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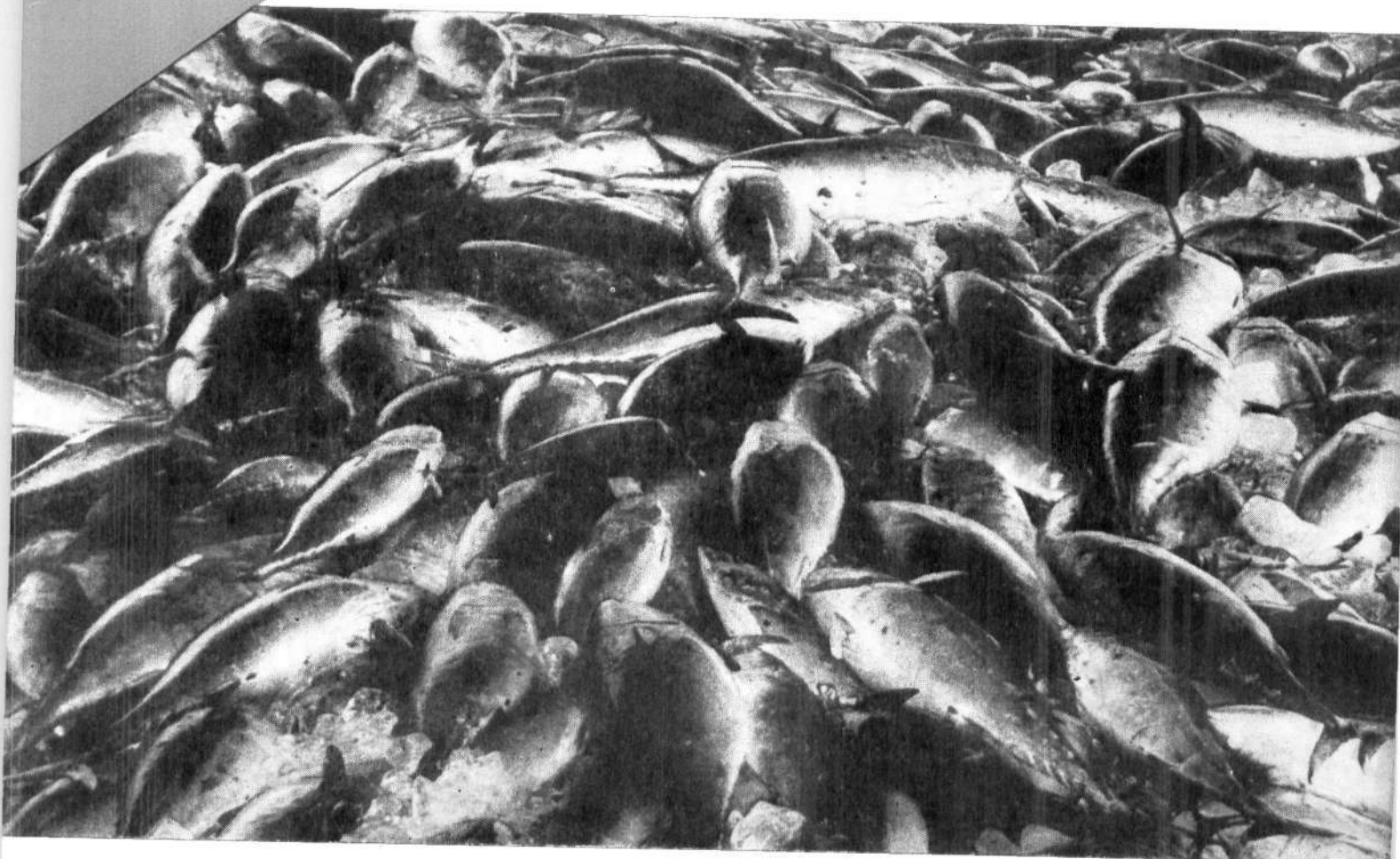
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TUNA FISHERIES OF THE EXCLUSIVE ECONOMIC ZONE OF INDIA: Biology and Stock Assessment

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FISHERY AND BIONOMICS OF TUNAS AT COCHIN

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As stated earlier, the Central Marine Fisheries Research Institute furnishes the production figures of various species of marine fishes based on multistage, stratified random sampling techniques. For detailed biological investigations involving aspects of species composition, size, age, growth, spawning, maturity, food and feeding habits and other parameters, the Project has selected some important centres for tuna investigations which would help in monitoring the resources. The fishery and biological aspects collected from 6 centres *viz.*, Mangalore, Calicut, Cochin, Vizhinjam and Tuticorin in the mainland of India, and from Minicoy in the U.T. of Lakshadweep are analysed and results presented in the ensuing section under different modules.

Prior to 1977, tuna catches at Cochin were insignificant with occasional catches in the experimental purse seine operations of the vessels of the Integrated Fisheries Project and in the artisanal fishery from hooks and lines and shore seines. The small mechanised fishing vessels (9.7 m OAL 'Pablo' type boats) commenced operation of effective nylon drift nets in 1977 bringing in good catches of tunas at the Fort Cochin landing centre. The Cochin Fisheries Harbour was commissioned early in 1978 and in 1979 about 160 gillnetters were registered at this centre. Purse seiners also landed tunas at this centre from 1980 although their contribution to the total catch was relatively low.

FISHING AREA

The area of operation of drift gillnetters is generally in the 20-50 m depth zone off Cochin (Fig. 1). The fishermen start from the base by 1600 hrs and reach the fishing ground by 2000 hrs. Setting and hauling time range from 1-2 hrs depending on the size of the net and the amount of catch respectively. Soaking time usually range between 3-4 hrs. The fishermen get back to the Fisheries Harbour to unload their catch between 0600-0900 hrs. In the case of purse seiners,

operating during the day, the time taken to complete a haul is 1-3 hours depending upon the catch. The catches are sent to the Fisheries Harbour as quickly as possible through carrier boats.

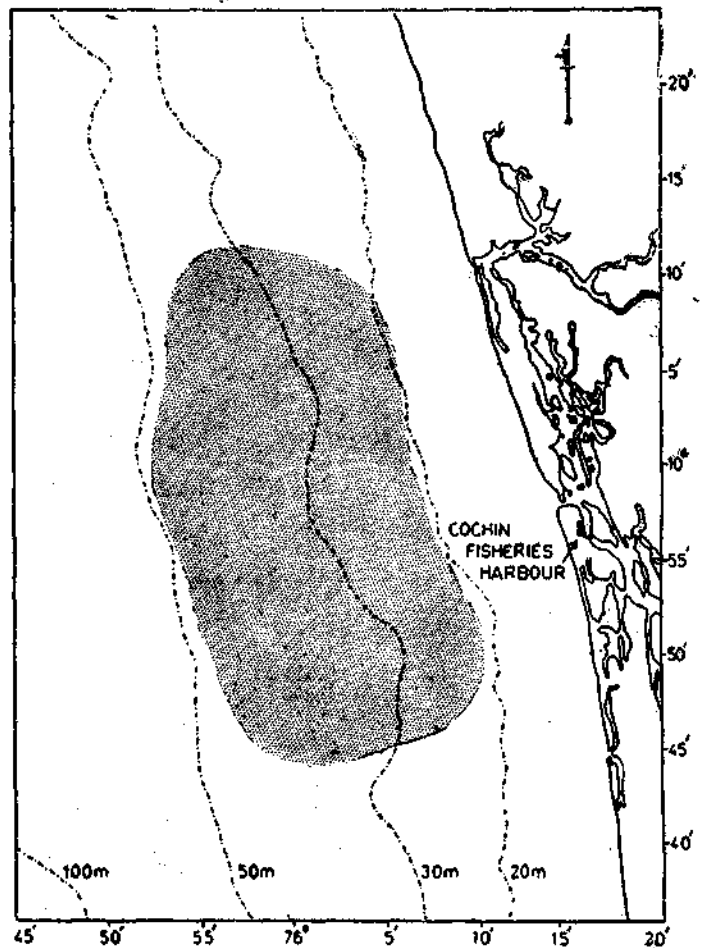


Fig. 1. Operational area of drift gillnetters off Cochin.

CRAFT

The size of the mechanised boats (Pablo type) operating drift gillnets off Cochin range from 7.6-9.7 m (OAL). These boats are fitted with 2 or three cylinder 'Ruston' /

'Bukh'/'Yanmar' (24-45 HP) engines. These mechanised boats are owned by local persons and fishermen, especially from Kanyakumari District in Tamil Nadu. The crew complement is 3-4 persons.

