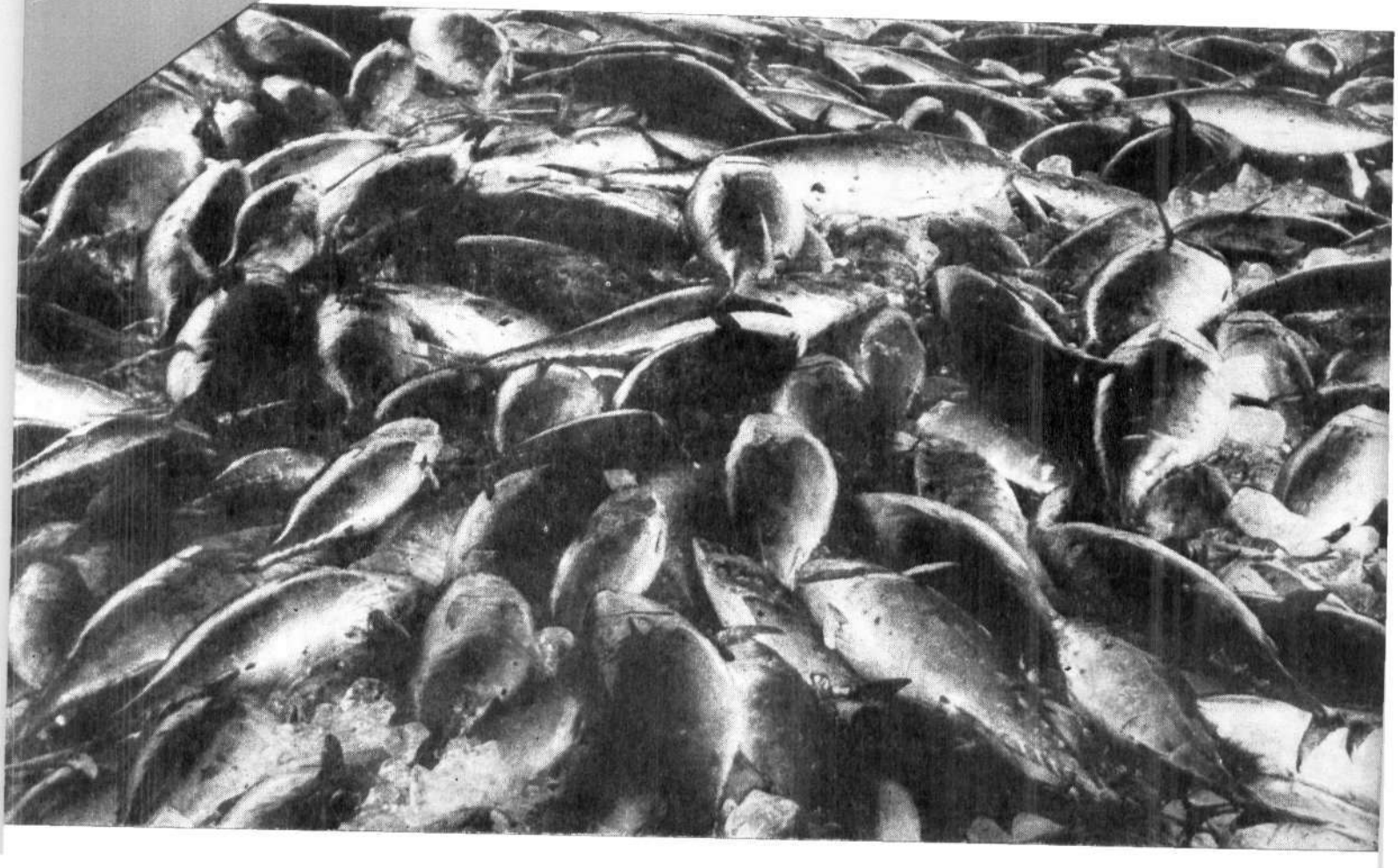
CMFRI
bulletin 36

JUNE 1985

TUNA FISHERIES OF THE EXCLUSIVE ECONOMIC ZONE OF INDIA: Biology and Stock Assessment

Edited by : E. G. SILAS



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FISHERY AND BIONOMICS OF TUNAS AT MINICOY ISLAND

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The Union Territory of Lakshadweep is represented by twenty islands out of which only ten are inhabited. Oceanic species of tunas such as skipjack (*Katsuwonus pelamis*) and yellowfin tuna (*Thunnus albacares*) are available in Lakshadweep area from October to May every year. They are being exploited from Minicoy waters by pole-and-line tuna fishing using live bait. Since 1960, pole-and-line fishing has been adopted in the other islands of Amini group with the introduction of mechanised boats. The seventies has seen an almost complete transition of replacement of the 'Odum' (traditional tuna fishing boats) with mechanised boats fitted with bait tanks at Minicoy Islands. Thus tuna fishing became popular in the Union Territory which is now fetching a good amount to the islanders and helping in the improvement of the economy of these islands.

The earliest accounts about tuna fishing of Minicoy were that by Hornell (1910) and Ellis (1924). Later Mathew and Ramachandran (1956), Jones (1958) and Jones and Kumaran (1959) have described tuna fishery of this island in detail. Varghese (1970) compared the landing of the mechanised boats with that of non-mechanised boats and suggested for the speedy mechanisation of the fishing fleet of Minicoy island. Puthran and Pillai (1972) described tuna fishing methods in Minicoy waters and suggested for steady supply of live-bait fish during tuna fishing season, introduction of big size vessels to serve as mother ship and equip present fishing fleet with fish finding devices. Varghese (1982) summarised the fishing practices and the development of fishery in the Lakshadweep Island.

There is no clear indication from the published literature regarding the introduction of pole-and-line fishing at Minicoy. It is believed that this fishery is being in practice from time immemorial. Before 1960, locally built non-mechanised boats (*Masodi*) were used for pole-and-line fishing which were unable to go beyond ten km from the islands. Gradually mechanised boats were introduced in the island and with the result of this now twenty mechanised boats are in operation at Minicoy.

FISHING AREA

The area of operation of Minicoy tuna fishery is spread over a stretch of the oceanic waters extending from the island up to about 22 km around (Fig. 1). A clear cut difference in the fishing areas operated during different periods is discernible. During monsoon months, the boats usually fish in the nearby waters lying within the 5 km zone. During non-monsoon months, they operate far off up to the distance of 20-22

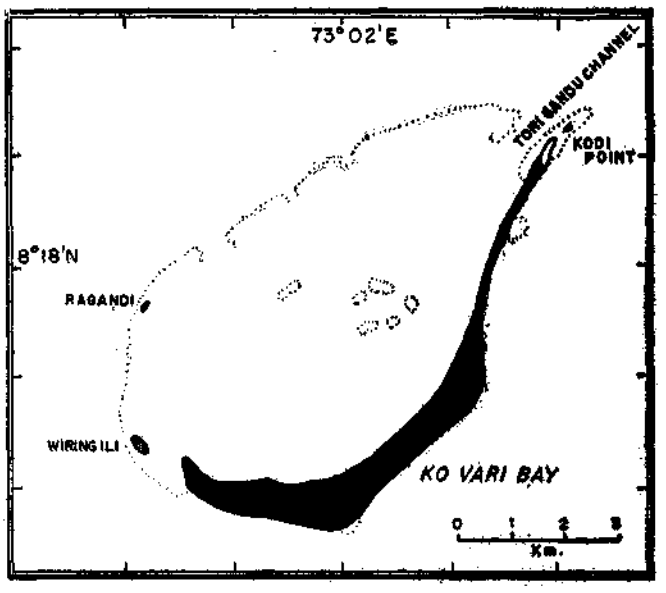
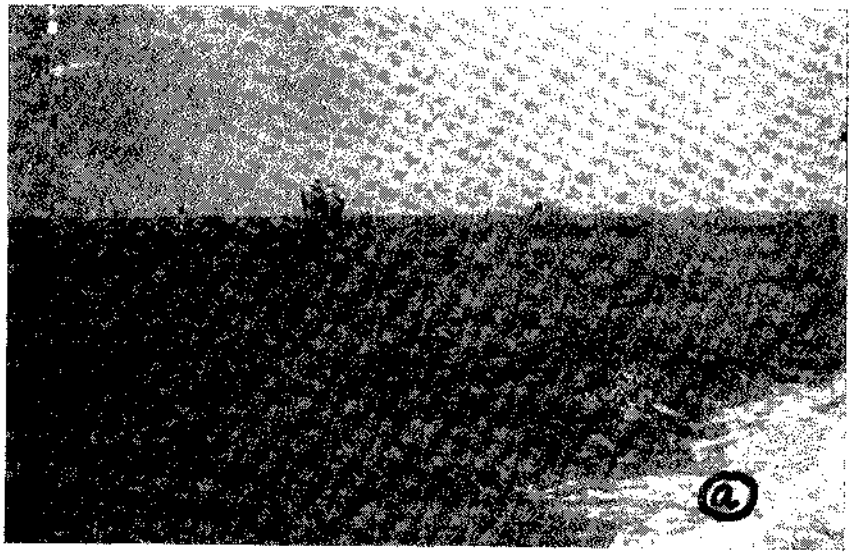


Fig. 1. The lagoon at Minicoy.



