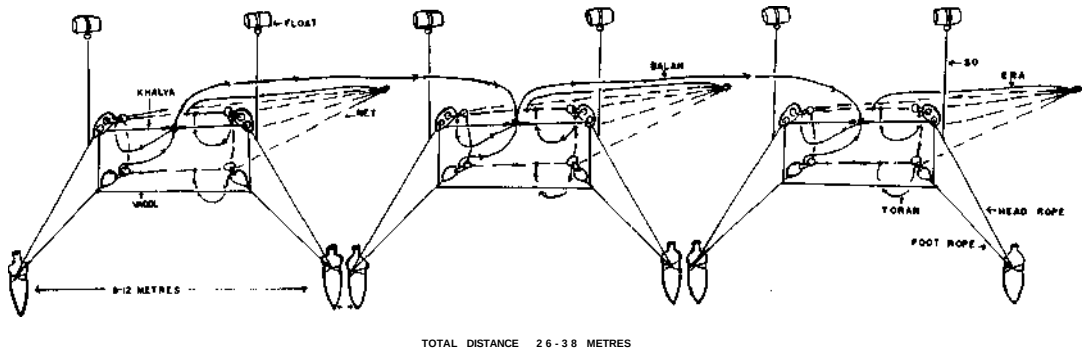


FIG. 4. General lay-out of three *id* nets shot by one boat.

net and the depth at which the net is used and also on the craft used. In general, thicker and stronger ropes are used for the nets operated in deeper water.

Farya and Heti: As mentioned earlier, these are the two ends of a single rope tied around the spike by clove-hitch. *Farya* is longer than *heti* by about 2-4 metres. *Farya* and *heti* of both the spikes secure the four corners of the *sus,* both *faryas* tied to the upper corners and *hetis* to the lower corners. These four ropes, besides securing the *sus* and the net attached to them also have to bear the drifting force of the net as well as of the boat and the floats. Therefore they are stronger. Their length as explained earlier is dependant on the depth of the water. The *farya* and *heti* of two sides are tied around the grooves of the wooden and iron thimbles respectively as shown in Figure 3. These thimbles locally known as *timlee* are oval shaped about 30 cm in length and with 4 cm deep groove around the circumference and two holes on the flat sides. They not only prevent abrasion of ropes but also give buoyancy and sinking ability to *farya* and *heti* respectively.

Khalya: These are two ropes one on either side of the *sus* and joined in the middle by eye-splicing. Their lower ends are tied to the iron thimble and upper ends pass through the wooden thimble. Each *khalya* is about 45 m in length.

So: The upper ropes of the *sus* are prevented from sagging by two large wooden barrels tied to *khalya* on either side by two vertical ropes called *so.* It helps in adjusting the depth of operation of the *sus* and accordingly the net can be operated at surface or at bottom. The length of this rope is also determined by the depth of water and usually a ratio of 1.5:2 is maintained.

Chalani: It is a long rope about 75-80m in length and 14-20 mm in diameter. It is tied at one end in the centre of *khalya* and its other end is used for tying the boat to the sws at the time of hauling of the net.

Vavool: This rope is tied to the two foot ropes, *hetis,* by rolling hitch near the iron thimble. It is 45-50 m in length and gives additional support to *hetis* (Fig.6).

Toran: These are four ropes used for fastening the net at the four corners of the *sus* in such a way that the entire net can be detached from the *sus* at the hauling. Each *toran* is about 50 mm in length and almost

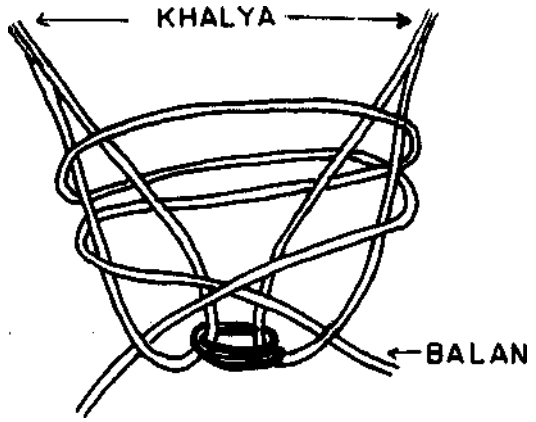


FIG. 5. Attachment of knot by *balan* to the *khalyas.*

permanently tied to the corner rings or *chauras* of the net. The diameter of *toran* is not uniform throughout the length. The proximal 6-10 metres is thick, with 16-20 mm diameter whereas the rest 40 metres is 12-14 mm in diameter. Of the four *torans* two of one side are joined at the centre of *khalya* by clove-hitch, the other two being tied separately to the centre of *farya* and *heti* of the net (Fig. 3). Each of the four *toran* is tied separately to the thimble by a slip-knot so that when all the *torans* are pulled the net gets completely detached from the *sus* (Fig. 7).

