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Dr. P.S.B.R. JAMES
DIRECTOR
Central Marine Fisheries Research Institute
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Edited by

Dr. K.J. MATHEW
Central Marine Fisheries Research Institute
COCHIN - 682 031

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OCEANIC SQUID RESOURCES OF THE EEZ OF INDIA

K. Prabhakaran Nair, K. Satyanarayana Rao*, R. Sarvesan*, M.M. Meiyappan*, G. Syda Rao**, Mathew Jospeh and D. Nagaraja *

Central Marine Fisheries Reserach Institute, Cochin - 682 031

Abstract

Surveys made by FORV *Sagar Sampada* using pelagic trawl specifically for oceanic squids in the Arabian Sea within 6°30'-22°07'N and 64°16'-78°00'E and in the Bay of Bengal within 15°00'-19°00'N and 82°40'-87°25'E have revealed the occurrence of the squid *Symplectoteuthis oualaniensis* (Lesson) at many stations with depths over 1000 m. About 95% of the squids were taken in night hauls, which indicates that this species has the habit of nocturnal vertical migration towards surface. There was great variation in size, from 20 mm dorsal mantle length to the largest squid of 472 mm weighing over 4.5 kg. Most of the squids were immature and of small size, with unequal sex ratio. Mature squids were almost equal in number. This species feeds mainly on fish and crustaceans.

Introduction

The neritic squids of the family Loliginidae and the oceanic squids of Ommastrephidae account for over 70% of the world's cephalopod catch. A substantial portion of the squid catch is constituted by oceanic squids of the Atlantic and Pacific Oceans. There is very little exploitation from the Indian Ocean and more so from the Indian waters. The occurrence of different species of oceanic squids in our waters had been recorded by Fillippova (1968), Silas (1968, 1969), Okutani (1973), Yamanka *et al.* (1976, 1977) and Roper (1984), and some of these authors have indicated the possibility of oceanic squids being potential species for exploitation. However, no attempts have been made to locate and identify the stock of potential species primarily because we did not have the means to venture into the oceanic waters. With the acquisition of FORV *Sagar Sampada* for making exploratory surveys and oceanographic studies in the Exclusive Economic Zone of India, it has become possible to study the distribution of oceanic squid resources in the Arabian Sea and the Bay of Bengal. This account is based on the results of surveys made during 1985-'88 period.

Material and Methods

Three surveys were made in the Arabian Sea and one in the Bay of Bengal with the objective of locating and assessing the oceanic squid resources; apart from these, the data available on the squids obtained in another cruise (SS/20/86) are also included here. The details of the cruises, including the number of stations from where oceanic squids were obtained are given in Table 1. Data on squids collected in many other cruises are not included as they were not direct observations of the authors. The oceanic squids were netted in pelagic trawl. The bottom depths of stations varied from 250 m to 3,671 m , and the depth at which the net was operated was 40-250 m from the surface. The squids obtained were analysed for species composition, and the most abundant species *(Symplectoteuthis oualaniensis)* was biologically sampled for length-frequency, maturity stages and food habits. The size of squid always refers to dorsal mantle length.

Observations

Species

The most important squid at all stations was the purpleback flying squid *Symplectoteuthis oualaniensis* (Lesson) of the family Ommastrephidae which comprises the economically important species of oceanic squids of the world. Apart from this species very stray numbers of *Onychoteuthis bnksii* (Leach) of the family Onychoteuthidae, *Thysanoteuthis rhombus* Troschel (family: Thysanoteuthidae) and fairly good numbers of small species of oceanic squids belonging to the family Enoploteuthidae were also collected.

Areas of occurrence

The geographical position of stations from where the purpleback flying squid was obtained

Present address : * Madras Research Centre of CMFRI, Madras.
** Kakinada Research Centre of CMFRI, Kakinada.

TABLE 1. *Survey of oceanic squids - details of cruises*

Cruise No.	Month	Area	Depth (m)	No. of squid stations
9	Oct., 1985	15°30'-18°30'N 67°30'-71°00'E	1550-3671	5
20	Aug. - Sep., 1986	06°30'-15°23'N 72°00'-78°00'E	941-2893	5
22	Oct., 1986	17°58'-22°07'N 64°16'-69°03'E	2475-3437	10
37	Oct., 1987	15°59'-21°00'N 67°00'-69°50'E	1307-3200	3
44	Mar., 1988	15°00'-19°00'N 82 °40' 87°25'E	250-3100	6

and the number of squids collected in each pelagic trawl operation at these stations are shown in Fig. 1. In Cruise 9, the occurrence of the squid was noticed at five stations. Attracted by the ship's lights at night, the squids were seen aggregating near the surface, but they were not caught in the pelagic trawl. At Station 242 (17°30'N, 71°00 'E), a squid of 268 mm dorsal mantle length was taken in a hand-jig operated at night from the deck of the ship. In Cruise 20, the objective of which was to study the distribution and abundance of demersal and pelagic resources, the purpleback flying squid was obtained from five stations within 6°30'- 15°23'N and 72°-78°E, varying from 11 to 33 squids.

