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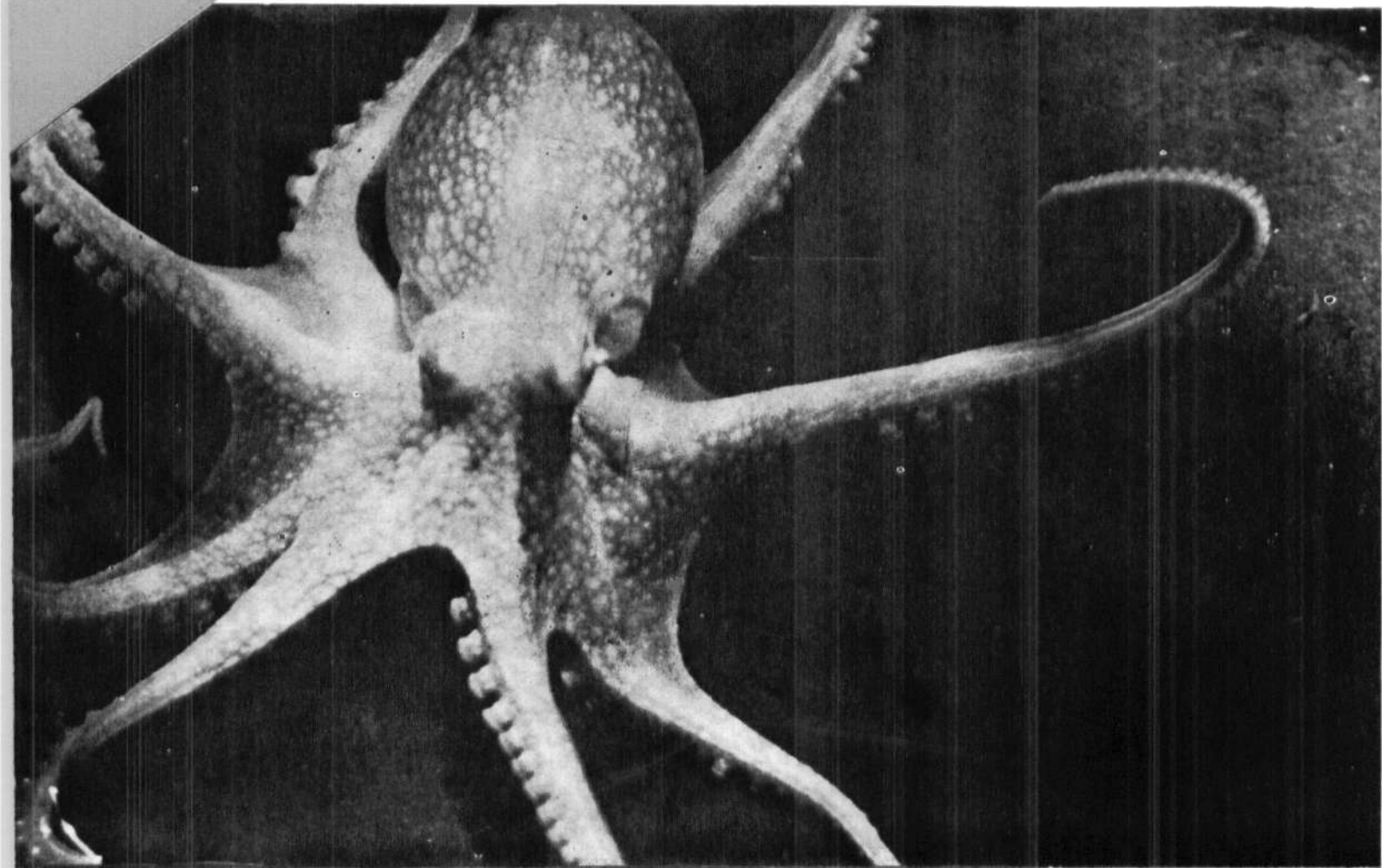
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CEPHALOPOD BIONOMICS, FISHERIES AND RESOURCES OF THE EXCLUSIVE ECONOMIC ZONE OF INDIA

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CEPHALOPOD PRODUCTION IN INDIA AND CONSTITUENT MARITIME STATES

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ABSTRACT

The fishing craft and gear in which cephalopods are obtained in India and the all India, statewise and east and west coast cephalopod production are presented. The bulk of the cephalopod catches is obtained along the west coast and trawl net accounts for major portion of landings. Maharashtra, Kerala, Tamil Nadu and Gujarat are the leading states in production.