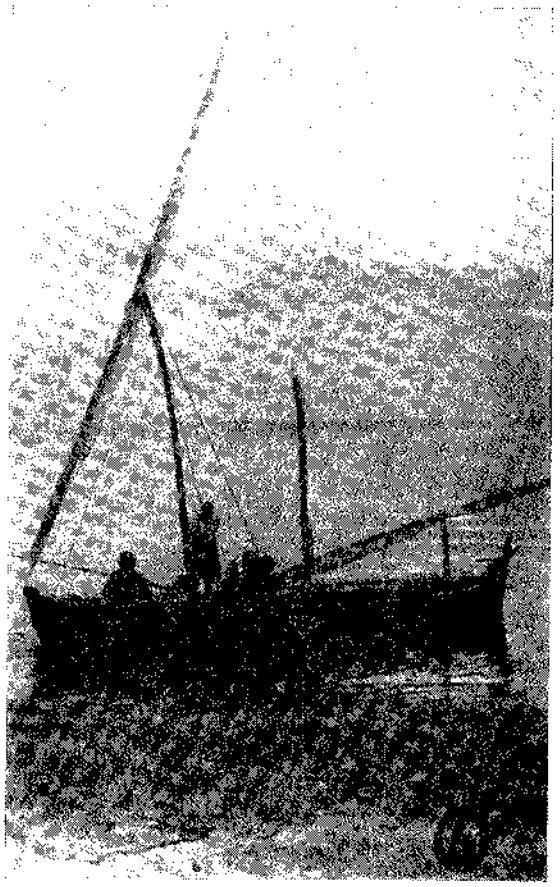


PLATE I. (*a*) Tuna fishing by pole and line in the open sea off Minicoy. (*b*) Non-mechanised tuna fishing boat (*Odam*) at Minicoy.

PLATE III. (*a*) Mechanised pole and line tuna fishing boat at Minicoy. (*b*) 'Masmin'—tuna product at Minicoy.

km from the island. The daily fishing course of the island is stereotyped, and the north-eastern ground of the island is exploited much.

Crafts

Prior to 1960 only non-mechanised boats were used for tuna fishing and the details of the boat are given by Jones and Kumaran (1959). But now these boats are used only during south-west monsoon period for troll line fishing from the eastern side of the island. The first mechanised fishing boat was introduced to Minicoy in 1959.

Mechanised boats of two sizes i.e. 7.93 metres and 9.14 metres long are being used for pole-and-line tuna fishing. Engine of 10 to 40 BHP is fitted in the middle of the boat and is surrounded on all the sides with wooden planks. This engine room is covered by a roof consisting of two pieces of wooden planks.

Bait tank of $1.6 \times 0.8 \times 0.8$ metre size is fitted in front of the engine room. Live-bait fishes are taken to fishing ground by keeping them in the water tight bait tank in which sea water is circulated through the tank with the help of special water circulation device. The temperature, dissolved oxygen level and salinity are maintained at the same time at the optimum level with the help of sea water circulation in the bait tank. The bait tank is divided into two parts by fitting a partition in the middle of the tank which can be removed easily. The partition helps in collection of bait fishes from the tank at the time of chumming.

Quarter deck which is about one metre broad is provided on the top of the quadrant. This serves as platform at the time of pole-and-line fishing. The space between the engine room and fishing platform which is somewhat deeper is used as fish hold. A partition is provided in the middle of fish hold and is covered with removable wooden planks. A hand pump which is fitted on right side of engine room is used for drawing out dirty water from the fish hold.

Pole and line

Bamboo poles of 3 to 4 metres in length and 35 to 40 mm diameter which are straight, strong and flexible are used as poles. A line of nylon twine or polythene line is attached at the tip of the pole. Barbless, lead coated hooks of small and big size are used. One end of the hook is flattened to avoid it from slipping from the knot due to the weight of the fish. The total length of the line along with the hook from the pole end is almost equal to that of the pole. The hook is kept fixed to the base of the pole when it is not in use.

Bait collection

Bait fishes are collected from Minicoy lagoon either in the morning of the fishing day or the previous day evening.

Bait fishes are caught by luring them with the help of some type of bait which is made up of crushed crabs, tuna meat or other fish's meat. This crushed bait is thrown over bait net lowered into the lagoon from the side of the tuna boat by four persons. Bait fishes after being attracted, come up and gather over the net. Two persons hold two poles as near as possible to the boat vertically. One person rubs the bait, either crab or tuna meat on a coir padding at the end of a bamboo pole and the other person standing on the side pushes pole up and down in the lagoon water. By doing this fine particles of meat will spread in all directions which attracts bait fishes from coral colonies to come out and gather over the net. When sufficient quantity of bait fish gathers over the bait net, it is quickly raised and bait fishes are transferred into live bait tanks.

For another method of bait fish collection, poles are removed from the bait net and two corners of the net are tied to two small wooden poles which are fixed in the lagoon. The two other corners of the net are anchored at the bottom of the lagoon with the help of coral stones which provides the net a slanting position. A 15 to 20 metre long rope with a row of coconut palm leaves closely tied all along is drawn by 4 to 5 persons by making a very narrow circle towards the anchored net. Bait fishes get scared and try to run out of this circle by moving towards the anchored net and finally get trapped in the bait net.

Scouting for shoals

Following methods are used to locate fishable tuna shoals.

(1) *Presence of bird flocks ;* In Minicoy waters fishermen are mostly dependent upon the presence of sea birds for locating tuna shoals (Silas 1969). As soon a sa bird flock is sighted, tuna fishing boats rush to that area for fishing. The size of the tuna school is judged by the spread of the bird flock rather than by the number of birds involved. Presence of a compact group of birds indicates availability of small school while a flock scattered over a large area suggests a large fish school. If a bird flock is flying high it is believed that tuna school is moving very fast. But if tuna shoals are almost stationary while feeding on small fishes present in the area, then bird flock will be flying quite low and also be diving for feeding.

(2) *By troll and line operation :* When birds are not sighted in the area, fishermen operate their troll line gear on their way to tuna fishing grounds. As soon as tuna strike a trolling jig, the person operating the line informs the captain of the boat who slows down the boat immediately. This indicates the presence of sub-surface tuna shoals. This type of tuna shoals take some time for chumming.

(3) *Breezing shoals :* When a skipjack school swims on the surface without actively feeding on small fishes, it appears as black spots from the tuna fishing boat. Big-sized black spot denotes the presence of a big tuna shoal.

(4) *Jumping shoals :* In Minicoy waters, tuna shoals are observed jumping out of sea water from December to March when temperature of sea water is comparatively lower than other months of the fishing season. It is very interesting to observe this type of shoals which are found quite near the Minicoy island in the morning hours. Sometimes these shoals are associated with dolphins. Since dolphins also jump during morning hours, tuna shoals also follow the behaviour pattern.

(5) *Tuna shoals associated with floating objects :* Some tuna shoals are found associated with floating objects. Floating objects are mostly wooden logs. The presence of flotsam makes the task of the fishermen easy in locating tuna shoals. Generally good quantities are fished from near the floating objects. These are found in all directions of Minicoy upto ten km distance. Generally these shoals are composed of juveniles of skipjack and yellowfin tuna which are accompanied with the sharks and *Coryphyaena* spp.

Chumming

When a tuna shoal is located the tuna fishing boat is steered towards the shoal. Before the ' Chummer ' starts throwing bait, all preparations are made and fishermen on board get ready to react quickly. Bait fishes are thrown overboard by the ' chummer ' and the reaction of the tuna shoal is noticed. If tuna shoal exhibits good bait biting, bait fish are thrown continuously and thin but regular bait line is maintained. Tunas are chummed near the fishing platform of the fishing boat. Water splashers start splashing water over the bait fishes to hide them and hooks together. Sometimes a tuna feed on the live bait, but do not bite the hooks. In such cases bait fish is attached to the tip of the hook and tuna are chummed.