In Cruise 22 in which the northeastern Arabian Sea off Maharashtra-Gujarat coasts within 17°58' - 22°07'N and 64°16'- 69°03'E was surveyed, this squid was obtained from as many as ten stations, and their number ranged from one to 318 squids. Cruise 37 also was in the same area but slightly towards the coast. Squids came from three stations, the number varying from 15 to 56.

Cruise 44 was in the northern Bay of Bengal with pelagic trawl operation at nine stations out of

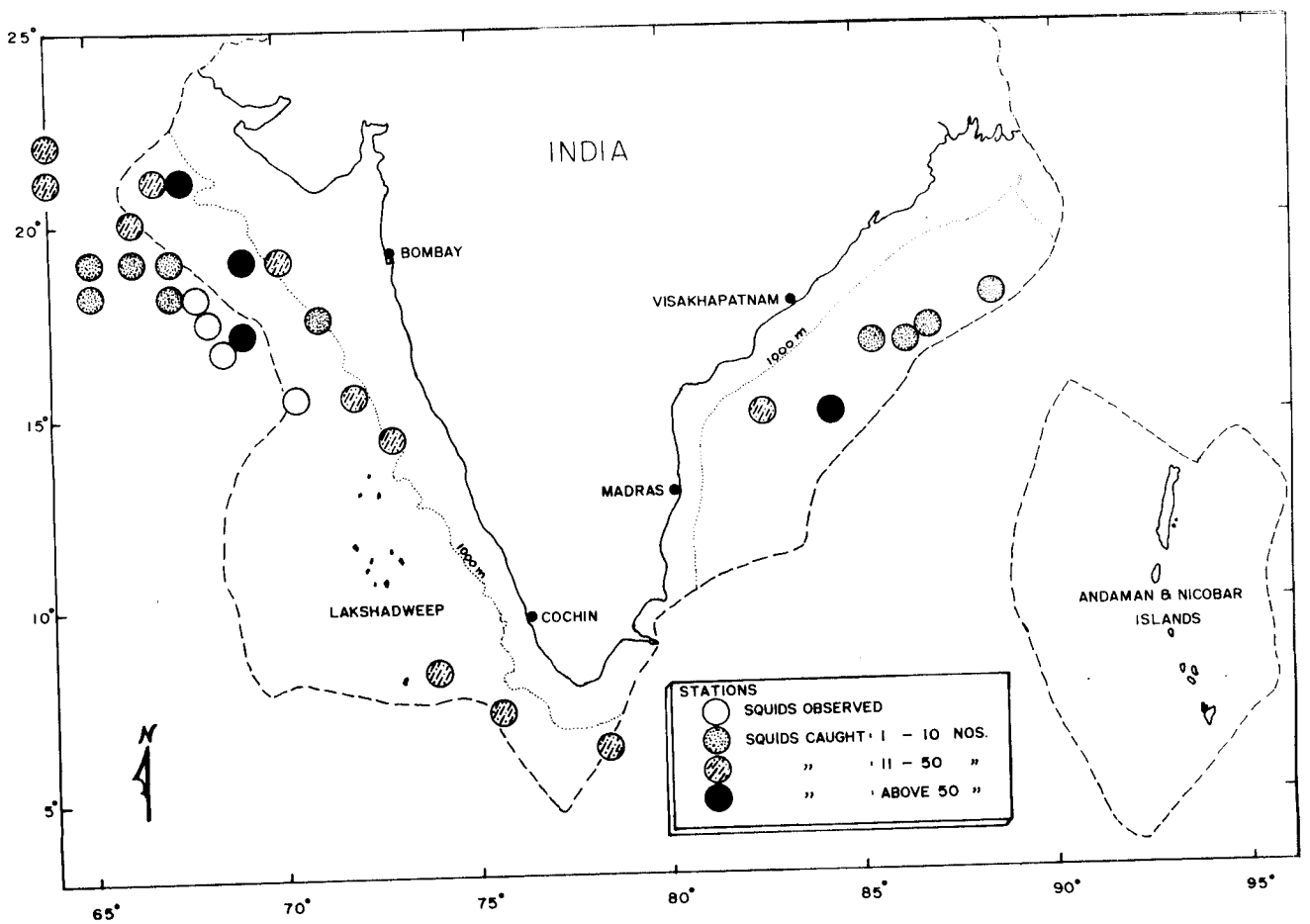

Fig. 1. Sagar Sampada cruise stations where *Symplectoteuthis oualaniensis* occurred, and the intensity of occurrence.