FISHING CRAFT AND GEAR

The cephalopods have been obtained until the last two decades mainly in conventional gear such as shore seines, boat seines, fixed bag nets and hooks and lines operated from indigenous craft. With the advent of trawlers the trawl net has become an important gear in which cephalopods are caught in good quantities from a number of areas.

FISHING CRAFT

Catamaran

This is a simple age-old craft consisting of three to five logs of wood tied together in the form of a raft and operated by two to four fishermen. The crafts are used along the east coast from Orissa to Kanyakumari and extending upto South Kerala on the west coast for operating boat seines and hooks and lines.

Canoes

Different kinds of canoes such as dug-out canoes, plank-built canoes, flat-bottomed canoes and out-rigger canoes are used. Of these the dug-out canoes made by scooping out a log of wood are most common in

Kerala and Karnataka. The canoes measure 6.10-12.50 m in length and are used for operating boat seines and shore seines. In recent years a large number of canoes operating in Kerala are being fitted with out-board and inboard engines.

Plank-built boats

These are sturdy craft 6.5-13 m in length made of strong wooden planks. The shape of the plank-built boat varies in different areas in relation to the nature of the sea coast and conditions in the sea such as wave action and wind force. The boats are used in the northeastern and northwestern coasts for operating shore seines and boat seines.

Mechanised craft

There are over 18,000 mechanised boats in the country out of which about 10,000 are trawlers which do trawling mainly for shrimps. There is a continuous increase over the years in the fleet of trawlers in most of the maritime states due to the high returns from shrimp fishing and the financial assistance given by the Government. The trawlers are 6-13 m in length and fitted with 10-60 b.h.p. engines. In addition there are about 80 steel trawlers (23 m and above in length) with 90-300 or higher b.h.p. engines and refrigeration facilities which operate in offshore areas.

FISHING GEAR

Varied types of gear are employed in the commercial marine fisheries for the capture of pelagic and demersal species. Only in a few among those viz. the trawl nets, and the traditional gears shore seines, boat seines, fixed bag nets (*dol* nets) and hooks and lines squids and cuttlefishes are caught.

Shore seine

This is a beach seine with a conical bag net which is operated along both the east and west coasts of India. There are wide variations in the size and design of the net as in the case of *Sarini jal* of West Bengal, *Pedda vala* and *Alivi vala* of Andhra Pradesh, *Kara valai* and *Perla valai* of Tamil Nadu, *Kara vala*, *Kara madi* and *Kamba vala* of Kerala and *Rampan* and *Yendi* of west coast. The net is payed out from plank-built boats or canoes and dragged towards the shore by 20-30 or more men. Squids and cuttlefish in the littoral waters are caught in the gear. In the Ramanathapuram area on the southeast coast of India, a special kind of shore seine, the *Ola valai*, with split palmyrah leaves tied to the wings as flares to drive the squids into the net is used to capture the squid *Sepioteuthis lessoniana*.

Boat seine

This is a conical shaped bag net operated using two canoes or catamarans for pelagic fishes. Fairly good quantities of squids are obtained in this gear of different sizes known as *Iraga vala* of Andhra Pradesh, *Turi vala* of Tamil Nadu, and *Thattu madi*, *Kolli vala* and *Paithu vala* of Kerala.

Fixed bag net (Dol net)

This is a funnel shaped bag net either tied to stakes or kept in position by means of floats and sinker stones. The net is in horizontal position facing the tide and is operated for prawns and Bombay duck in the littoral waters where there are currents of appreciable intensity off Maharashtra and Gujarat.

Hooks and line

There are different types of hooks and lines viz, long line, trolling line, hand line and hand jigs in which the number and size of hooks, length of line and mode of operation differ. Although hooks and lines are operated in several areas along the east and west coasts of India for fin-fishes, cephalopods are obtained in large quantities in the gear only in southern Tamil Nadu and southern Kerala. In the latter areas apart from the usual type of hooks and lines, specialized types of hand jigs are used for catching cuttlefishes and also squids. One kind of hand jig consists of umbrella rib or iron rod provided at the end with two or more

circles of hooks tied in a grapnel manner. In Colachel-Vizhinjam area hand jigs with bait are operated by means of a long line which is tied to the jig and manipulated from a catamaran.

Trawl net

The trawl net which is operated for shrimps on a large scale in a number of areas off both the coasts of India is at present the gear in which large quantities of cephalopods are caught. Two or four seam trawl net with headline length of 7 to 27 m between upper wing ends and provided with otter boards of appropriate size and weight is the common trawl net used in India. In recent years trawling with bulged belly trawl, high opening trawl and outrigger trawl is also being carried out in certain areas.