The purse seiners are of wooden hulls, by and large of 43' in length and a few of 38' also. A few of them have fibreglass hulls. The strength of crew of a purse seiner varies from 20-25. This excludes the crew of the carrier boat (2-3).

GEAR

Ninety five per cent of the gear (nylon drift net) are owned by the Tamil Nadu fishermen. The size of the net presently used is 800-1,000 m long and 4-8 m deep. During operation, 9-10 pieces are plied together and suitable floats and sinkers are attached for maintaining buoyancy. The net is fabricated from 6/8/22 nylon monofilament. Usually, the stretched mesh size of the net vary from 7-13 cm.

The purse seine net is of synthetic fibre and usually knotless. This is about 600 m in length with a height of 50 m and with a mesh size of 14-18 mm. About 40-50 brass rings are used for pursing the net.

EFFORT AND CPUE

The relationship between effort and catch and CPUE is presented in Fig. 2. During 1979-82, the effort expended was high, amounting to more than 2500 units in the monsoon months of May to August. The effort expended was relatively low during October to January period. In 1979, maximum effort put in was more than 3400 units in the months of May, July and October in 1980 and 1981 during June to August; and in 1982 in July (3560 units). Although the effort expended were normally low during October to December period, in 1979, lowest effort put in was in June.

CATCH

As in the case of effort, catch was also high during the monsoon months, recording values above 300 tonnes per month in all the four years. Lowest catch during this period was recorded during October-December (Fig. 2).

CPUE

The CPUE showed an unimodal trend in 1980 (110 kg) in June, but in all the other years it was multimodal. In 1979, it was bimodal, maximum CPUE being in June (125 kg). In 1981 and '82 major peaks were in April and July and minor peaks observed were in February and September (Fig. 2).

Purse seiners also landed tunas from 1980 in the Fisheries Harbour, Cochin mainly in the pre-monsoon months of 1980, pre-monsoon and post-monsoon months of 1981 and during the premonsoon months of 1982. The CPUE was relatively high during March and May in 1980, in April and November 1981 (56 and 40 kg) and in May (10 kg) in 1982 (Fig. 3).

CATCH COMPOSITION

Euthynnus affinis and *Auxis thazard* were the two species which contributed to the major share of tunas landed at Cochin (Fig. 4). *E. affinis* contributed to about 61%, 77%, 61% and 44% during the years 1979 to 1982 whereas *A. thazard* contributed to 37.8%, 18.7%, 34.0% and 53% of the catch respectively in these years. Others included longtail tuna, oriental bonito, bullet tuna, yellowfin tuna and billfishes such as sailfish and black marlin which were caught sporadically, and their percentage composition in the total catch was below 5% in all these years. In the purse seine catches also *E. affinis* constituted the dominant species (Fig. 3).

SIZE DISTRIBUTION

The length distribution of different species landed at Cochin Fisheries Harbour showed different pattern during different months.

E. affinis occurred in the size range 20-70 cm in 1979, 22-76 cm in 1980, 22-72 cm in 1981 and 22-70 cm in 1982. Their monthly fluctuations and yearly pooled values are presented in Figs. 5, 6 and 10. During 1979, the major mode was in the size range 52-60 cm, in 1980 it was 48-60 cm, in 1981 in the range 52-60 cm and in 1982 it was in 48-60 cm. Annual pooled values of size groups indicate that the major modes were at 58 cm (1979), 54 cm (1980), 52 cm (1981) and 58 cm (1982). Minor modes were observed at the size 42-48 cm in the years 1980-82. It was also observed that the smaller specimens (20-22 cm size group) of *E. affinis* appeared in the fishery during July-September period of all the four years.

E. affinis taken by the purse seine gear showed a bimodal distribution, the major mode at 52 cm and another mode at 58 cm size (Fig. 14).

The monthly size distribution of *A. thazard* have shown that they occurred in the size range 22-48 cm in the landings at Cochin (Fig. 7). Monthly modes were invariably around 36-42 cm. Annual pooled figure indicates that their major mode was at 38-40 cm size, in the years 1979-82 (Fig. 10).

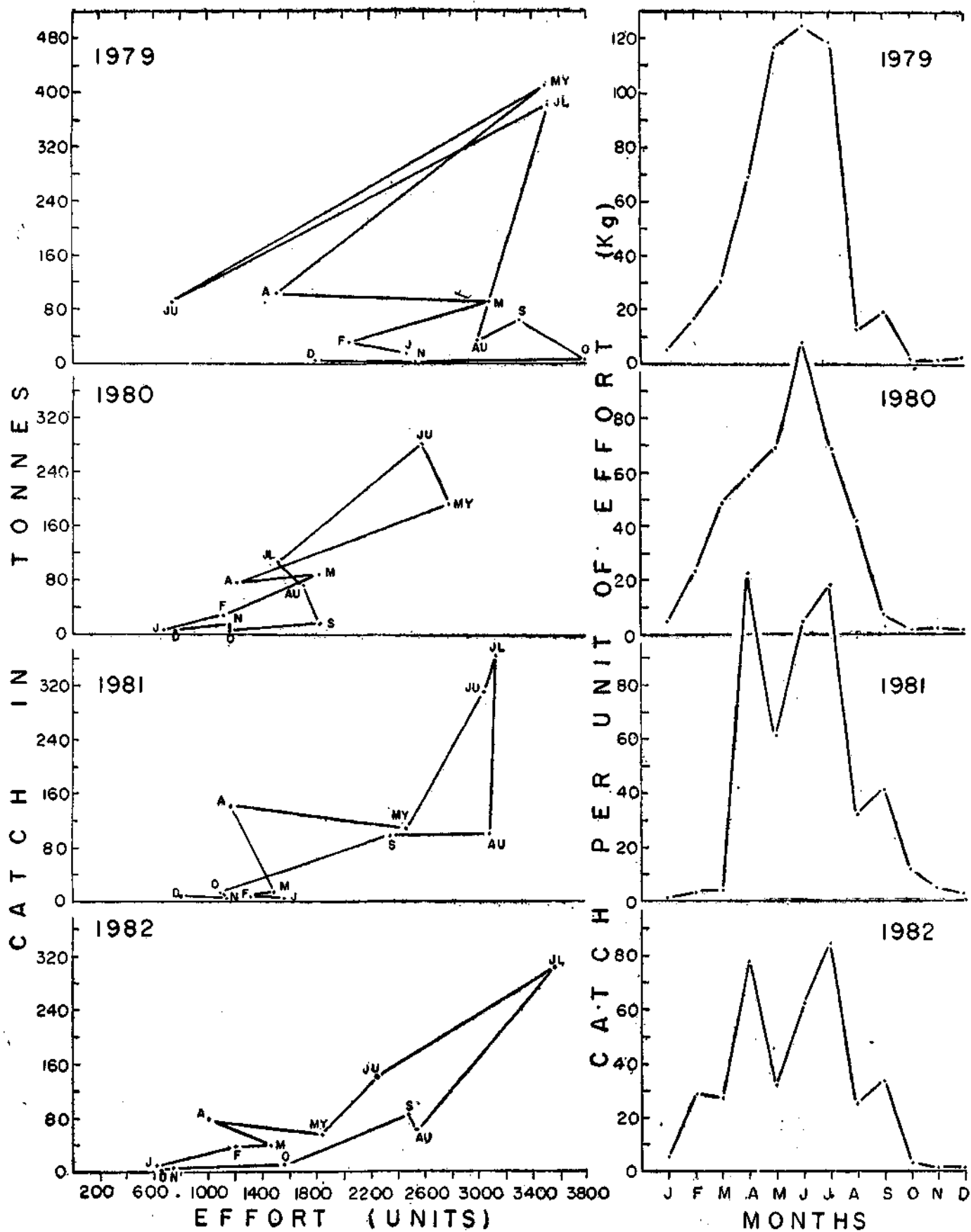


Fig. 2. Catch-effort relationship and catch per unit of effort of tunas in the drift gillnet fishery at Cochin, 1979-'82.

T. tonggol appeared infrequently in the landings and was represented by specimens in the size range 30-72 cm. Although no major mode is discernible, it was

8 and 9). Annual pooled size group distribution indicate bimodal peaks, the major peak at 44-48 cm and the secondary peak at 56-60 cm size group.