which six stations within 15°-19°N and 82°40'-87°25'E gave oceanic squids. A total of 119 squids was obtained in this cruise and the maximum number (65) was at Station 1366 (15°N, 84°15'E) where the depth was 3,100 m and the depth of operation of the net 60 m.

Diel variation

It was observed that the number of squids caught during the night was much higher than those taken during day. Table 2 gives the number of squids caught in night and day hauls during the 5

TABLE 2. *Day-night variations in number of* Symplectoteuthis oualaniensis

Cruise No.	Day	Night	Total
9	-	1	1
20	17	100	117
22	3	494	497
37	15	88	103
44	37	82	119

cruises. It is seen that out of a total of 837 squids, as many as 765 (91%) were taken at night and only 72 (9%) at day. This trend was noticed during all the cruises.

Size range

The length-frequency data of *Symplectoteuthis oualaniensis* available for three cruises are presented in Fig. 2. The squids collected in cruise 20 had a size range of 50-210 mm (Fig. 2A). Of these, the males had a smaller size range between 70 mm and 120 mm, with a modal size of 95 mm. The females were in larger size range with the maximum length of 210 mm but their modal size was smaller than that of males, 75 mm. There were no female squids in sizes between 130 and 160 mm, and above this upto 210 mm they were very rare.

The length data separately for males and females are not available for Cruise 22, and therefore the combined frequency is shown in Fig. 2 B. The size range was very large, 20-480 mm. The length classes between 30 and 60 mm were not represented; from 250 mm onwards the occurrence was discontinuous. There were two main modes, the larger mode at 115 mm and the smaller at 175 mm. The largest squid had a length of 472 mm (470-480 mm length class) and it weighed 4.7 kg. Another squid measuring 456 mm weighed 3.5 kg. There were six squids above 400 mm, and they were caught from depths of 110-250 m, four of them at night and the rest during day and evening hours.

In cruise 37, the size of squids varied from 90 mm onwards, and the largest squid caught was 425 mm in length weighing 4.5 kg. This was caught from a depth of 120 m at station 1225 (20°N and 67°E) where the bottom depth was 2,034 m .

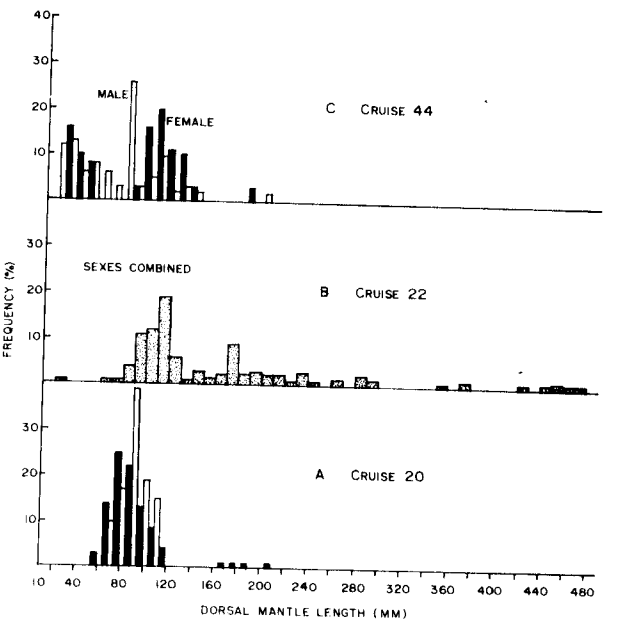

Fig. 2. Length-frequency of *Symplectoteuthis oualaniensis* collected during Cruise 20 (A), 22 (B) and 44 (C).

In cruise 44 (Fig. 2 C) the males measured 20-210 mm with gaps of length groups in between. The main mode was at 85 mm. The females ranged from 20 mm to 190 mm with discontinous length classes within 50-80 mm and within 140-180 mm. The main modal size for females was 105 mm.