Cephalopod production

Although squids and cuttlefish have been obtained as by-catch in indigenous gear such as shore seine, boat seine and hooks and line since very early times forming localised fisheries in some places, realising their importance as a potential resource, the Central Marine Fisheries Research Institute has started collecting statistics on cephalopod production in the country from 1959. During the period 1959-64 the estimated annual cephalopod production was low and varied from 93 t (1961) to 464 t (1964) (Fig. 1). As there was significant increase in the operation of indigenous gear as well as mechanised vessels doing trawling in later years, the annual production showed a rise to 951 t in 1966 and 1,636 t in 1968. With the demand for cephalopods for export the production more than doubled in 1974 and amounted to 3,677 t compared to that in 1968. The year 1975 was yet another landmark in cephalopod fishery when once again the production more than doubled (7,889 t) compared to the landings in the previous year. Then onwards the production continued to rise progressively in the succeeding years, reaching a maximum of 15,931 t in 1978. However, in the recent years, there has been a fall in landings to 15,032 t in 1979, 11,335 t in 1980 and 9,548 t in 1981. The fall in the All India production was due to a marked decrease in landings by 35-64% in Kerala and by 13-74% in Maharashtra in these years.

CEPHALOPOD LANDINGS IN MARITIME STATES

Data on cephalopod landings in the maritime states of India are available for a number of years. Fig. 1 shows the annual landings (including the offshore cephalopod catch in some of the states) in West Bengal,

Orissa, Andhra Pradesh, Tamil Nadu, Pondicherry, Kerala, Karnataka, Goa, Maharashtra, Gujarat and Lakshadweep for the period 1960-79, the statewide percentage contribution to the all India cephalopod production based on the annual average catch for 1960-78, the seasonal trend of the landings in each state derived from the average catch for the period 1968-78, and the gears in which the cephalopods were obtained in these states.

Among the major cephalopod producing states, Kerala has been ranking first, contributing 38.5% to the country's production during 1960-78, but it was relegated to the second place with 26.7% by Gujarat during 1979-81 accounting for 32.2%. Gujarat has improved considerably to this position from the fourth place with 11.9% of the production during 1960-78. While Maharashtra's share remained almost the same during the respective periods (19.2% and 19.1%), that of Tamil Nadu improved slightly from 14.1% during 1968-78 to 17.9% during 1979-81. Gujarat, Kerala, Maharashtra and Tamil Nadu together accounted for 92.2% of the total cephalopod production in the country during the period 1978-81. The fluctuations in the annual cephalopod landings in each of the maritime states are dealt with below.

WEST BENGAL

Up to 1967 the combined figures of annual cephalopod landings of West Bengal and Orissa are available and they varied from 1 t to 12 t. In later years cephalopods were not landed except in three years 1971, 1978 and 1980 when the annual production amounted to 82 t, 30 t and 4 t respectively (Table 1, Fig. 1). Cephalopods formed 0.1-0.9% in the total marine fish production of West Bengal and the state contributed less than 1% to 5.4% to the country's cephalopod production.

ORISSA

Unlike in West Bengal, cephalopods were caught in small quantities in Orissa during the years 1968-79 and the annual landings varied between 2 t (1969 and 1975) and 27 t (1976). In 1980 the production was much higher, 98 t, and there was a decline in the landings to 57 t in 1981. In the annual total fish production of Orissa, cephalopods formed less than 1% and the state's contribution to the annual cephalopod landings of India was less than 1% to 1.2%.

ANDHRA PRADESH

The cephalopod production of Andhra Pradesh fluctuated between 1 t (1960) and 10 t (1968) during the period 1960-69. The highest production of 663 t was obtained in 1970. In the later years, 1971-76, there was decline in catches. During the years 1977-81 the annual landings varied between 297 t and 523 t with the highest landings of 523 t and 512 t in 1979 and 1981. The cephalopods constituted only less than 1% in the State's annual fish production. The state accounted for 0.2% (1960) to 56.0% (1970) in all India cephalopod production during 1960-70 and 1.9% (1975) to 7.6% (1971) during 1971-81.

TAMIL NADU

Tamil Nadu is the leading state in cephalopod production on the eastcoast of India accounting for 6.5-37.4% of the country's production during 1975-81. The landings were low during 1960-67 ranging between 2 t and 195 t. In the period 1968-74 there was a rise in the catches reaching a maximum of 955 t in 1974. The highest annual landings of 2,953 t were obtained in 1975 and in the later years, 1976-81, the production varied between 1,042 t (1978) and 1,903 t (1979). Cephalopods constituted 0.1-1.3% of total marine fish production in Tamil Nadu during 1960-81 and the state contributed 2.1-38.1% to all India cephalopod production during the same period.