Era: It is used in tying the cod-end of the net (Fig. 3).

Balan: The successive *sus* are connected by a rope called *balan.* It is tied at the centre of *khalya* by double-reef-knot. The length of this rope is 50-60 m and it helps the boat from going one *sus* to the other (Fig. 5).

OPERATION OF THE NET

The operation of *dol* net involves setting the net at *sus* and hauling it for removal of catch. The structure of the present day *dol* net of Versova is essentially same as that described by Setna (1949) and Gokhale(1957) consisting of five parts with successively smaller mesh sizes and decreasing numbers of meshes. Table 2 shows the dimensions of the different parts of the net and their mesh sizes.

The net is mounted on 4-5 plies of 4 mm ropes running throughout the margin of the net and leaving a hanging co-efficient of 0.5%. At the four corners of the rectangular net there are corner rings called *chaura* through which the net is fastened to the *sus* by means of slipknots (Fig. 7).

Setting of the net

At the fishing ground, the boat locates its *sus* by means of floats which have a symbol or name inscribed on them. An extreme float of the *sus* is caught by means of a noose of a rope and the rope tied to the float, the *so,* is pulled by the crew until centre of *khalya* where *balan* is also tied, is reached. Now, the crew is divided into two groups and they pull *Khalya* on either side in order to *get farya* (headrope) and *heti* (foot rope) of both sides of the sws. *Farya* and *heti* are temporarily tied by a small rope to the boat. The cod end of the net is tied with one end of *era* by rolling hitch and the distal three-fourth portion of the net is re-

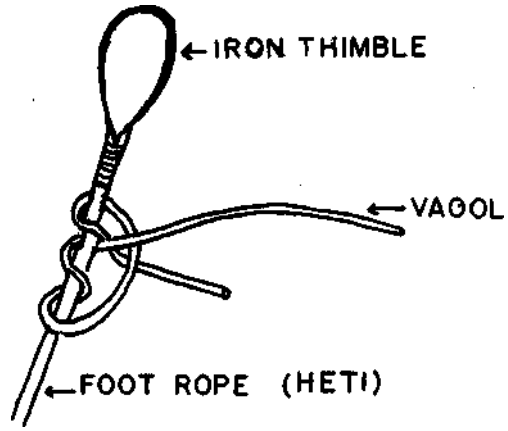


FIG. 6. Foot rope with iron thimble and *vaool* rope

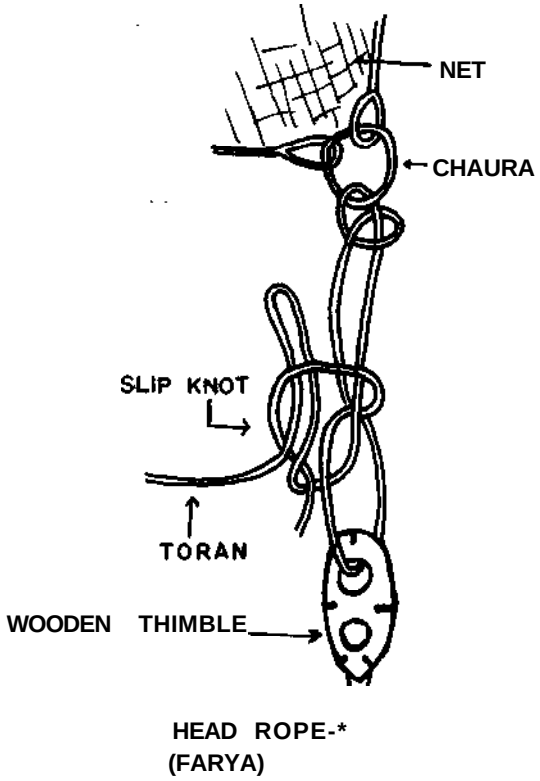


FIG. 7. Slip knot between head rope and *chaura* of net.

leased into the sea. The mouth of the net is twisted around a wooden peg on the gunwale and four corner rings. *Chauras* of the net are tied to the thimbles *oifarya* and *heti* by *toran* by means of slipknots (Fig. 7). The other end of *era* is tied to the centre of *farya* by clove hitch and now the rest of the net is paid into the sea which drifts for sometime and then the mouth of the net opens due to tidal current. The height of operation of the net is adjusted by the length of so. With the help of *balan* tied between the successive *sus* the boat moves to the second sws where the same procedure is repeated for setting the second net.

After all the three nets are set the boat remains stationary at the *sus* and it is tied by *dupota* to the so and by *chalani* to *khalya* of the last net. The setting of the three nets takes nearly one hour.