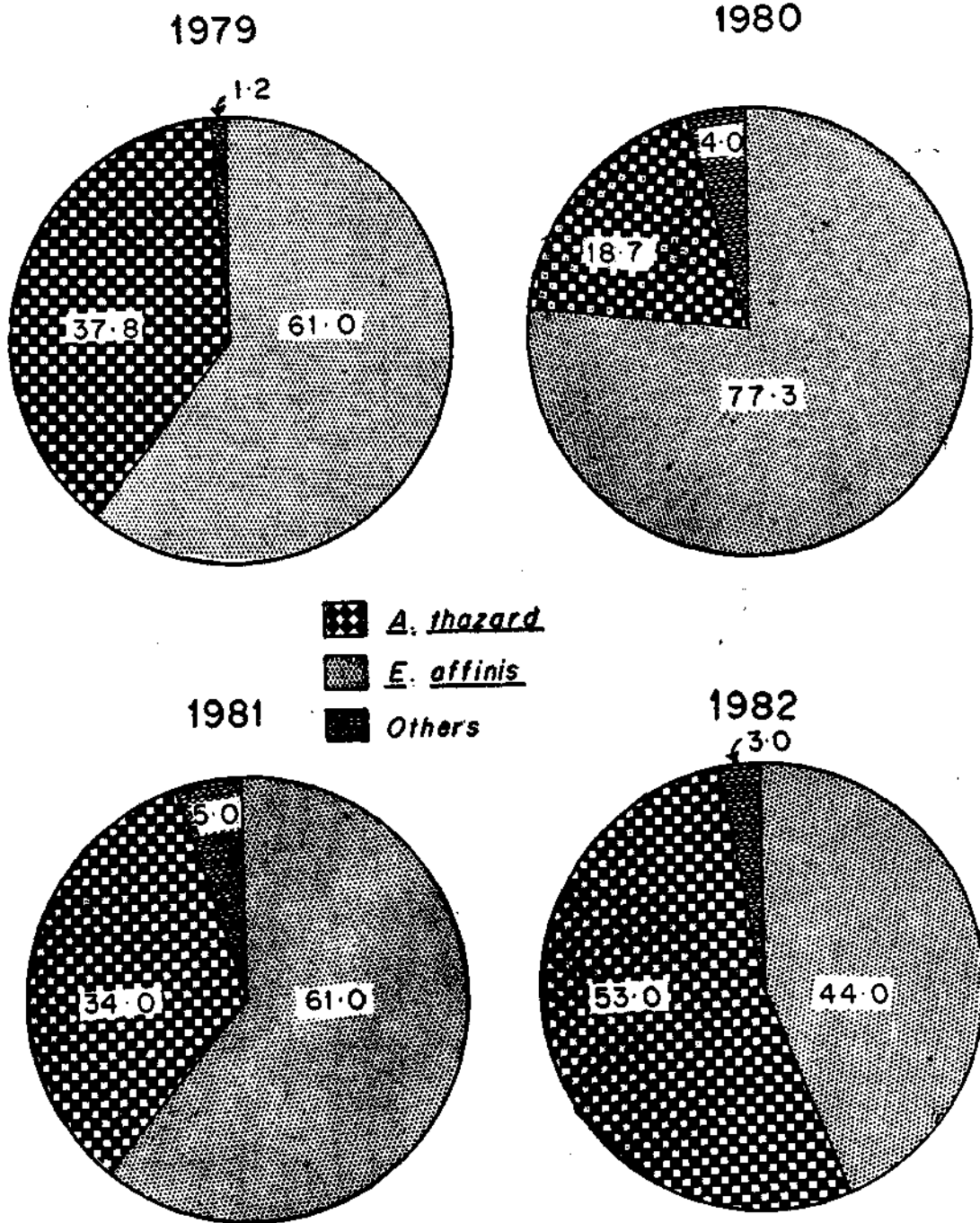


Fig. 3. Percentage composition of different species of tunas and billfishes in the drift gillnet fishery at Cochin, 1979-'82.

observed that relatively small specimens occurred in the January to June period and bigger ones in the later half of all these years. Small sized specimens (30-42 cm) occurred in all the three years in February (Fig.

S. orientalis was met with in the collections during May-November in 1980, May-September in 1981 and May to October in 1982 (Fig. 12). They occurred in the size range 28-60 cm and their major modes were

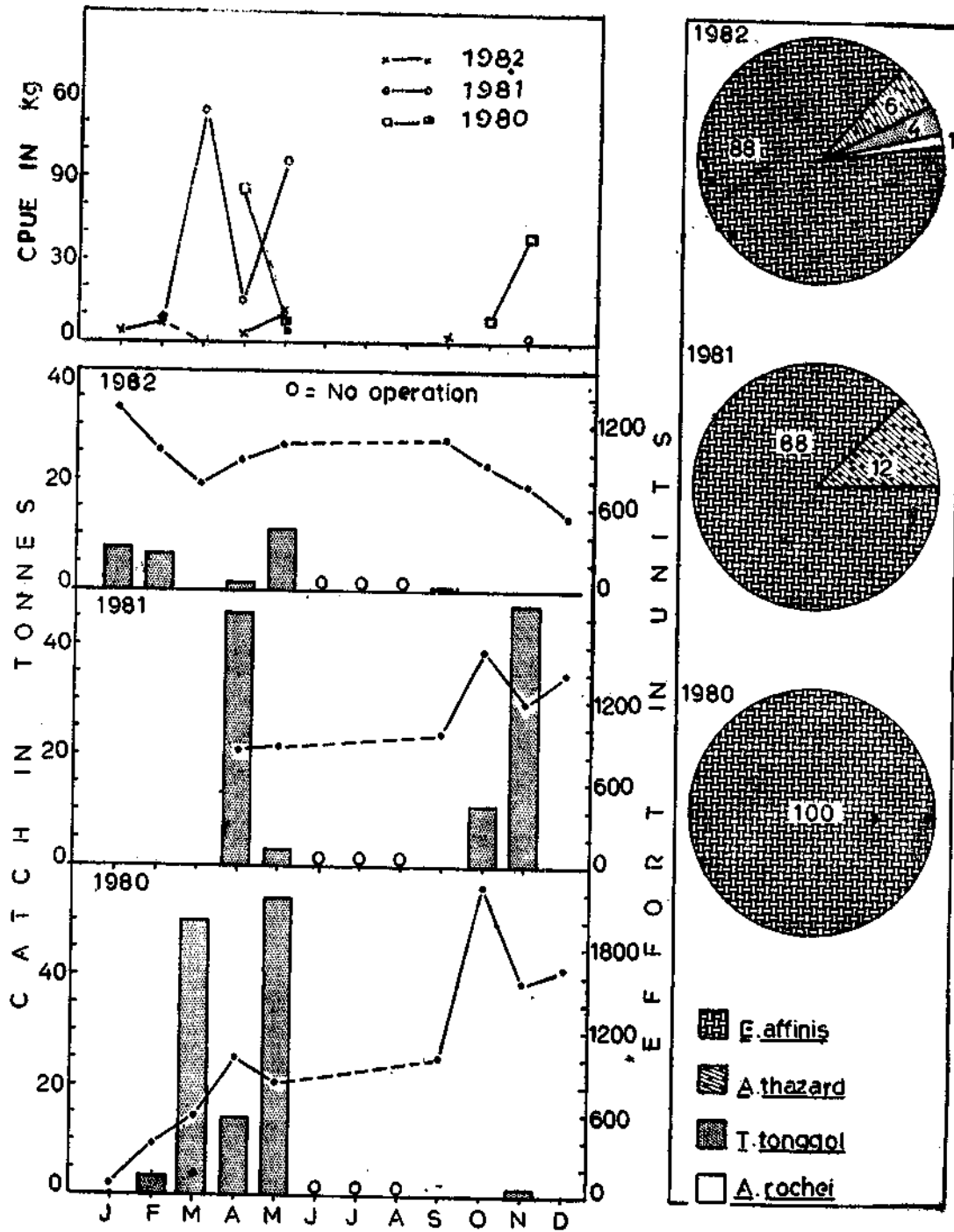


Fig. 4. Catch-effort relationship and catch per unit of effort of tunas and percentage composition of different species of tunas in the purse seine fishery at Cochin, 1980-82.