PONDICHERRY

The annual cephalopod landings of the state varied between 9 t and 58 t during 1968-75 and in the subsequent period, the highest catch of 211 t was obtained in 1976. Thereafter the catch dropped to 36 t in 1978. The landings formed up to 2.1% of total marine fish production of Pondicherry and the state accounted for 0.2-3.3% of the country's cephalopod production.

KERALA

The landings in the state during 1975-81 constituted 11.0-49.7% of the all India production. The annual cephalopod landings varied between 17 t and 714 t during 1960-67 and increased to 1,122 t in 1968 followed by a decrease in 1970-73. During 1974 and 1975 the production was again higher, 2,175 t and 3,342 t respectively. The period 1977-81 was characterised by large fluctuations in annual landings between 2,376 t (1981) and 6,516 t (1978). Cephalopods constituted up to 1.8% of the annual marine fish production of Kerala

EXPLOITED CEPHALOPOD RESOURCES OF INDIA (1960-79)

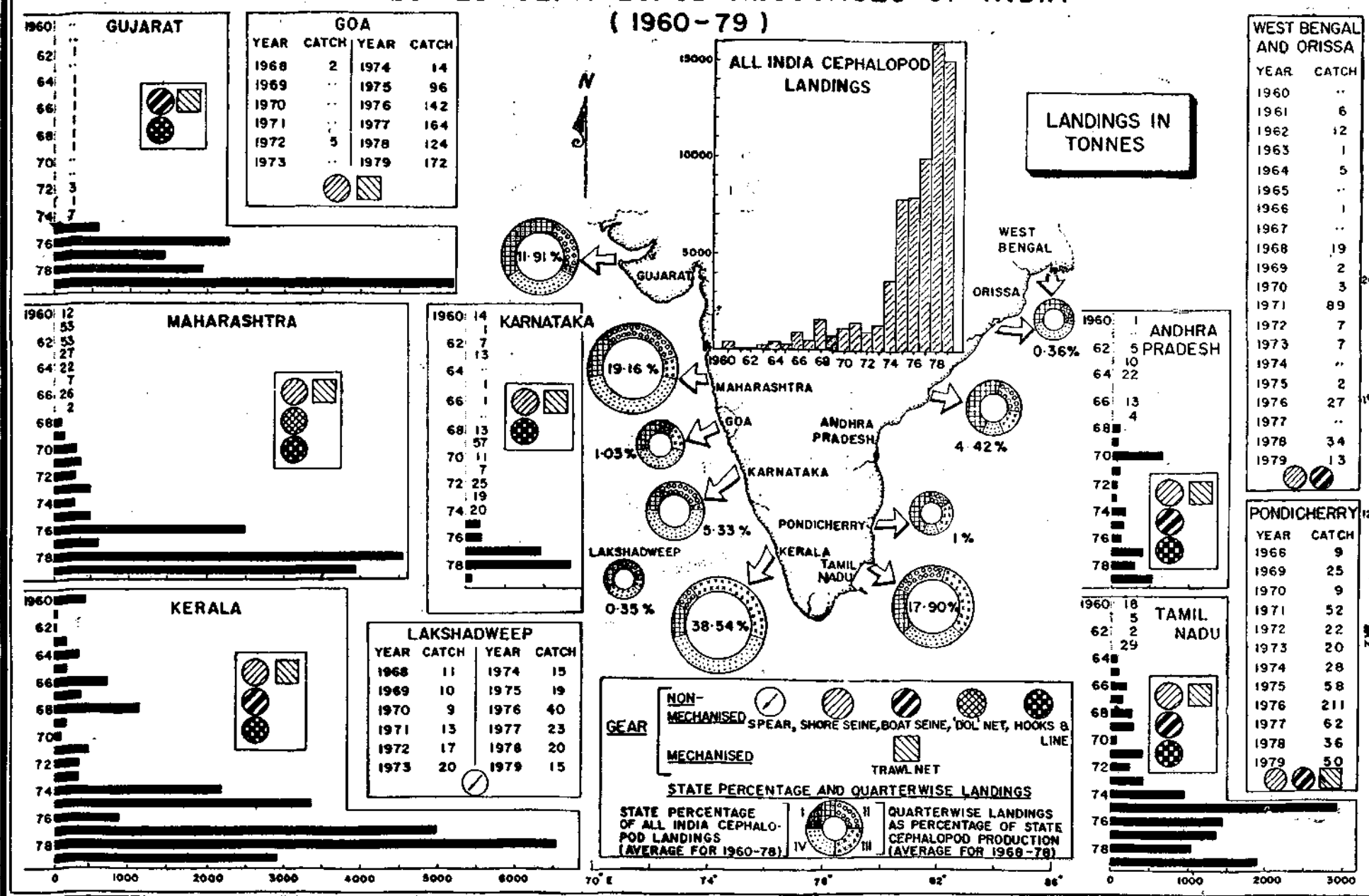


FIG. 1. Annual all India cephalopod landings during 1960-79. Statewise landings, state percentage of all India landings (average for 1960-78) and quarterwise landings, as percentage of state production (average for 1968-78) and gears used in the exploitation of cephalopods.