Fishing operations

When tuna shoals are 'chummed near the fishing boat, actual tuna fishing operation commences. Crew take their position on the fishing platform and lower their hooks just below the sea surface. When tuna bites the hook, the fish is lifted up out of sea water with a slight jerk to the body and with the help of a second jerk the tuna is released from the hook and falls inside the boat. A special skill is required for operating pole and line and usually only trained personnel are taken on board. Whenever tuna feeding on bait and biting the hook is very quick, the angling of tunas will also be fast and sometimes a tuna fishing boat is loaded with tunas within half an hour. During the peak tuna fishing season a fishing boat can make 2 or 3 trips in a day and every-time return with good catches.

Troll line

Big size hooks are used during the south-west monsoon season for tuna fishing. While some fishermen prefer naked hooks when fishing others prefer hooks covered with feathers. Since troll line fishing is conducted in deeper waters nylon twine or polythene thread are used as line of various length.

From June onwards climatic conditions does not favour pole and line fishing. Sea towards the western side of the island becomes rough and it is difficult for mechanised fishing boats to cross the lagoon reef and go out in the open sea. Moreover bait fishes are also not available during this period.

Therefore non-mechanised boats operate troll line from the windward side of Minicoy Island where the sea will be very calm. Upto 10 persons go in a boat and after reaching the fishing grounds each crew operate troll line. Usually catches during monsoon period by troll lines are very poor since this is the lean period for tuna fishing season at Minicoy. The main feature of this fishing is that billfishes and big sized yellowfin are also caught during this period.

Effort, catch and cpue

During 1976 high value of standard effort was recorded from January to April and November to December ; maximum effort in December and minimum in July. Next year it was high from February to April and December, maximum in February and minimum in June. In 1978 high effort was recorded for January, April, November and December, the maximum during December and minimum in July. During 1979 effort was recorded high in March, April and December, maximum being in December and minimum in July. In 1980 during March, April and December high values were recorded, maximum being in March and minimum in June. During 1981 high values were recorded from January to March and in December, maximum being

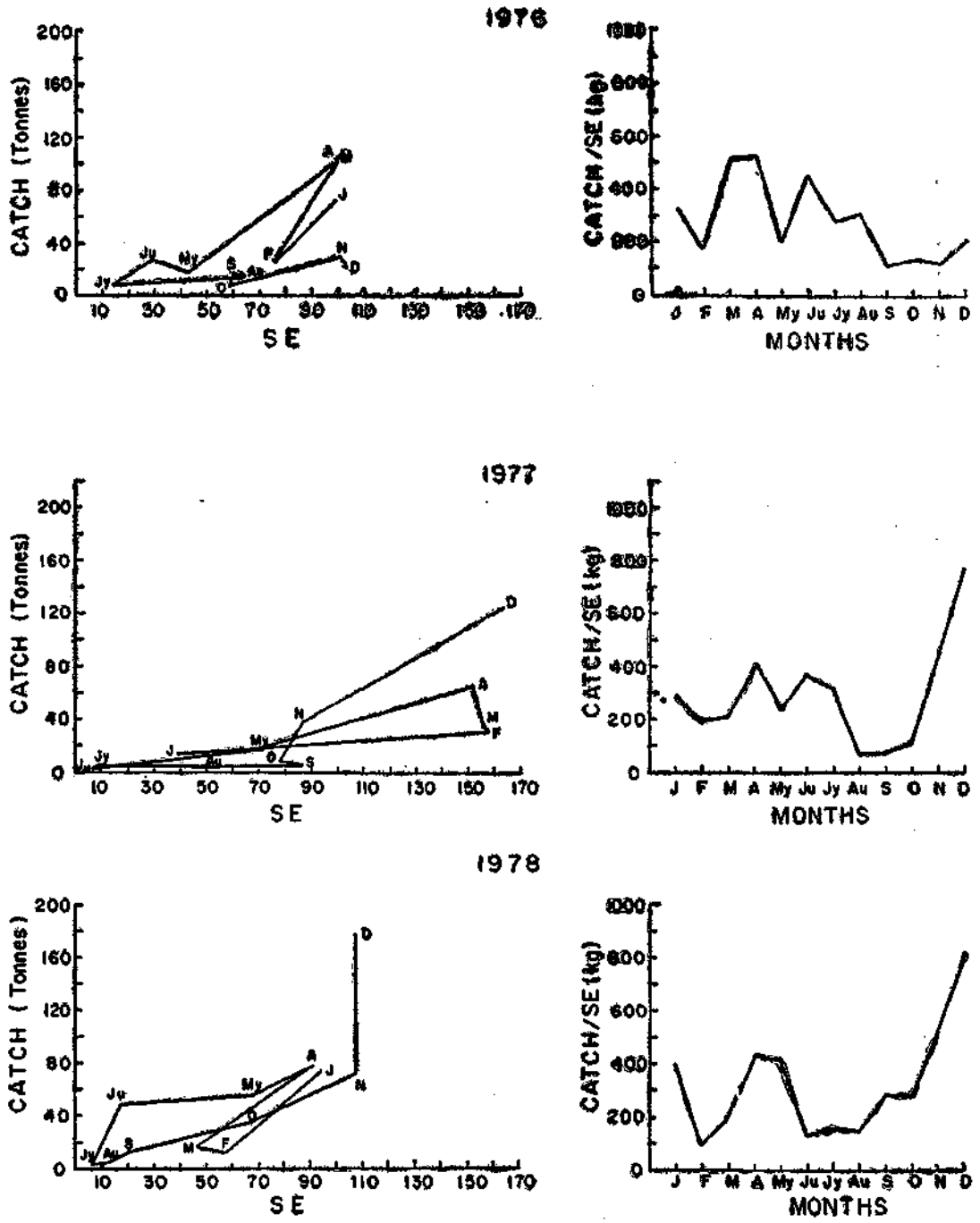


Fig. 2. Catch-standard effort relationship of tunas at Minicoy, 1976-'78.

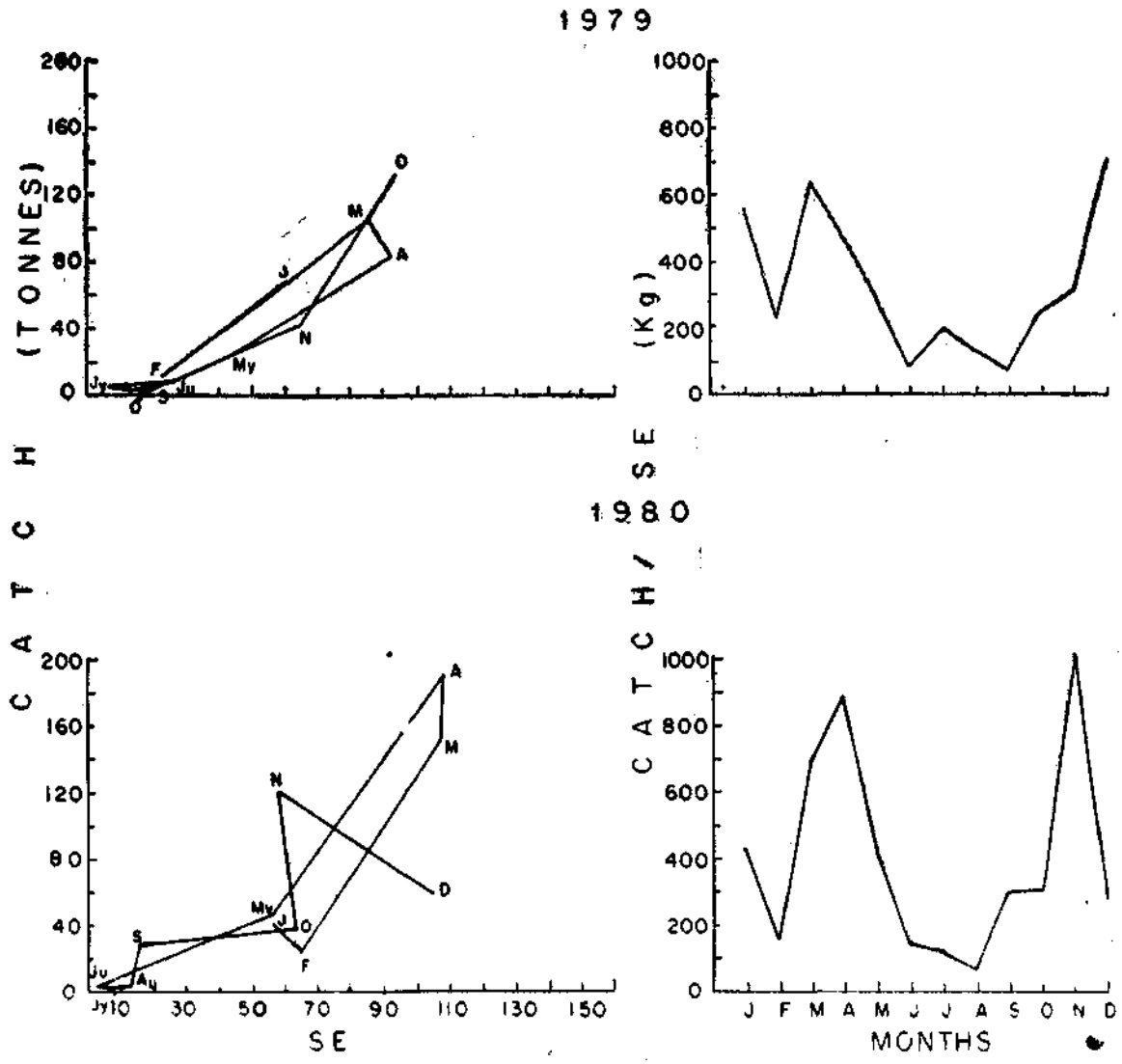


Fig. 3. Catch-standard effort relationship of tunas at Minicoy, 1979-'80.