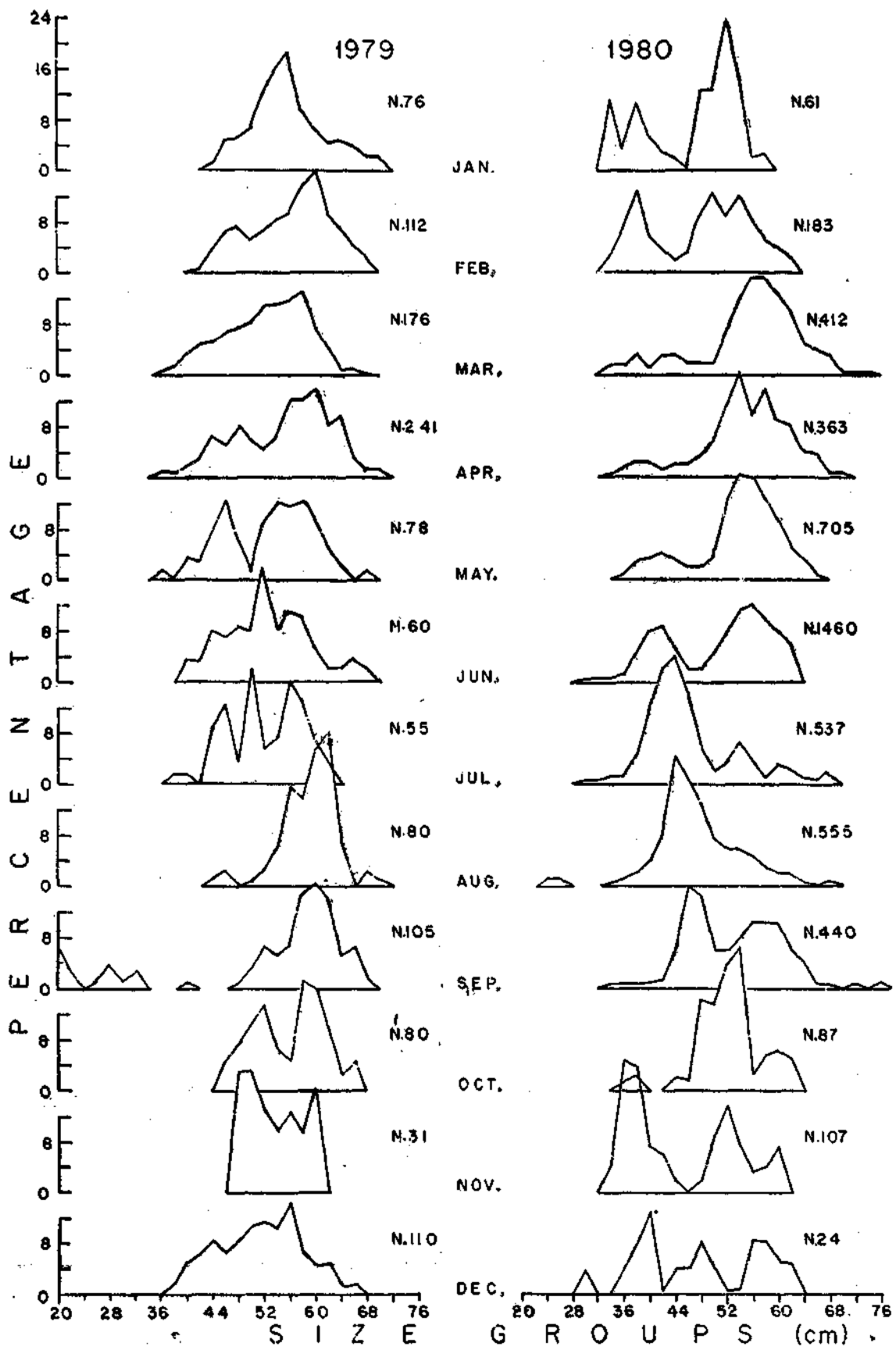


Fig. 5. Monthly length frequency distribution (percentage) of *E. affinis* at Cochin, 1979-'80.

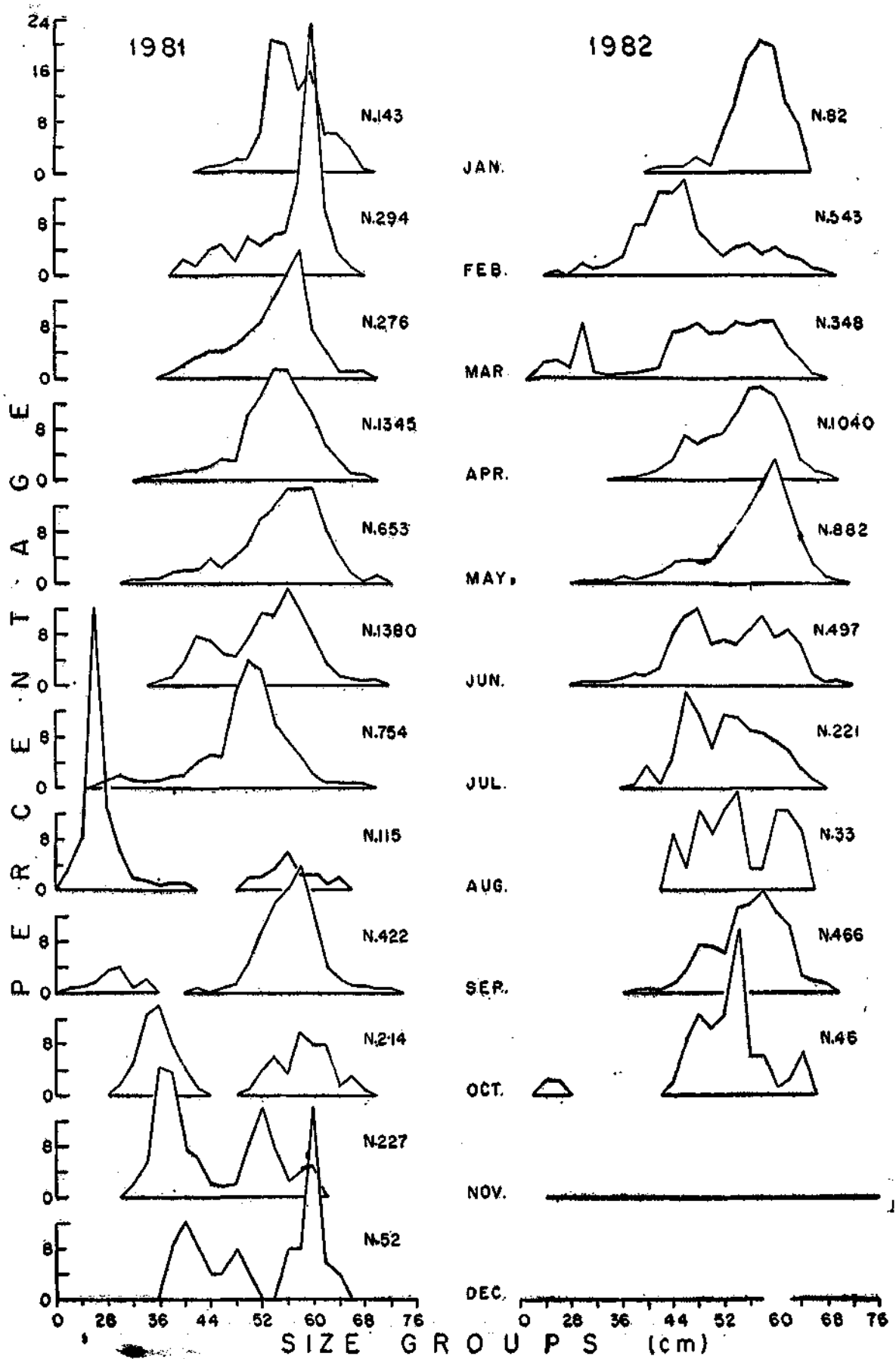


Fig. 6. Monthly length frequency distribution (percentage) of *E. affinis* at Cochin, 1981-'82.