and the State's contribution to annual cephalopod production of the country varied from 7.3% (1970) to 90.3% (1960).

KARNATAKA

Up to 1974 the annual production in the state was very low, within the range 1 t to 57 t and there were no landings in some years. The landings increased to 175 t in 1975 and to a maximum of 1,346 t in 1978. During 1979-81 there was a decline in the landings. Cephalopods formed 1% to 8.5% of the annual fish production of the state, and the state's share in the total cephalopod production of India ranged up to 9.6%.

GOA

The annual cephalopod landings of Goa amounted to only 2-14 t in the years 1968-74. In the subsequent years the landings were higher, but showed fluctuations. The annual production increased from 96 t in 1975 to 164 t in 1977, decreased to 124 t in 1978 and rose to 210 t in 1980. In 1981 there was a fall in production to 94 t. The maximum contribution of cephalopods to the total fish landings in the state was 1.8% and the state's share in the all India cephalopod production 1.9%.

MAHARASHTRA

Till 1967 the cephalopod landings were low, though their percentage contribution to the country's landings was quite high. From 1968 to 1975 the landings were moderately high, 147-501 t. In the subsequent period starting from 1976 the production rose steeply to 2,488 t, declined to 597 t in the next year and rose to a high level of 4,557 t in 1978 when production was high in other states like Kerala, Karnataka and Gujarat also. The landings showed a descending trend till 1980, and then improved slightly to 1,755 t in 1981. Cephalopods constituted 0.1-1.6% of annual marine fish production of Maharashtra and the State's cephalopod production accounted for 0.4% (1967)—57% (1961) in the country's annual cephalopod production.

GUJARAT

The annual cephalopod production of Gujarat was nil or very negligible till 1974. In 1975 the cephalopod landings amounted to 611 t and increased by over three times to 2,286 t in 1976. In the next two years there was a decrease in the catches followed by a steep rise to the highest ever peak of 5,351 t in 1979. The

landings were lower subsequently, 3,471 t and 2,743 t in 1980 and 1981. These data show that there are wide fluctuations in the cephalopod landings in the state during recent years. Cephalopods formed up to 2.8% of the state's annual marine fish production. Gujarat's contribution to the country's cephalopod production was very insignificant till 1974 but it rose to 12.3-35.6% during 1976-81.

LAKSHADWEEP

The cephalopod production of Lakshadweep consists entirely of octopods. During 1968-81 the annual production of the Islands varied between 9 t (1970) and 40 t (1976). The octopods formed 0.5-1.6% of the annual marine fish production of the Islands and they contributed from less than 1% to 1.7% to the country's annual cephalopod production. One of us (E.G.S.) noted spear fishing for octopods in the reefs of Agati and Minicoy islands.

ANDAMAN-NICOBAR ISLANDS

There is regular exploitation of octopods in the Car Nicobar Island. One of us (E.G.S.) has seen as far back as 1960-61 light fishing for octopods in the reefs of Car Nicobar. Octopus fishing is carried out mainly at night by spearing and with the help of torches made of coconut twisted palm leaf. Hundreds of families from different villages participate in this fishing. During daytime women and children go to the reefs and poison rock pools, tidal pools and tidal rivulets with ground paste of *Barringtonia* seed. The catch thus obtained includes small octopods, fishes and crustaceans. Similar subsistence fishery exists in other Nicobar islands. A variety of traps are laid at night and picked up at dawn and this yields octopods with fishes. Bait may or may not be used in trap fishing.