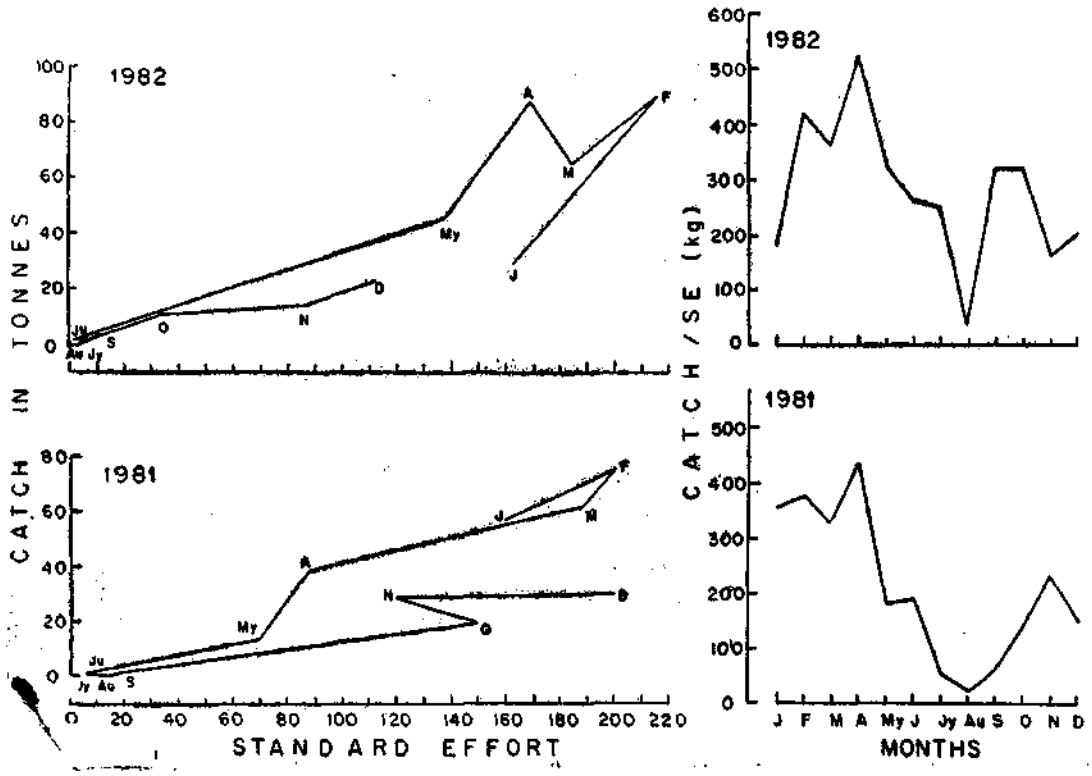


Fig. 4. Catch-standard effort relationship of tunas at Minicoy, 1981-'82.

in February and minimum in June. In 1982 from January to May high values of effort were recorded, maximum being in February and minimum in August.

Tuna catches have exhibited variations at Minicoy from 1976 to 1982 (Figs. 2-4). While tuna catches were 421.8 tonnes during 1976, it was about one hundred tonnes less during next year. But during 1978 tuna catches improved and 509 tonnes were landed at Minicoy. Next year catches were almost similar to that of 1978 catches. But during 1980 record catches of 675 tonnes were landed which was the highest annual production at Minicoy for the period from 1976 to 1982. In 1981 only 324.4 tonnes were landed, which did not show any improvement in 1982.

During 1976 catches were relatively high during January to April when maximum catches of 104 tonnes were recorded in March (Fig. 85). In 1977, high catches were from January to March and December with maximum catch of 126 tonnes in December and lowest in July. In 1978 good catches were recorded in January, April, May and December and a maximum catch of 178 tonnes was recorded in December and lowest in July. In 1979, there were good catches in January, March, April and December. In 1980 maximum catches of 190 tonnes were observed in April and lowest in July. In 1981, there were good catches from January to April with the maximum catch of 75 tonnes in February and lowest in August. In 1982 the maximum catch was recorded in February and lowest in August.

From the above it is clear that the tuna fishing season at Minicoy commences from November and lasts upto May.

As can be seen from the Figs. 2-4, during 1976 catch per standard effort was high from March to June and 530 kg was recorded during April. Next year it was high from January to June and in December. For this year maximum CPSE of 770 kg was recorded in December and lowest from July to September. In 1978, CPSE was good in January, April, May and December and CPSE was maximum in December (820 kg) and lowest in February. Next year again maximum CPSE was recorded in December (710 kg) when it was good in January, March and December and lowest in June. In 1980 CPSE was high in January, April and November and maximum CPSE of 1010 kg was recorded during November and lowest 70 kg in August. In 1981 it was high from January to April and November when maximum CPSE was recorded in April and lowest 24 kg in August. In 1982 CPSE

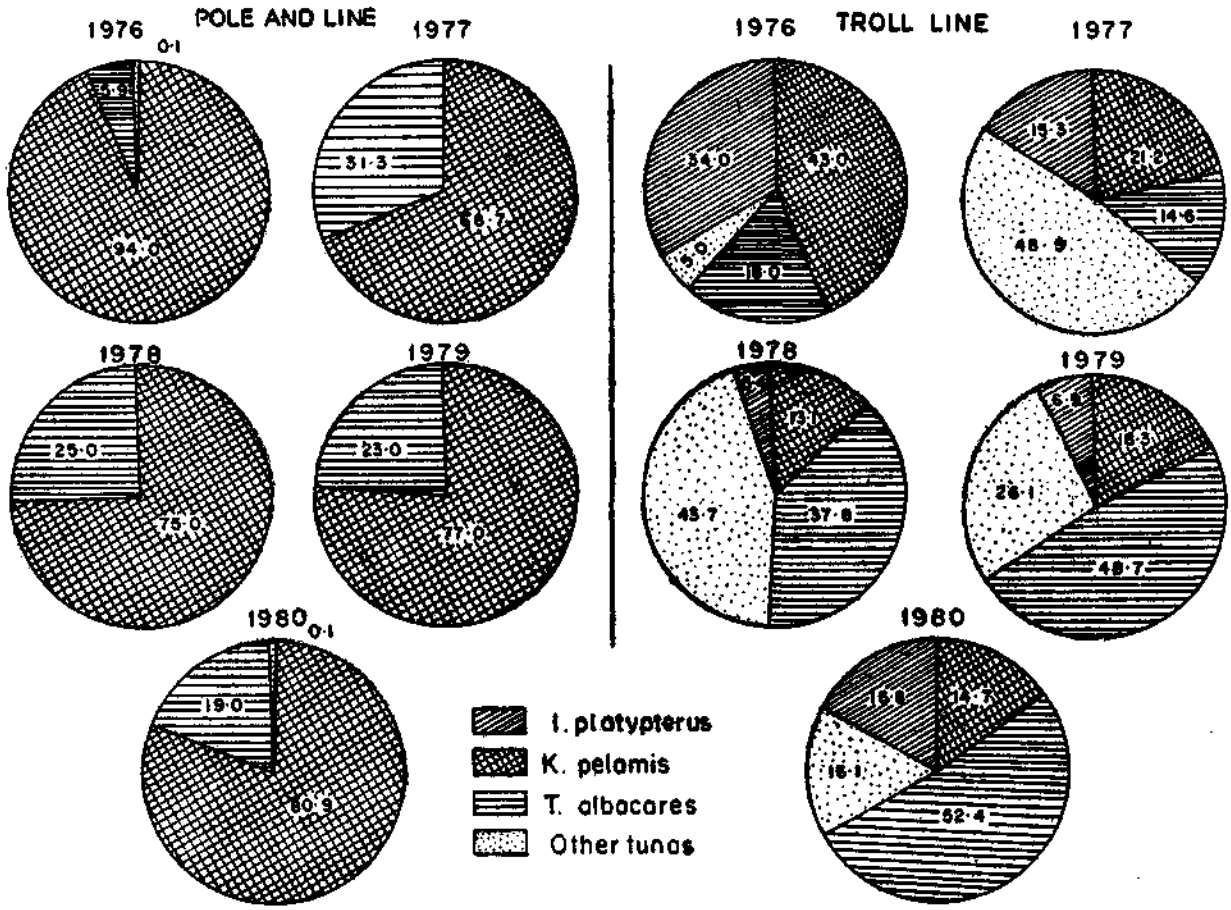


Fig. 5. Percentage composition of tunas in the pole and line, and troll line fishery at Minicoy, 1976-'80.