Hauling of net Hauling of net starts nearly 1-1.5 hours before the tide turns. It means the net remains set 3 to 3.5 hours. However, it varies from 2-4 hours depending on the tidal force existing at the place. The hauling begins with pulling up of *dupota* and *chalani* to obtain *khalya* where the pair of toraH is fastened with the net by clove hitch. When the distal end of *toran* is pulled with a jerk the slipknot, the *sus* holding the net is released. The head rope and foot rope of the net are collected by the crew members which yield lower pair of *toran* which when pulled with jerk completely releases the net from the *sus*. Now all the four corners of the net are pulled aboard and the crew starts drawing the net inside the boat. The pre-cod end is tied temporarily and the cod end lying in the water is hung to the stern by twisting it around a wooden peg. With the help of *balan* the boat then goes to another net and hauls its cod end. When all the three cod ends are collected the catch from them is removed by means of baskets. The catch is sorted out while removing from the net and quality fishes such as pomfrets, ghol, catfish, eels and other large sized fish are kept in ice and stored in insulated boxes. The rest of the catch, consisting of Bombay duck and non-penaeid prawns, is put on in smaller bamboo baskets.

Selective use of cod end

At Versova fishermen make use of different cod-ends with mesh size varying from 10 to 40 mm. The cod end with 30-40 mm mesh size is called *par* which is used when large sized fish, including Bombay duck are available. Cod end with 10-12 mm mesh called

TABLE 2. *Details of various sections of the Do\ net*

Part of the net	*Mohor*	*Chirat*	*Katra*	*Mazvala*	*Khola*	*Par*	*Ambadpar*
Average length	11	13	13	16.5	5.5	5.5	5.5
Mesh-size from beginning to the end of that part (mm)	350 - 280	260-130	130-140	40-12	12	30-40	25-30
No. of meshes	1065 - 890	890-870	870-850	850-400	400	200	250
No. of creases between meshes	-	2	3	8	-		
Polythylene twine size (mm)	1.5	1.0	1.0	1.0	1.0	1.25	1.0

khola, is used for small-sized non-penaeid prawns, *Acetes* spp. A *par* with 25-30 mm mesh called *ambad par,* is generally used from March to June when *Nematopalaemon tenuipes* is abundant. The selective use of *ambad par* enables filtering off of smaller *Acets* spp. also abundant in the same period, which otherwise block the cod end causing eddies. Another reason why fishermen do not prefer a mixture of *Acetes* and *N. tenuipes* is that their mixture fetches lower price than N. *tenuipes* alone.

Thus for Bombay duck, penaeid prawns, ghol, *Coilia, N.tenuipes* etc. generally a *par* is attached to *mazvala* and the net is set at bottom; whereas for pomfrets, scerfish, chirocentrus and other pelagic clupeids the net is set at surface by adjusting the length of *so.* A cod end with 10 mm mesh *khola* is used only when no quality fish, including Bombay duck is available and therefore in order to get at least *Acetes* sp. the smaller mesh is used. This indicates that the fishermen use the different cod ends with varying mesh sizes to regulate their catch.

Transport of catch from the sea

At Versova, boats operating nets at 20-25 metres depth bring their catch every day and this consists normally of two but rarely of three hauls. By and large these boats bring their own catch, as the time required to reach the landing centre from the fishing ground is about 2-3 hours. The boats operating in deeper waters (depth-30m) take at least four hauls and instead of bringing each boat's catch separately, the catch from 2-4 boats is collected and sent in one of the boats in separately marked baskets. Each boat from this group returns to the landing centre every three days to get fuel, water and provisions for the crew. This system of sharing a boat for transport not only saves fuel but also affords them more time for fishing. However, taking catch of four hauls in a single trip is quite deplorable, as rightly pointed out by Setna (1949), since the first two hauls turns to a highly decomposed state (paste of Bombay duck and non-penaeid prawns) by the time the boat returns to the landing centre. Since most of the catch of the nets consists of less

valuable non-penaeid prawns which are later sun-dried, the fishermen do not seem to mind having half the catch in decomposed condition.

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REFERENCES

GOKHALE, S.V. 1957 . Operation of 'Dol' net off Saurashtra coast. /. *Bombay. Nat. Hist. Soc.*, 54 : 714-725.

HORNELL, JAMES 1950. *Fishing in Many Waters.* Cambridge University Press, pp. 94-98.

PILLAI, T.V.R. 1948. Marine fisheries of Kodinar in Kathiawar. *].Jiombay Nat. Hist. Soc.*, 48: 47-61.

RAJAN, K.N., K.K. SUKUMARAN AND S.K. PILLAI 1982. On "dol' net prawn fishery of Bombay during 1966-'76. *Indian J. Fish.*, 29 (1&2): 29-36.

RAMAMURTHY, S. AND M. S. MUTHU 1969. Prawn fishing methods. *Bull. Cent. Mar. Fish. Res. Inst.*, 14:235-272.

SETNA, S.B. 1949. Bombay fishermen's ingenuity. J. *Bombay Nat. Hist. Soc.*, 41 : 340-368.