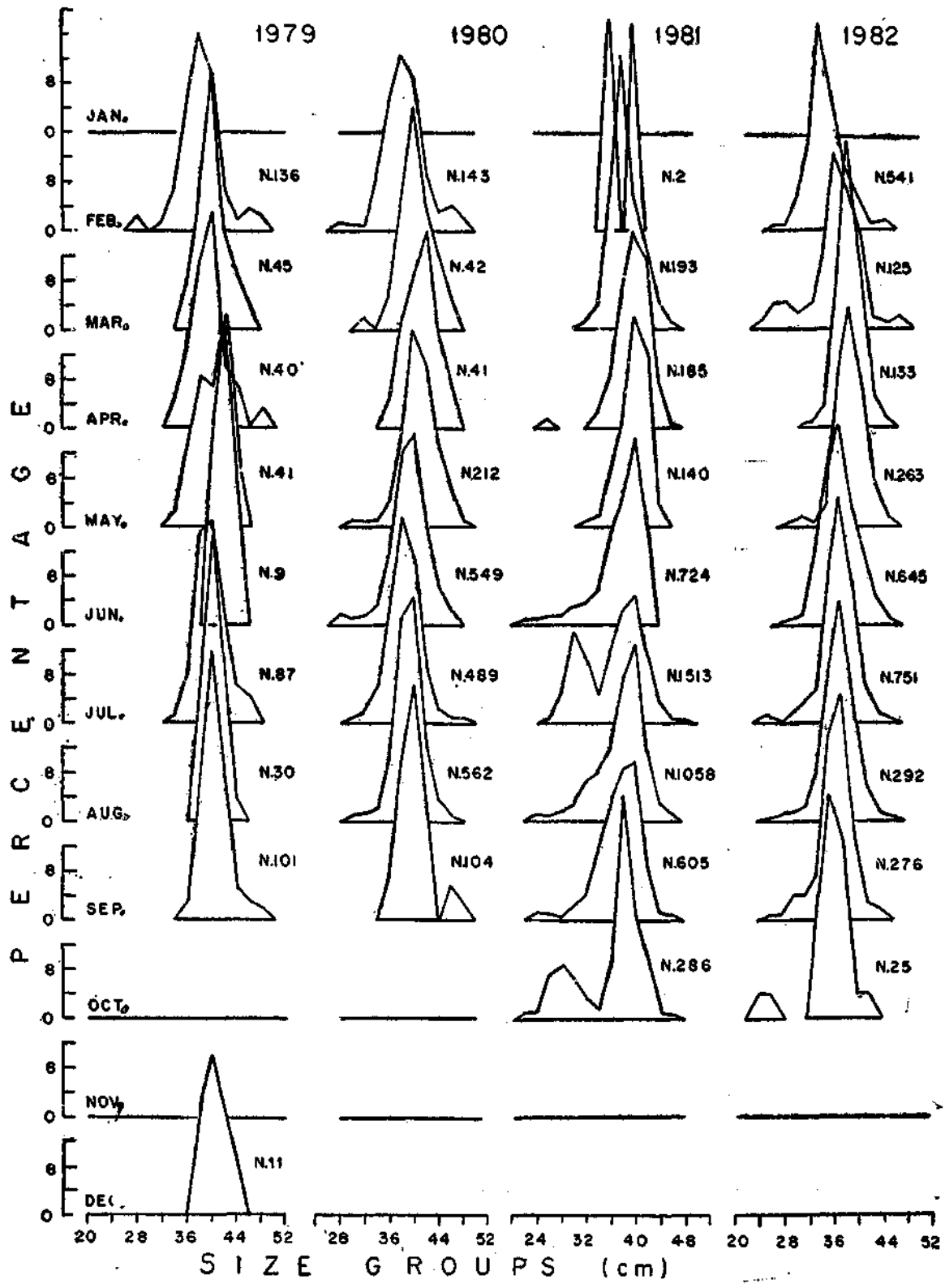


Fig. 7. Monthly length frequency distribution (percentage) of *A. thazard* at Cochin, 1979-82.

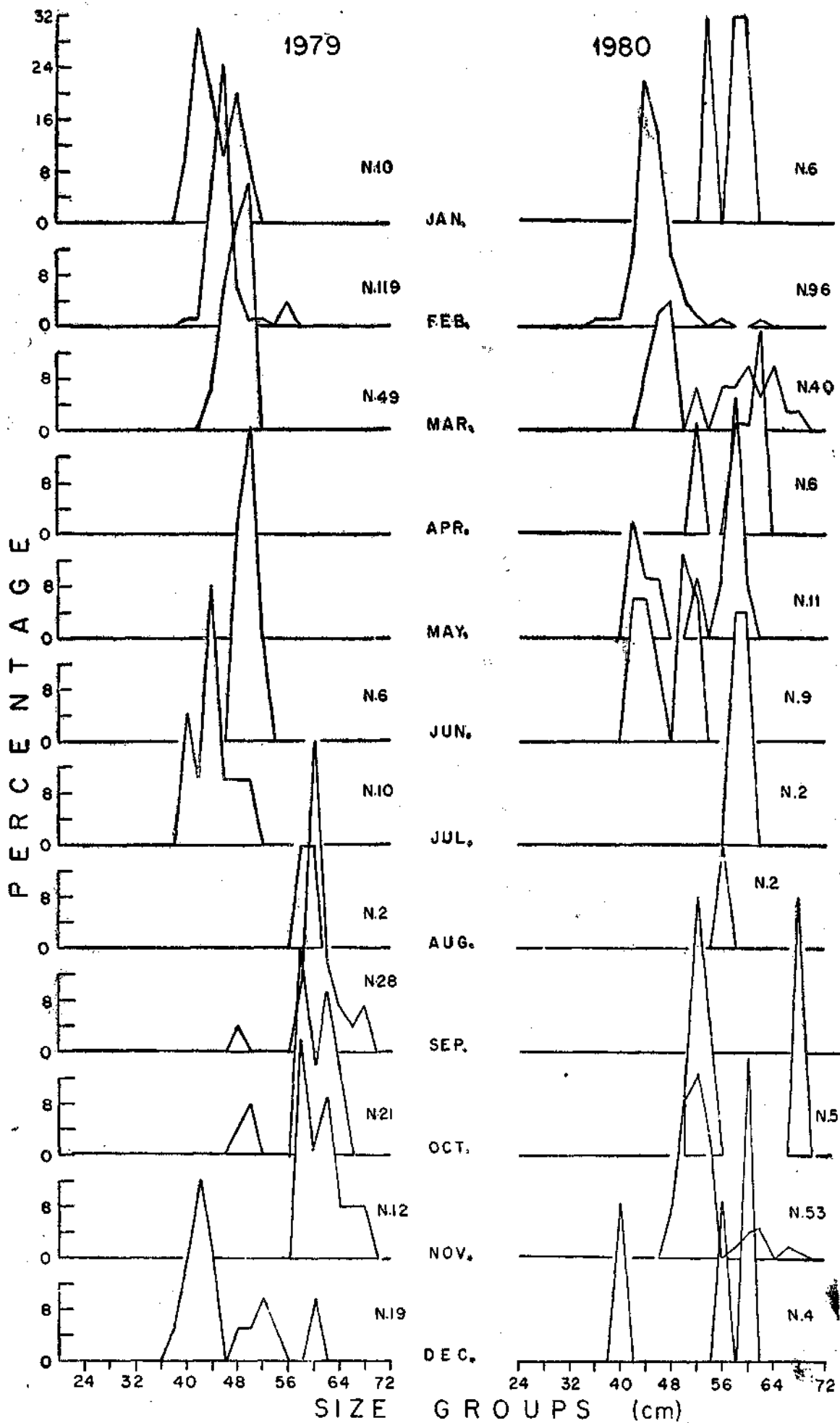


Fig. 8. Monthly length frequency distribution (percentage) of *T. tonggol* at Cochin, 1979-'80.