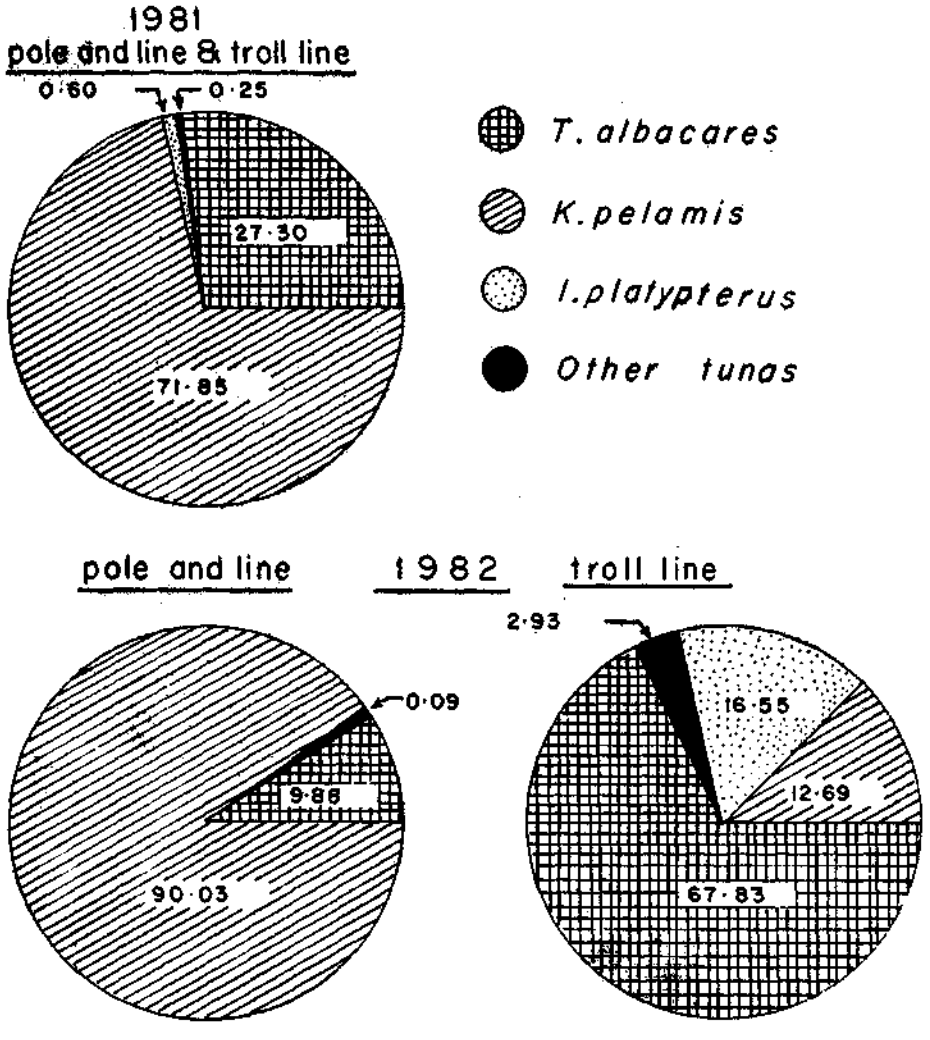


Fig. 6. Percentage composition of tunas in the pole and line, and troll line fishery at Minicoy, 1981-'28.

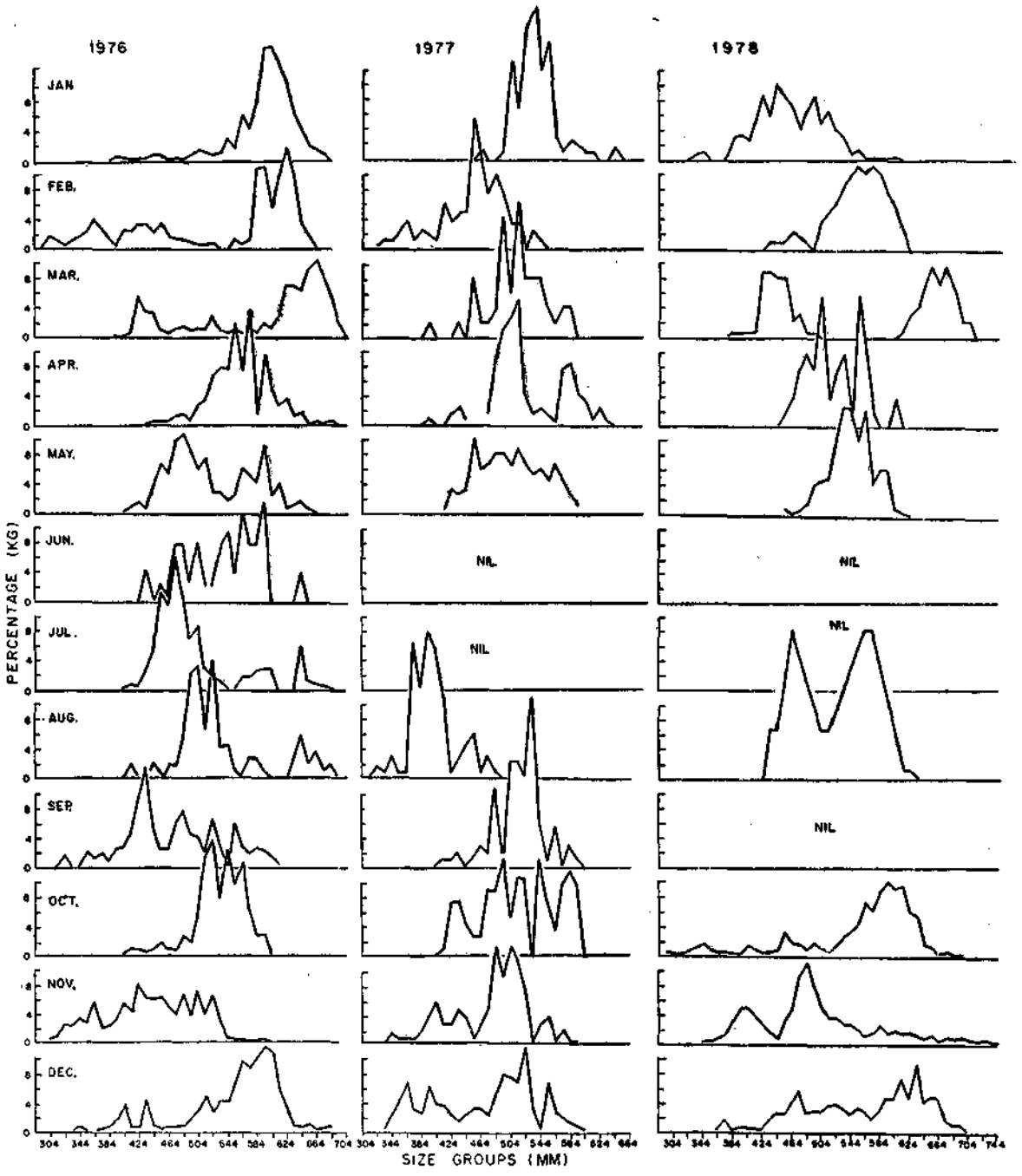


Fig. 7. Monthly length frequency distribution of *K. pelamis* at Minicoy, 1976-'78.