CEPHALOPOD PRODUCTION ALONG EAST COAST OF INDIA

The cephalopod landings of the east coast of India, coming from West Bengal, Orissa, Andhra, Pondicherry and Tamil Nadu (excluding its southwest coast), constituted 19-59% to the country's production during 1968-75 but accounted for only 6-16% in 1976-78. The production along the east coast showed two peaks, one in 1970 and another higher peak in 1975 (Fig. 2). The landings increased from 307 t in 1968 to 686 t in 1970 and after a fall to 245 t in 1972 rose to 879 t in 1974 and 2,292 t in 1975. In the later years 1976-78 the cephalopod production was much

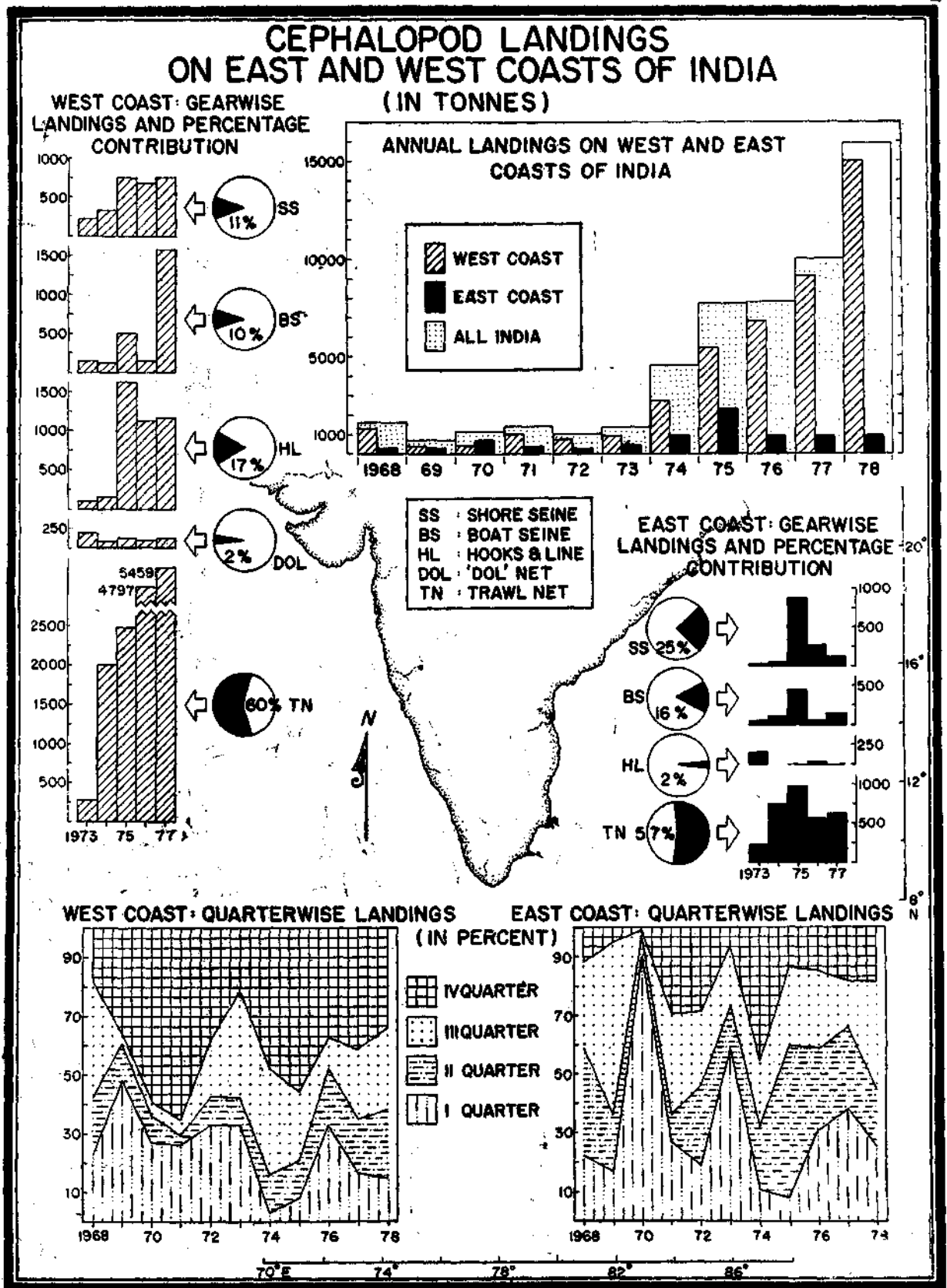


FIG. 2. Annual cephalopod landings along east and west coasts of India during 1968-'78, gearwise landings and percentage contribution (1973-'77) and quarterwise landings along east and west coasts of India (1968-'78).

lower and fluctuated between 915 t and 960 t. Along the coast the best months for cephalopods were March and April and the catches were moderately good in August and November. In some years fairly good catches were obtained in other months, e.g., January (1973), February (1970), May and July (1975). Quarterwise, the landings were higher in the first and third quarters than in other quarters.