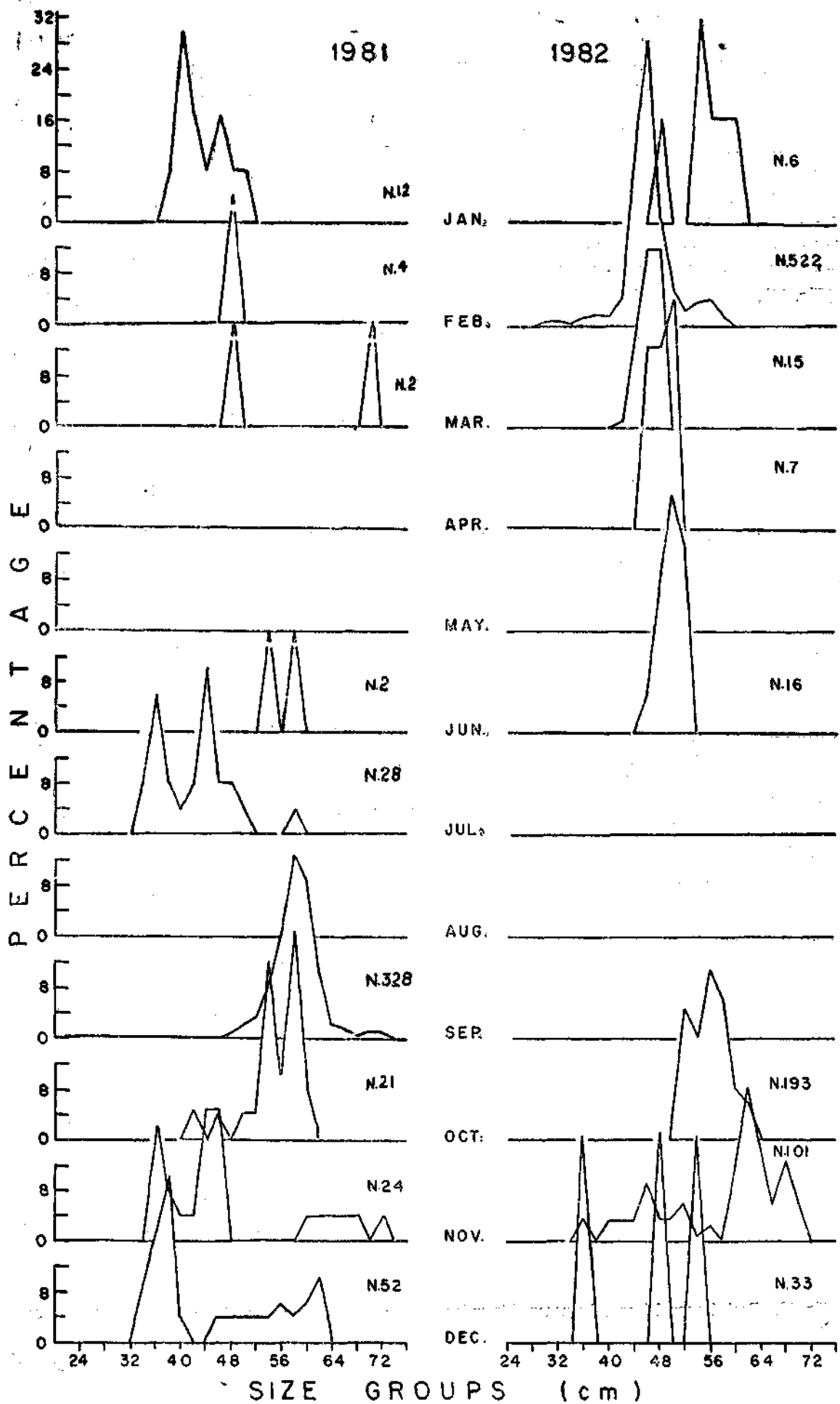


Fig. 9. Monthly length frequency distribution (percentage) of *T. tonggol* at Cochin, 1981-'82.

observed in the samples between 44-50 cm. The smallest specimen (28 cm) was observed in August 1981.

Similar to *S. orientalis*, *A. rochei* also showed seasonality in the occurrence. They were present in the sample during July to September in 1980, June to August in 1981 and April to October in 1982. They occurred in the size group 18-34 cm and monthly modal distribution indicate that they were dominant in the 26 cm size group in 1980 and '81 and in 26-32 cm size group in 1982 (Fig. 11).

LENGTH-WEIGHT RELATIONSHIP

The exponential relationship of length and weight of different species observed at Cochin (Fig. 13) is as follows :

<i>E. affinis</i>	:	$W = 0.0000213 L^{2.06244}$
<i>A. thazard</i>	:	$W = 0.000015012 L^{3.04329}$
<i>A. rochei</i>	:	$W = 0.00001487 L^{2.92648}$
<i>S. orientalis</i>	:	$W = 0.000017739 L^{2.97361}$
<i>T. albacares</i>	:	$W = 0.0002005 L^{2.42007}$
<i>T. tonggol</i>	:	$W = 0.0000065689 L^{3.19058}$

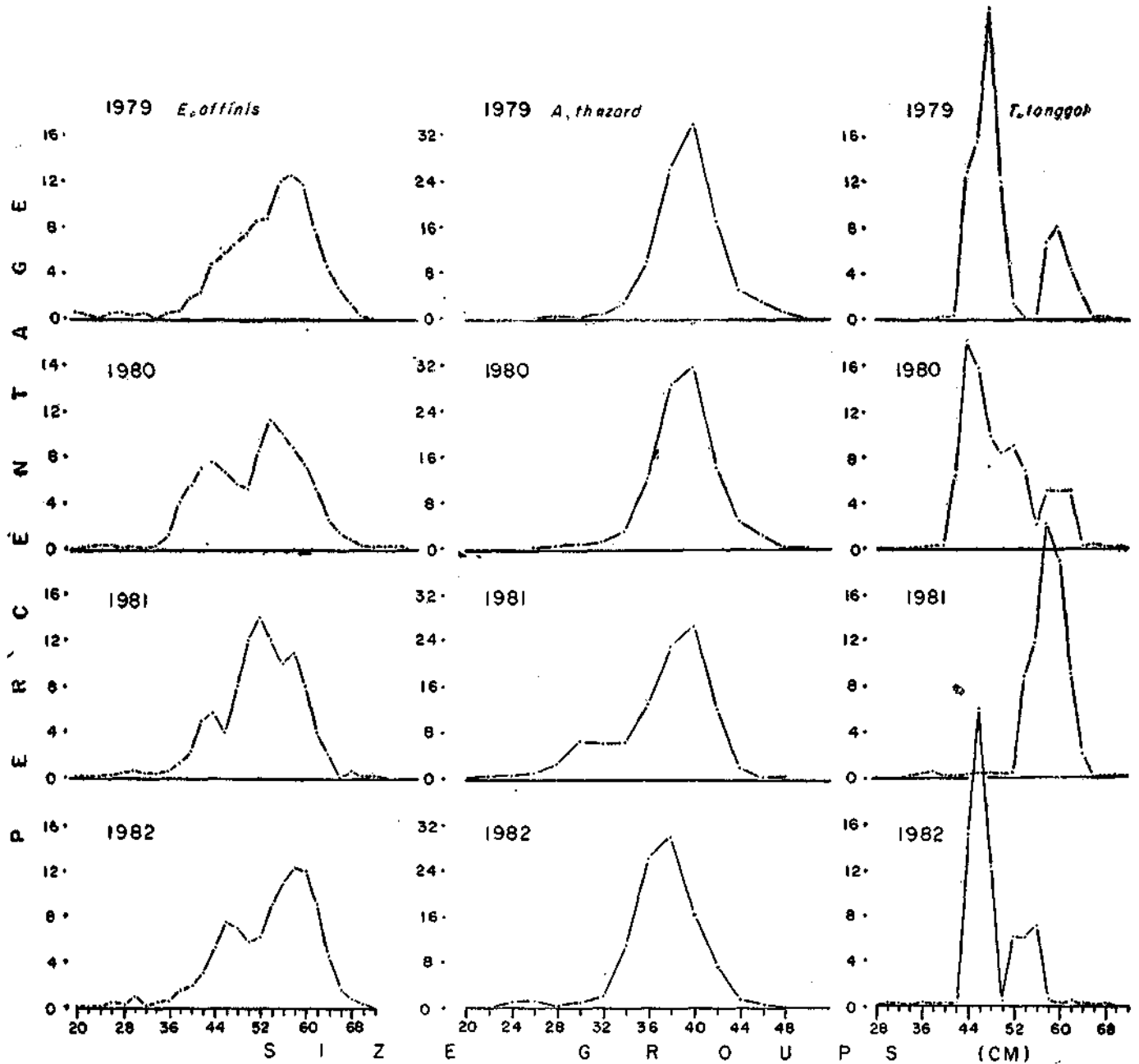


Fig. 10. Pooled annual length frequency distribution of *E. affinis*, *A. thazard* and *T. tonggol* at Cochin, 1979-'82.