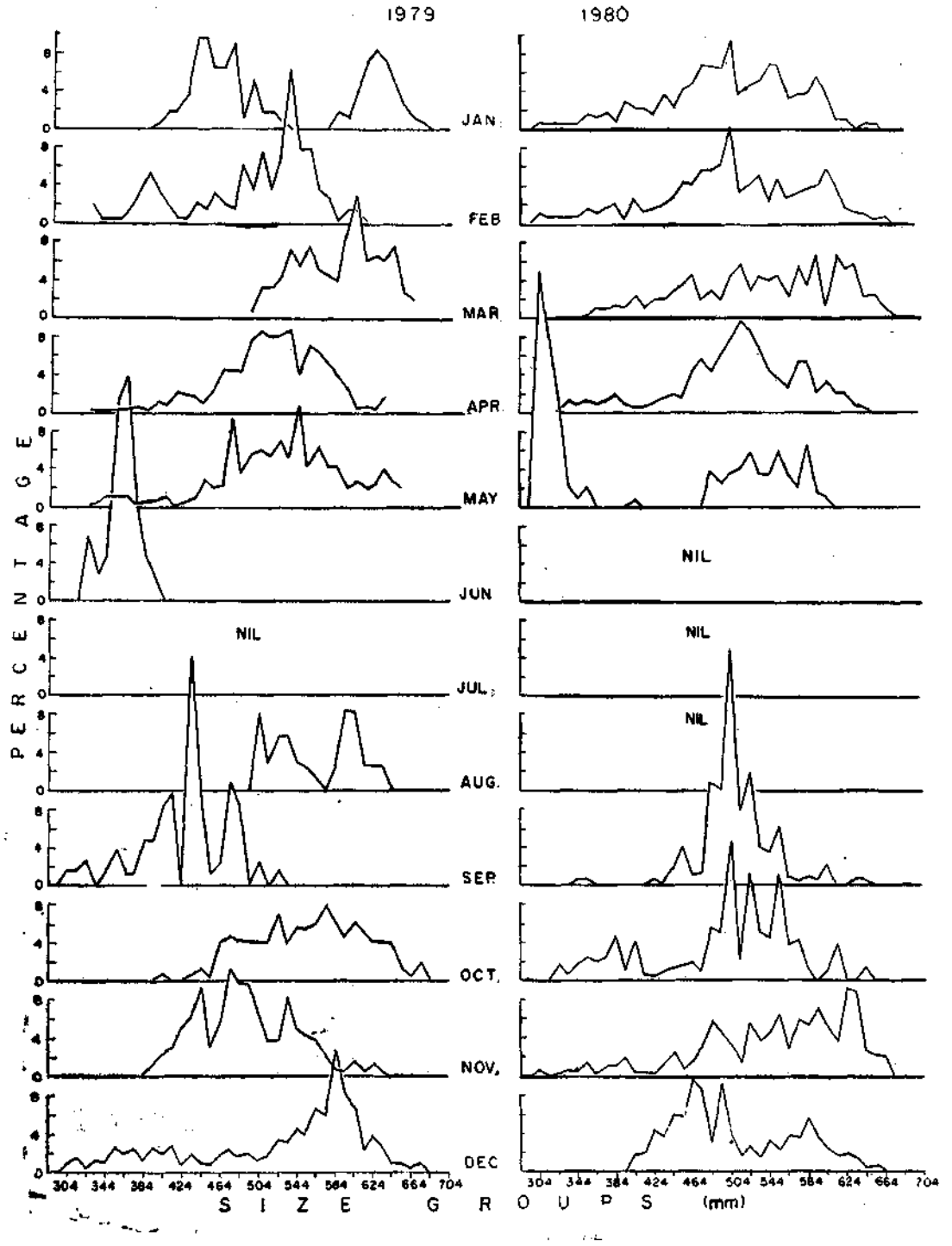


Fig. 8. Monthly length frequency distribution of *K. pelamis* at Minicoy, 1979-'80.

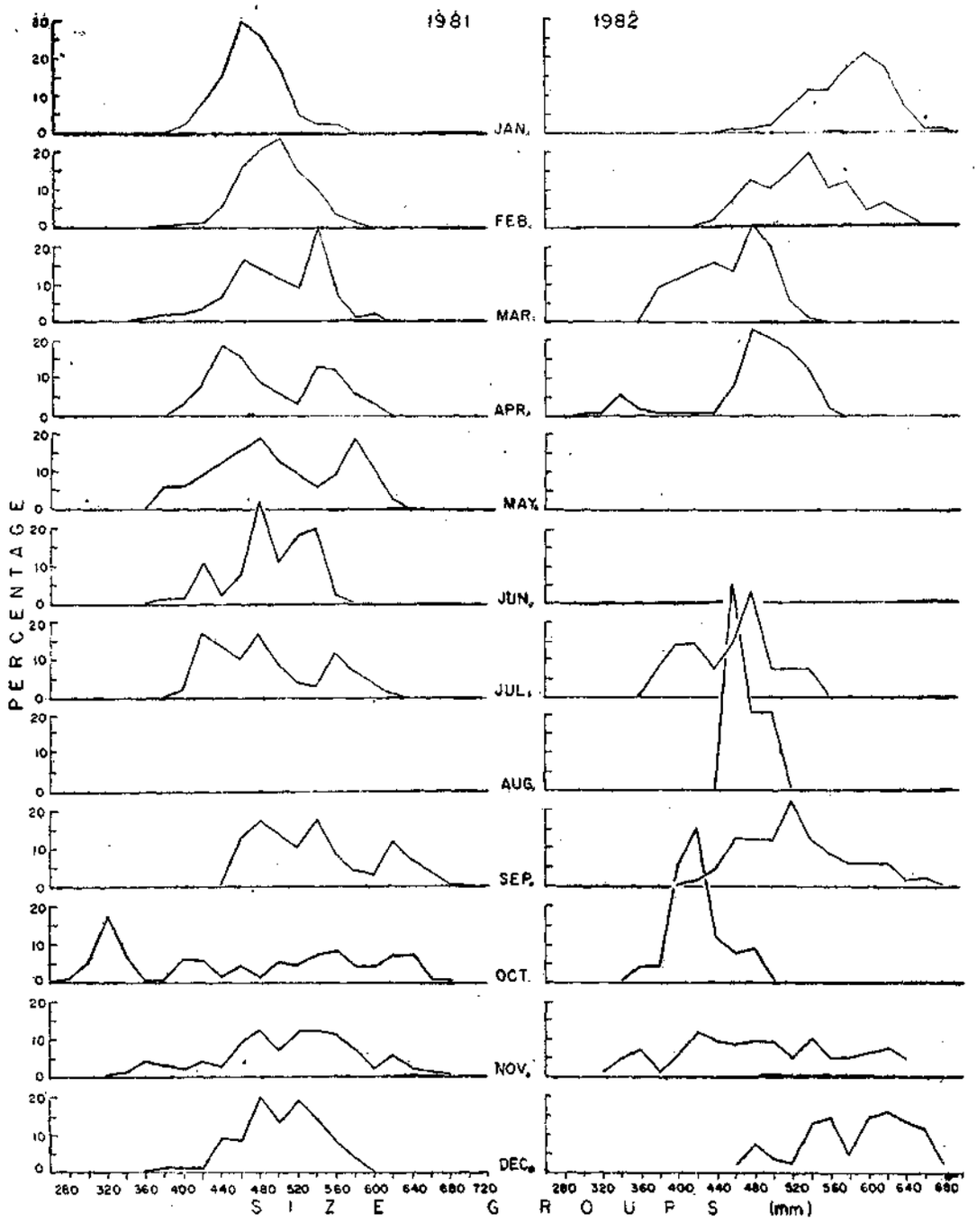


Fig. 9. Monthly length frequency distribution of *K. pelamis* at Minicoy, 1981-'82.