GEARWISE CEPHALOPOD LANDINGS ALONG EAST COAST OF INDIA

1. *Shore seine landings*

Cephalopods are caught in maximum quantities in shore seines among the non-mechanised gear, 5.1 to 38% of the total annual landings being obtained in this gear (Fig. 2). The landings by shore seines amounted to 30.3 t and 44.6 t in 1973 and 1974 respectively but sharply increased several-fold to 871.8 t in 1975 though the effort rose only by 27%. However, there was a fall in the catches to 282.4 t and 138.1 t in 1976 and 1977 when there was a decrease in effort by 27% and 23% respectively. The average annual landings from shore seines during 1973-77 were 273.4 t and average CPUE (Catch/Unit) 1.69 kg. The best catches were obtained in the months February to June and in some years in August and September. The average monthly CPUE varied between 0.03 kg and 9.81 kg and high CPUEs were observed in April and June.

2. *Boat seine landings*

10.3% to 19.3% of the total cephalopod catches along the coast during 1973-77 were obtained in boat seines which were the second important non-mechanised gear in which cephalopods were caught along the east coast. The boat seine landings showed a trend similar to those of shore seines. The catches were low, 53.9 t and 90.7 t, in 1973 and 1974 and there was a steep rise to 443.3 t in 1975 although there was no significant difference in effort compared to that in the previous two years. The landings declined to 107.7 t and 157.5 t in 1976 and 1977 when there was fall in effort by 21.2% and 25.3% compared to that in 1975. The average cephalopod landings of boat seines in the period 1973-77 amounted to 170.6 t and the average CPUE was much less than that of shore seines, being 0.2 kg. The average monthly CPUE varied between 0.07 kg and 0.41 kg with high CPUEs in January, April, May and November. The best catches were obtained in January, April-May and November.

3. *Hooks and line landings*

Hooks and lines contributed 0.2% to 33.9% to annual cephalopod catches along the coast during 1973-77. A total of 154.4 t of cephalopods were caught in this gear along the coast in 1973 but there were no landings in 1974. Compared to 1973 there was a decrease in effort by 34.2% in 1974. The landings were very low, 1.63-13.80 t during 1975-77. The average annual landings during 1973-77 amounted to 34.3 t and average CPUE 0.11 kg. The average monthly CPUE varied over a low range of 0.01-0.66 kg. The best months for cephalopod catches from hooks and lines were January and February.

4. *Trawl net landings*

The major portion of the cephalopod catches 47.7% (1973) to 84.6% (1974) (average 60%) of the total production along the coast was obtained in trawl nets. The trawl net catches increased from 217.2 t in 1973 over four times to 974.8 t in 1975 when there was a large rise in effort by 148%. The production decreased to 555.70 t in 1976 when the effort showed a decrease by 16.6% and a rise to 617.9 t in 1977 when the effort rose by 43%. The average annual landings during 1973-75 amounted to 621.8 t and average CPUE 1.83 kg. The average monthly CPUE varied from 0.96 kg to 3.16 kg with high CPUEs in February, June, July-September and November. Squids and cuttlefishes were obtained in trawl nets throughout the year and the catches were higher in March, May-September and November than in other months.

CEPHALOPOD LANDINGS ALONG WEST COAST OF INDIA

The cephalopod landings along west coast of India comprising those of Gujarat, Maharashtra, Goa, Karnataka, Kerala and Kanyakumari coast of Tamil Nadu formed 41-81% of the total landings of the country during 1968-75 and in the subsequent years the catches along the coast constituted as much as 84-94% (average 89.2%). The landings show three peaks in 1968, 1971 and 1978 (Fig. 2). They decreased from 1,327.5 t in 1968 to 415.6 t in 1969 increased to 1,056.2 t in 1971, showed a fall by 30.6% in the next year but the period from 1973 onwards was one of continuous rise in catches reaching a maximum of 14,977 t in 1978. The highest catches of cephalopods were obtained along the west coast from September to December and in April. In some years large catches were obtained in May (1975, 1977 and 1978) and July (1975) also. Quarterwise, the last quarter of the year was the period when large quantities

were obtained and the first quarter was the next one in which squids and cuttlefishes were fished in good quantities.

GEAR-WISE CEPHALOPOD LANDINGS ALONG WEST COAST OF INDIA

1. *Shore seine landings*

As on the east coast, cephalopods are caught in maximum quantities in shore seines among non-mechanised gear, this gear accounting for 8.3-25.6% of the total cephalopod landings along the west coast. The landings increased from 224.7 t in 1973 to 734.6 t in 1975 when the effort showed a small fall by 3% (Fig. 2). There was a decrease in landings by 8.1% in 1976 although the effort increased by 33% and it was followed by a recovery of the fishery in 1977 when the landings amounted to 748.5 t although the effort declined by as much as 31%. The average annual cephalopod production along the coast during 1973-77 was 542.8 t and average CPUE 2.20 kg. The average monthly CPUE varied between 0.4 kg and 9.36 kg and high CPUEs were recorded in September, October and December.