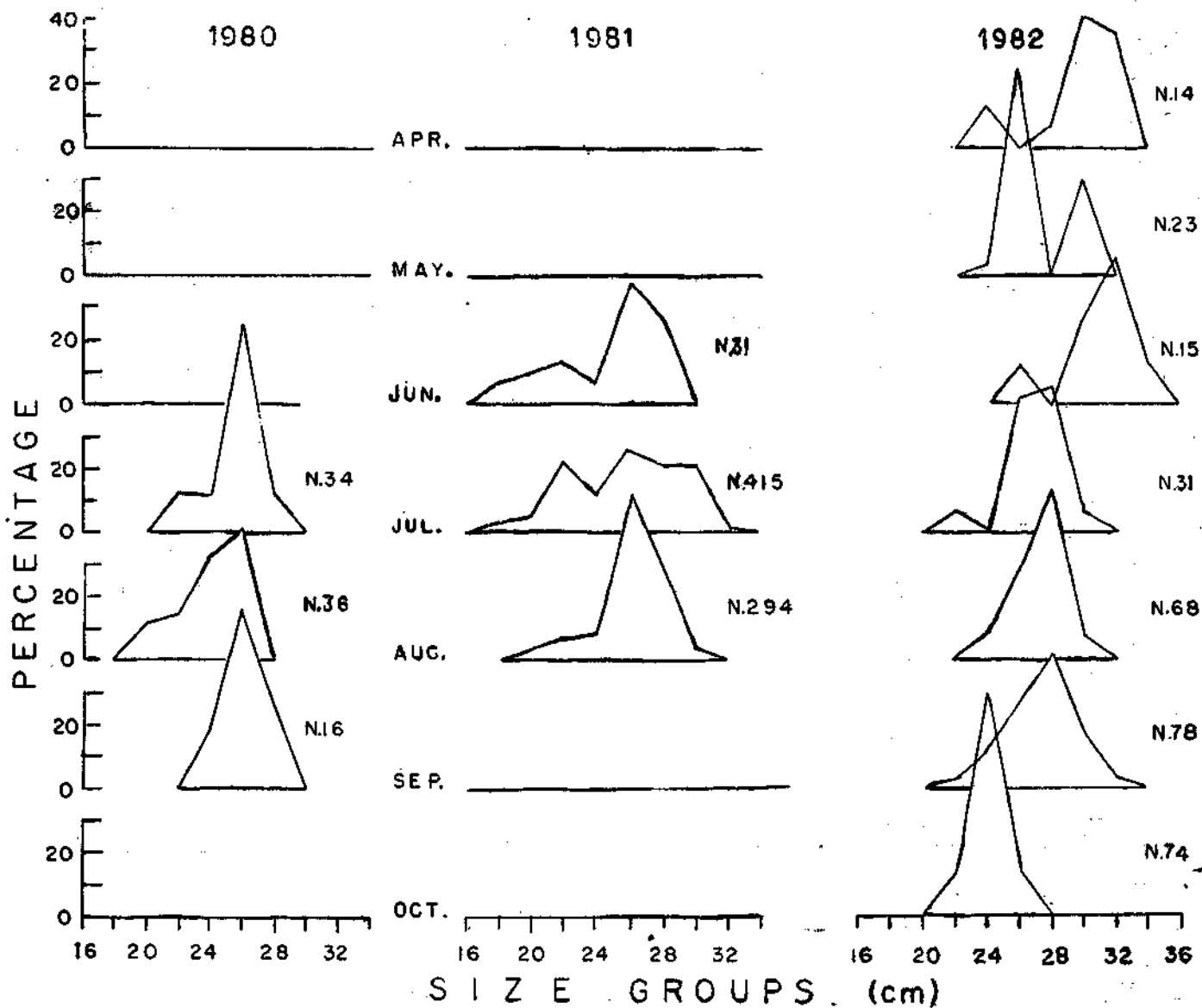


Fig. 11. Monthly length frequency distribution of *A. rochei* at Cochin, 1980-82.

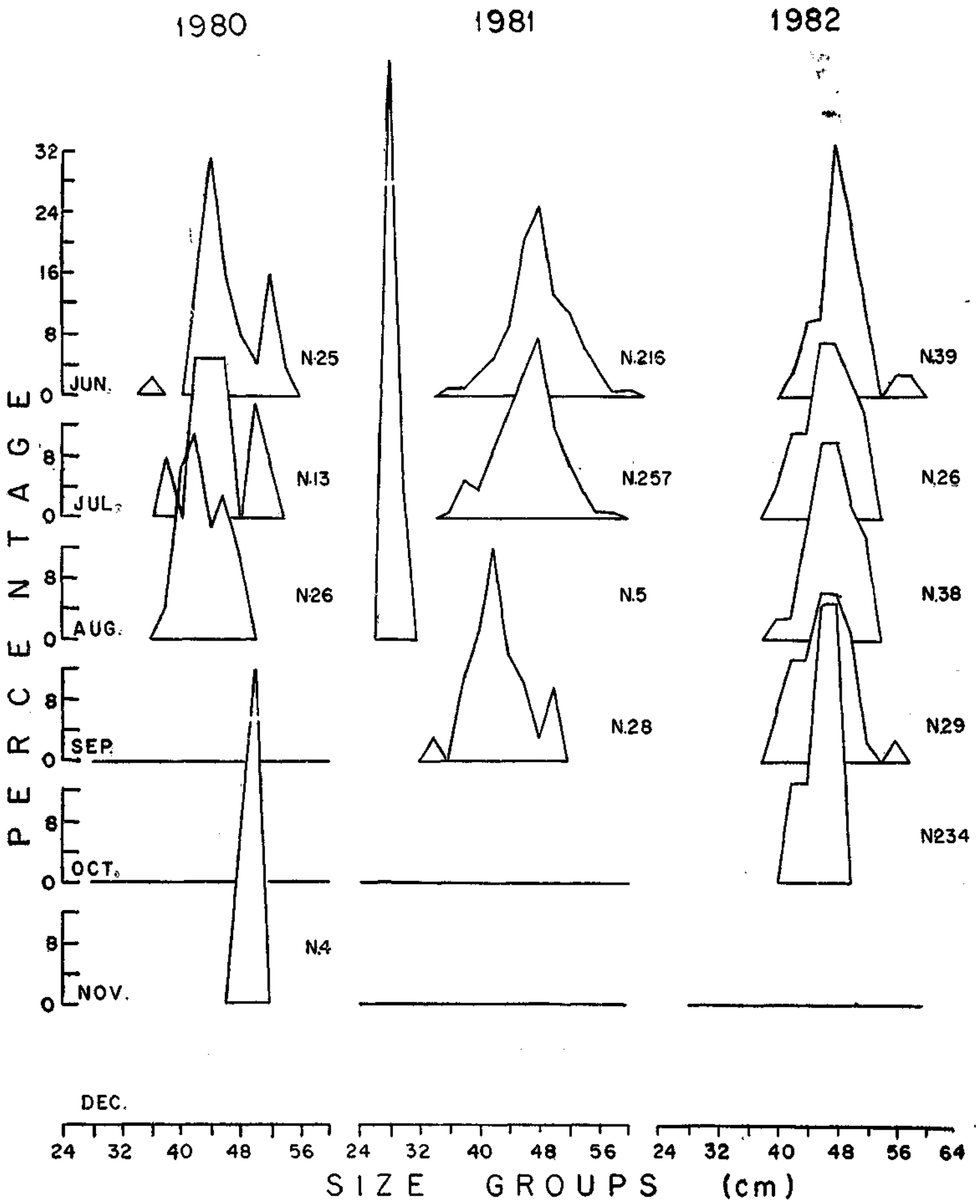


Fig. 12. Monthly length frequency distribution of *S. orientalis* at Cochin, 1980-'82.