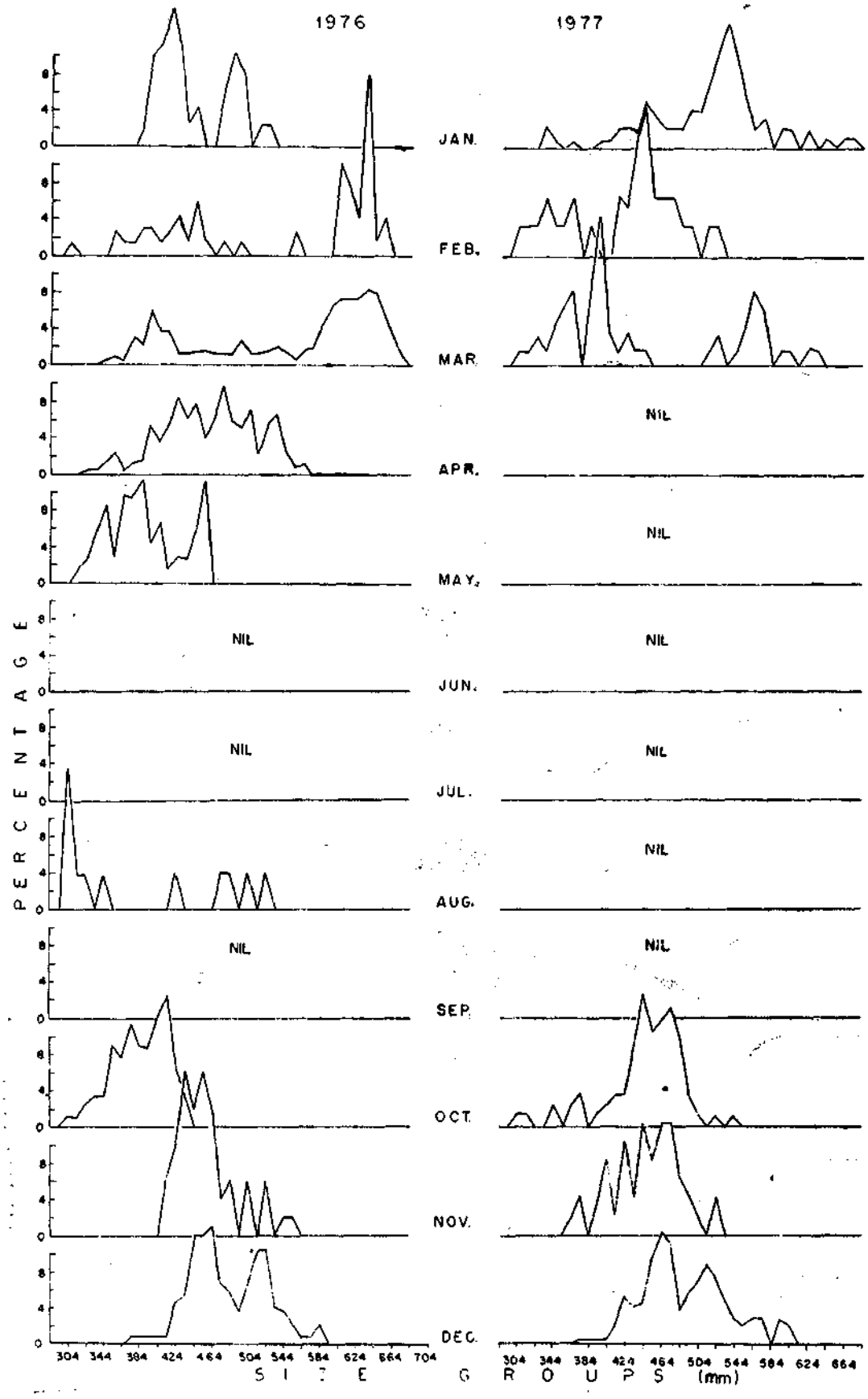


Fig. 10. Monthly length frequency distribution of *T. albacares* at Minicoy, 1976-'77.

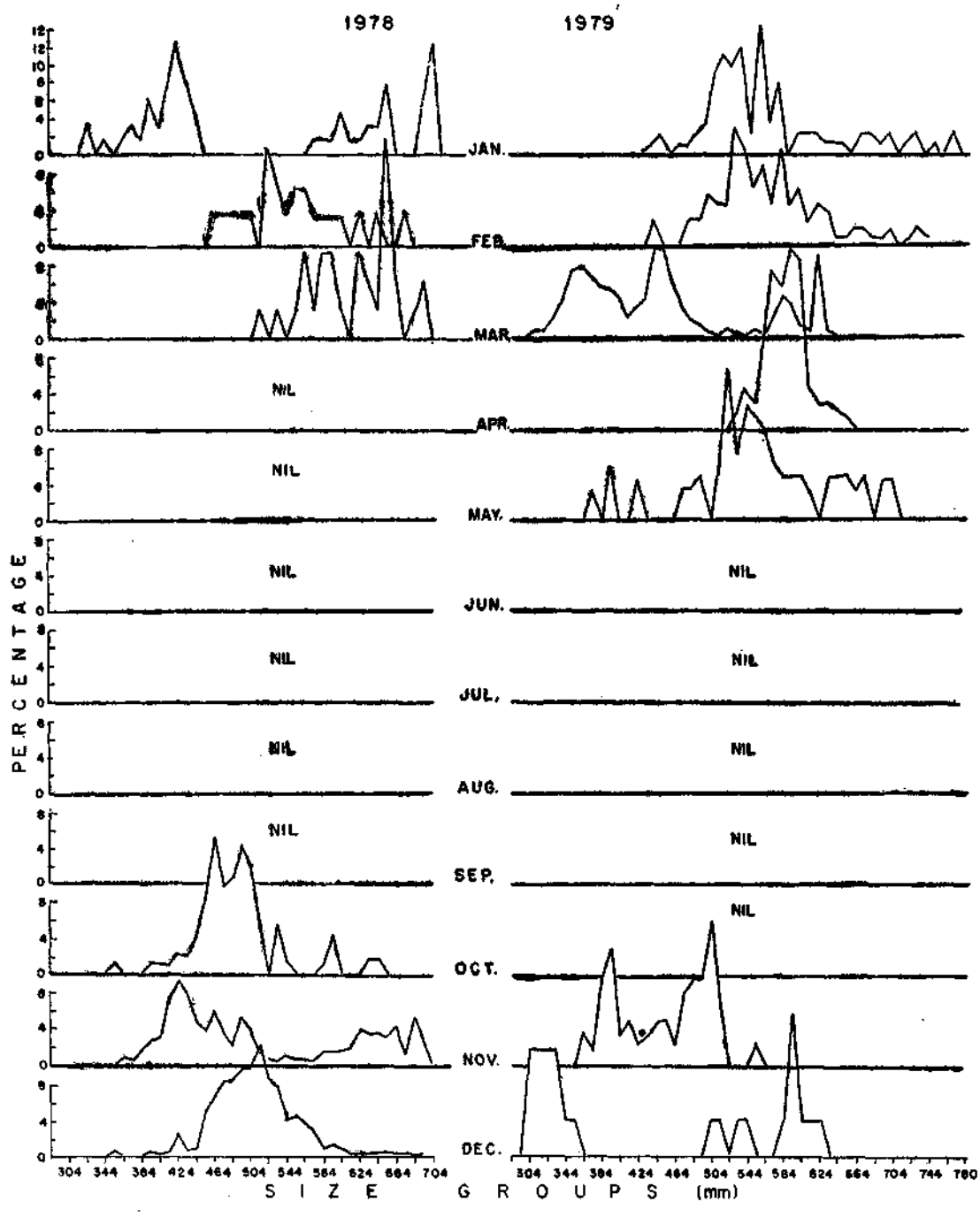


Fig. 11. Monthly length frequency distribution of *T. albacares* at Minicoy, 1978-'79.

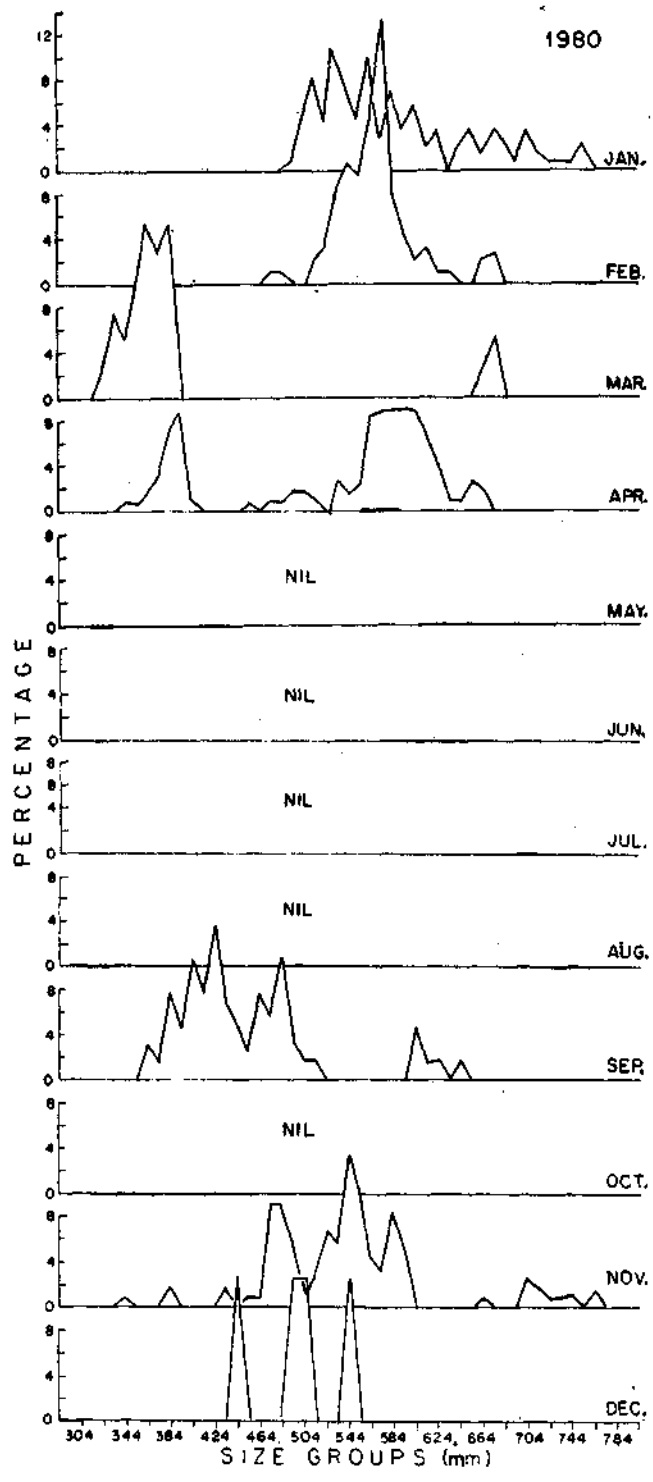


Fig. 12. Monthly length frequency distribution of *T. albacares* at Minicoy, 1980.