2. *Boat seine landings*

2-18.2% of the annual cephalopod landings along the coast during 1973-77 were obtained in boat seine and this gear is the third important non-mechanised gear, the second one being hooks and lines. The boat seine landings amounted to 152.3 t and 106.4 t in 1973 and 1974 and showed a large rise to 503.5 t in 1975 when the effort was only 9% higher than in 1974. In 1976 there was a fall in production by over 72% to 136.6 t. The highest ever landings of 1,572.5 t were recorded in 1977 when the effort was over twice that in 1976. The average annual boat seine landings during 1973-77 amounted to 495.7 t and average CPUE 0.4 kg. The CPUE showed a range of 0.01-1.68 kg with high CPUEs in July, September and October. The best catches were obtained from July to October.

3. *Hooks and line landings*

The hooks and line landings formed 100.8 t and 155.1 t in 1973 and 1974 and rose to a maximum of

1,628.7 t in 1975 although the effort was higher in that year only by 10.3%. In 1976 the landings amounted to 1,113.2 t when the effort was higher by 4.3%. In 1977 the landings were 1,161.1 t when the effort was less by 32% as compared to that in 1975. The average annual cephalopod landings of hooks and lines during 1973-77 were 831.8 t and average CPUE 1.1 kg. The CPUE of the gear ranged between 0.01 kg and 3.57 kg with maximum CPUEs of 1.46 kg-3.57 kg in September-November. The largest catches were obtained from September to November and in some years in January and December also.

4. *Dol net landings*

The *dol* nets landed 1.4-13.7% of the total annual cephalopod landings during 1973-77. The annual *dol* net catches of cephalopods amounted to 111 t in 1973 but in the next two years 1974 and 1975 the landings declined to 44 t (1974) and 83 t (1975) when the effort decreased by 19.7% and 2.7% respectively. In 1976 although the effort was seven times that in 1975, the landings were less by 5% being 78.9 t. The catches were extremely low, 3.4 t, in 1977 when there was a large decline in effort by 92% compared to that in 1976. The average annual landings with this gear during 1973-77 were 98.8 t and average CPUE 0.16 kg. The average monthly CPUE varied between 0.01 kg and 0.55 kg. The catches were better in September, November and December than in other months.

5. *Trawl net landings*

The major portion of the cephalopod production along the west coast ranging from 31.1% to 79.9% was obtained in trawl catches during 1973-77. The total annual landings were only 272.3 t in 1973 but increased progressively in subsequent years 1974-77 when the effort also increased progressively. A maximum of 5,459 t were caught in 1977 when the effort was double that in 1973. The average annual trawl landings of cephalopods during 1973-77 amounted to 3,002.4 t and average CPUE 5.38 kg. The average monthly CPUE varied during 1973-77 over a wide range of 2.1 kg (December) to 14.3 kg (October). High CPUEs of 5.19 kg to 14.3 kg were recorded in April, July and September-November. The best cephalopod catches were obtained in the months March-May and September-November.

The estimated cephalopod production in India and constituent maritime states in the recent years 1980-'84 are given below :

substantial increase in landings in Maharashtra, Kerala, Tamilnadu and Gujarat. Highest production was in Maharashtra which accounted for 30-36% of the

	1980	1981	1982	1983	1984*
West Bengal ..	4	..	6	18	42
Orissa ..	98	57	195	119	59
Andhra Pradesh ..	470	512	595	519	450
Tamilnadu ..	1,472	1,687	3,238	3,877	3,694
Pondicherry ..	40	44	84	121	37
Kerala ..	4,244	2,376	3,536	1,727	5,406
Karnataka ..	122	266	153	979	319
Goa ..	210	94	66	394	401
Maharashtra ..	1,191	1,755	4,781	6,613	7,650
Gujarat ..	3,471	2,743	3,023	3,972	3,007
Lakshadweep ..	13	14	22	16	14
All India ..	11,335	9,578	15,799	18,355	21,079

* provisional figures

After the marked decline in landings in 1981, the production rose progressively to 15,799 t in 1982 and 21,079 t in 1984. The rise in production was due to a

country's production and it was an all time high of 7,650 t in 1984. Kerala contributed 9-26% of the landings, Tamilnadu 18-21% and Gujarat 14-22%.

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