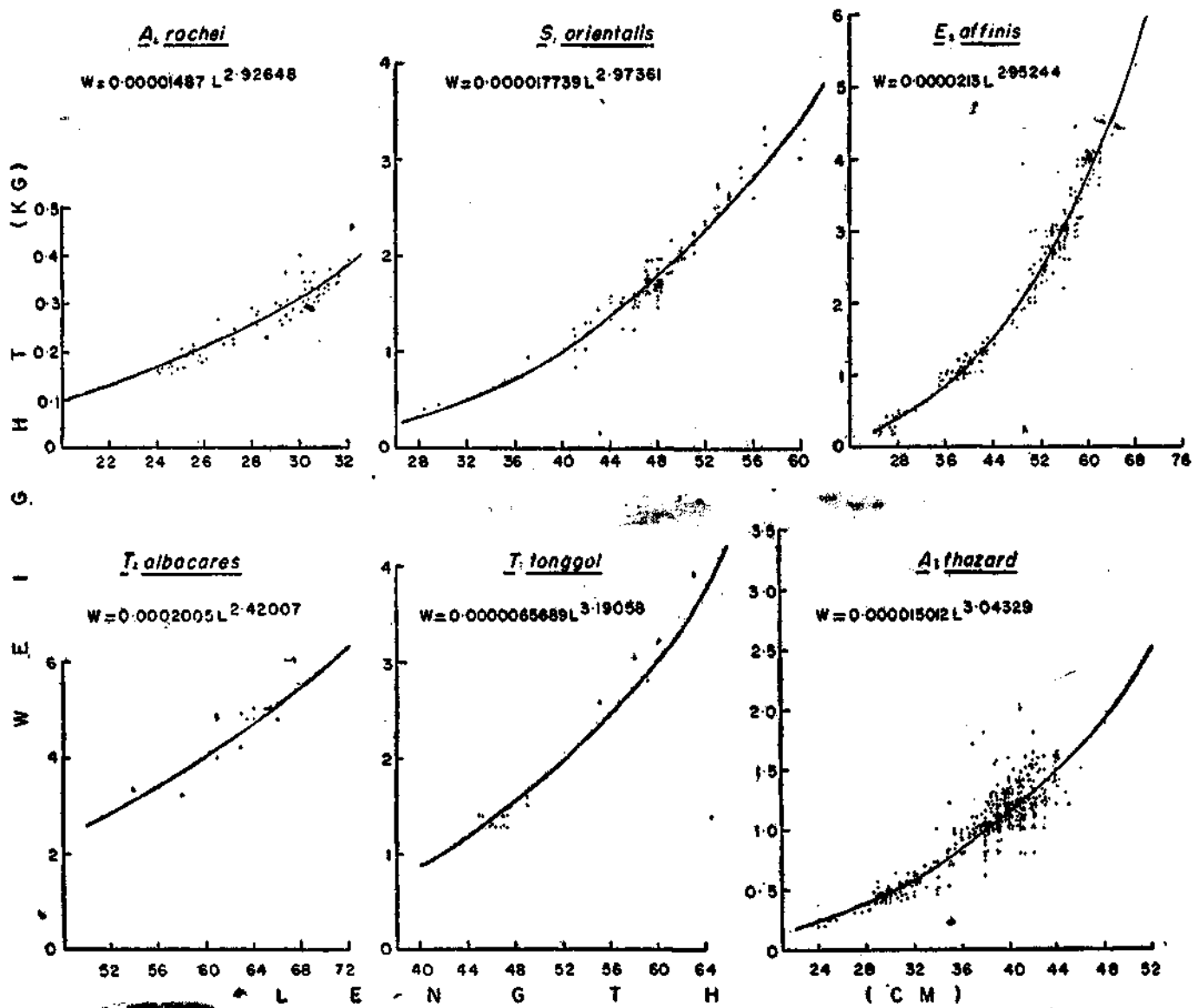


Fig. 13. Length-weight relationship of *A. rochei*, *S. orientalis*, *E. affinis*, *T. albacares*, *T. tonggol* and *A. thazard* at Cochin, 1979-'82.

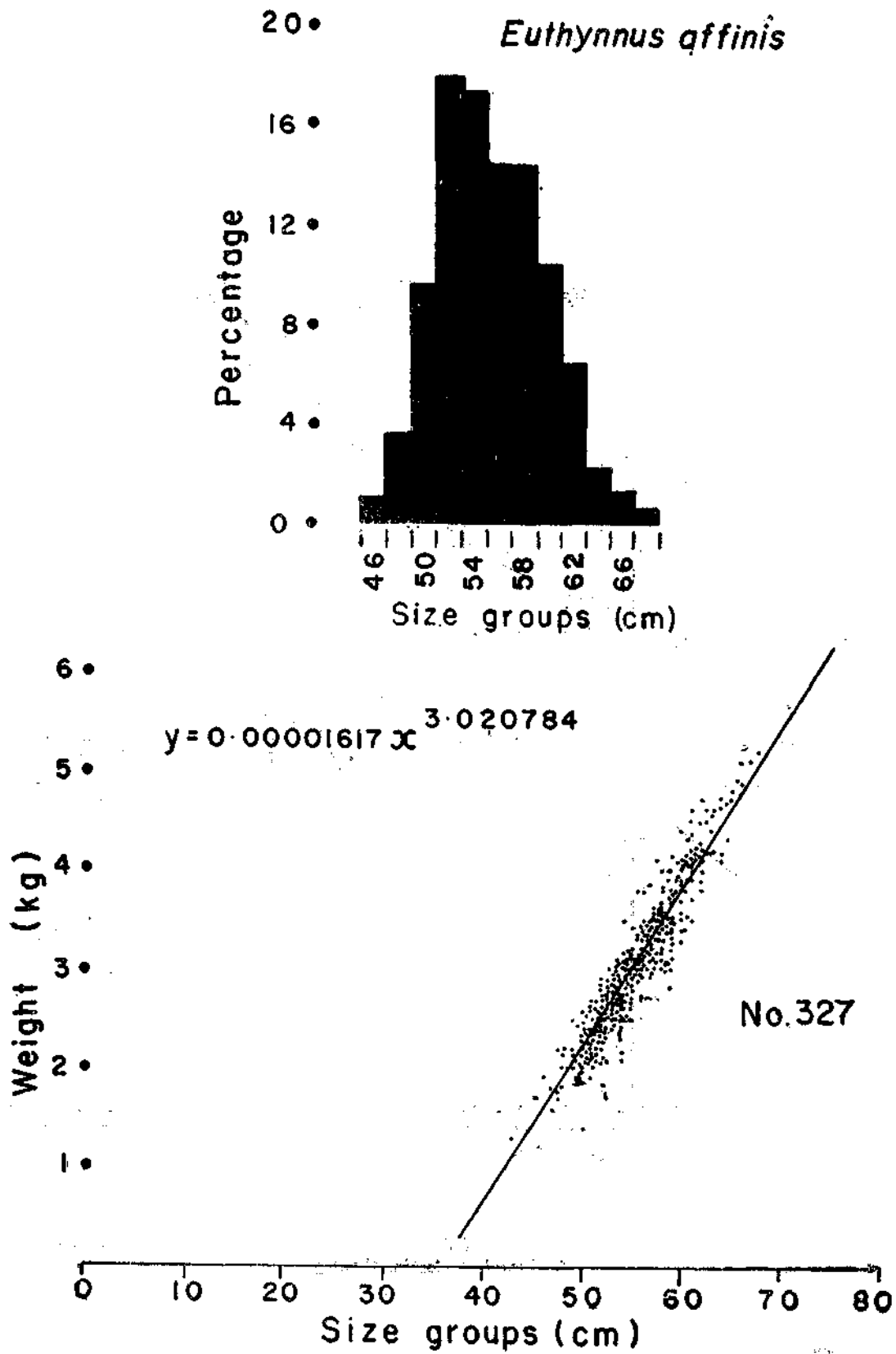


Fig. 25. Length frequency distribution (percentage) and the length-weight relationship of *E. affinis* taken by purse seine at Cochin, 1981-'82.

The results of studies on the length-weight relationship ($W = aL^b$) of *E. affinis* and *S. orientalis* conducted by the earlier authors are presented here for comparison :

Species & locality	Fork length (cm)	a	b	Wt. Unit	Lt. Unit	Source
<i>E. affinis</i> (Indian Ocean)	52-71	0.0166	2.963	gm	cm	Morrow (1954)
<i>E. affinis</i> (Indian Ocean)	12-58	0.0137	3.0249	gm	cm	Sivasubramaniam (1966)
<i>E. affinis</i> (Indian Ocean)	..	0.0138	3.0287	gm	cm	Silas (1967)
<i>E. affinis</i> (South China Sea)	..	0.08853	2.5649	gm	cm	Williamson (1970)
<i>E. affinis</i> (Hawaii)	..	0.0108	3.1544	gm	cm	Tester & Nakamura (1957)
<i>E. affinis</i> (M) (Philippines)	34.4-81.0	0.0334	2.83768	gm	cm	Ronquillo (1963)
<i>E. affinis</i> (F) (Philippines)	33.1-65.2	0.0211	2.94854	gm	cm	Ronquillo (1963)
<i>S. orientalis</i> (Indian Ocean)	..	0.0152	2.958	gm	cm	Sivasubramaniam (1966)

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