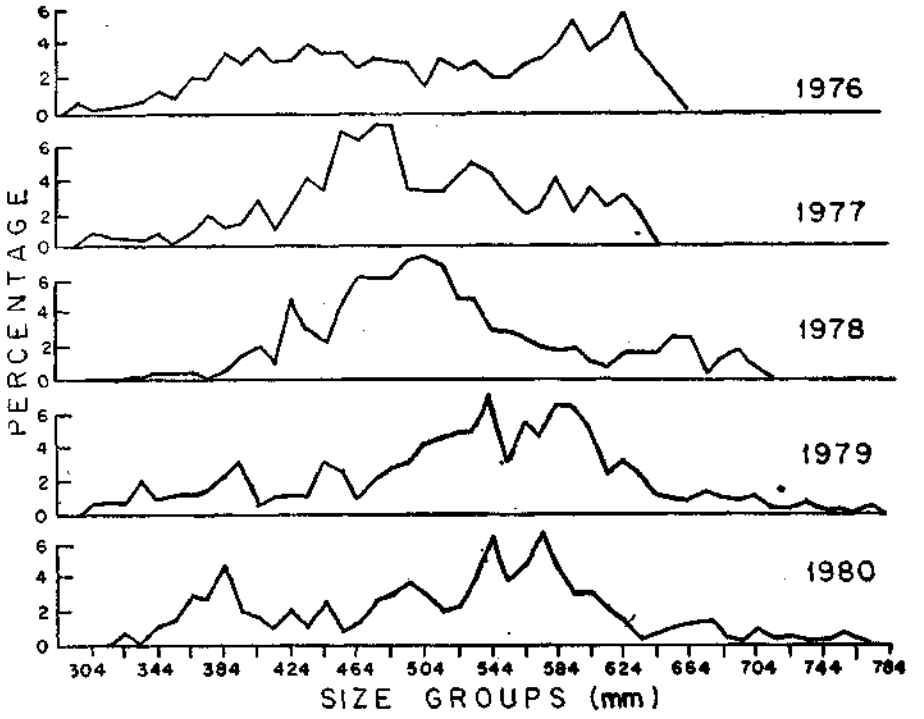


Fig. 13. Pooled annual length frequency distribution of *T. albacares* at Minicoy, 1976-'80.

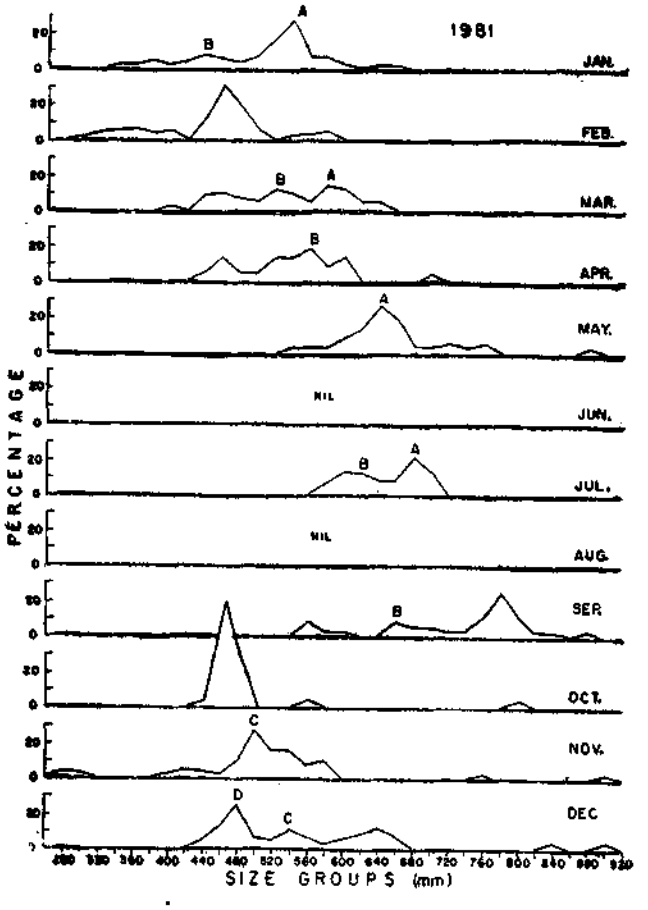


Fig. 14. Monthly length frequency distribution of *T. albacares* at Minicoy, 1981.

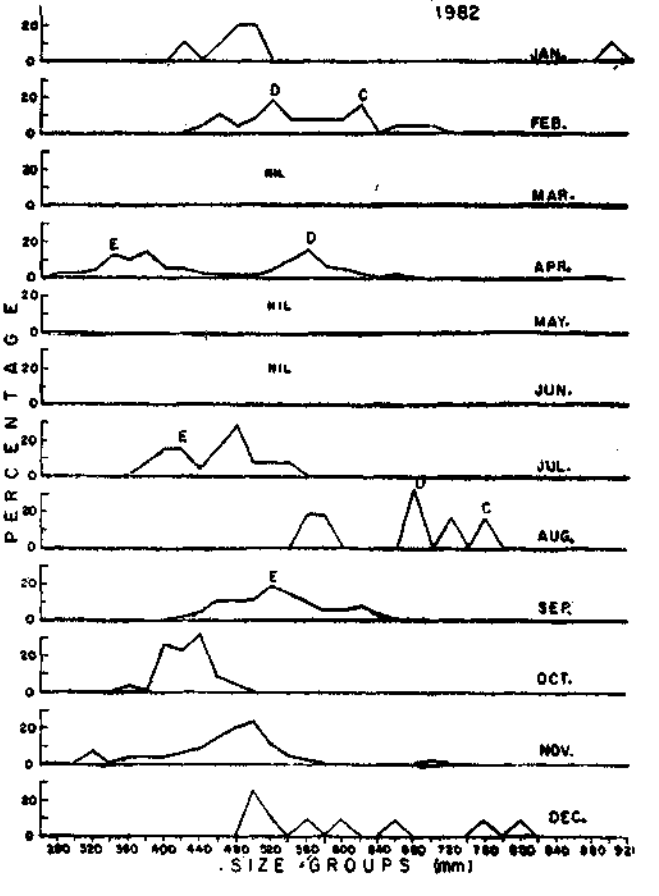


Fig. 15. Monthly length frequency distribution of *T. albacares* at Minicoy, 1982.

was high from February to May and in September and October. Maximum value of 522 kg was recorded in April and lowest 38 kg in August.

SPECIES COMPOSITION

Pole and line catches : It is evident from the fig. 5 that during 1976 *Katsuwonus pelamis* accounted for 94% of the total tuna catch followed by *Thunnus albacares* 5% and other tunas 1%. During 1977 the percentage of yellowfin increased by contributing 31.3% and skipjack with 68.7%. In the ensuing year skipjack contributed 75% and yellowfin 25%. In 1979 skipjack formed 77% of the tuna catch and yellowfin 23%. During 1980 there was a little increase in skipjack catch 80.9% followed by yellowfin 19% and other tunas 0.1%. In 1981, the catch of skipjack shoed a decline while that of yellowfin improved (Fig. 6). During 1982 *Katsuwonus pelamis* accounted for 90% and yellowfin 10%.

Troll line catches : Yellowfin tuna predominated in the troll line catches followed by billfishes from 1976 to 1982 (Figs. 5 & 6).

SIZE DISTRIBUTION

In *K. pelamis* the size ranged from 304-704, 304-664, 320-744, 304-684, 304-664, 260-700 and 280-680 mm during 1976-'82 respectively. The monthly progression of the various modes are given in figs. 7-9.

In *T. albacares* the size ranged from 304-664, 304-624, 324-684, 304-664, 324-764, 260-920 and 260-920 mm during 1976-'82 respectively. Monthwise progression of the modes are given in figs. 10-15.

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