Food

Symplectoteuthis oualaniensis feeds on a variety of organisms, as observed from the stomach contents. They include small fishes, pelagic crustaceans and other cephalopods. Since stomach contents are very small fragments, the prey animals are not easily identified. The fish component of food included mainly small myctophids, while crustaceans were mostly young crabs, stomatopod larvae and euphausiids. This squid is observed to have fed on other squids but it could not be confirmed whether the food included its own kind.

Size at maturity

Data on maturity stages of *Symplectoteuthis oualaniensis* are available for Cruise No. 9, 20 and 44. In the collections the minimum size of mature males was observed to be 85 mm and that of females 95 mm, as determined from the presence of spermatophores in the Needham's sac in the former, and mature eggs in the oviduct in the latter. Based on the length data of 44 mature males and 41 mature females, the size at which 50% of the squids of either sex attain maturity was derived. These values were 100 mm for males and 110 mm for females (Fig. 3), which can be considered as the sizes at first maturity.

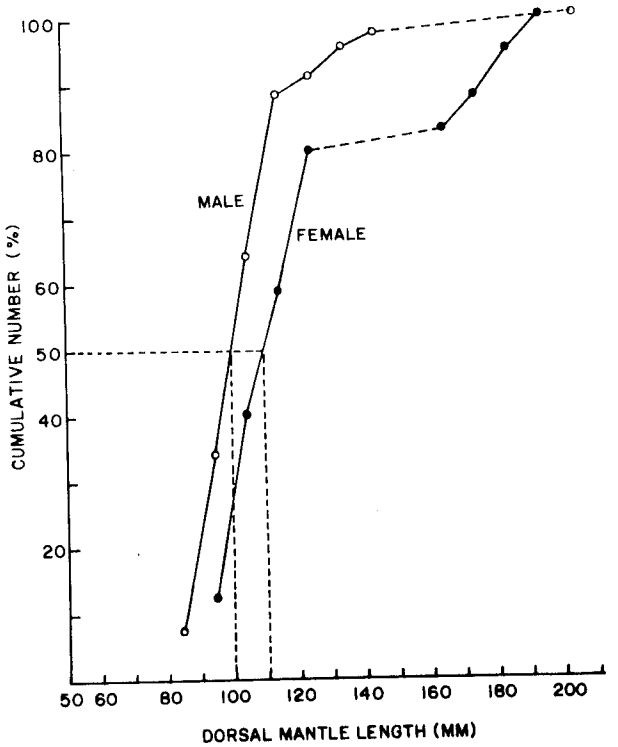

Fig.3. Size at first maturity of male and female *symplectoteuthis oualaniensis*.

Sex ratio

The data on number of squids by size for each sex collected during Cruise 20 and 44 show that males were numerically more than females in the ratio 1 : 0.8. But the sex ratio was different for immature squids and for mature squids. The ratio between immature males and immature females was 1 : 0.6, which in the mature squids was almost equal, 1 : 0.9.

Discussion

The purpleback flying squid *Symplectoteuthis oualaniensis* is a widely distributed Indo-Pacific oceanic species. In the Indian Ocean it occurs in the entire area north of 25°S (Roper *et al.*, 1984). The importance of this squid as a potential species in the Indian Ocean in general has been pointed out by many workers (Filippova, 1968; Zuev, 1971; Okutani, 1973). The distribution of adults and young ones off the west coast of India was discussed by Silas (1968) and the abundance in the northern Arabian Sea was indicated by Yamanaka *et al*. (1976 , 1977). Chikuni (1983) also has pointed to the possibility of commercial fishery for this species in the eastern Arabian Sea. At present there is virtually no exploitation of oceanic squids from Indian waters, but assuming the vast scope this resource gives, Silas (1986) has given the projection that by 1990 the potential harvest would be of the order of 2,500 t, and by 2000 A. D. it would be somewhere between 25,000 and 50,000 t.

The surveys made by *FORV Sagar Sampada* have revealed the occurrence of *Symplectoteuthis* in the Arabian Sea and the Bay of Bengal, and though its number and quantity were minimal, the results of these surveys have provided information on some biological and behavioural aspects. There was wide variation in the size form 20 mm to 480 mm. Since the squids were taken in pelagic trawls, the smaller sizes were well represented. On the other hand, the squids caught by jigs with light attraction at night by Japanese research vessel in the northern Arabian Sea had a size range of 240-500 mm in 1976 and 180-360 mm in 1977 (Yamanaka *et al* . ,1976, 1977) . This may be due to the fact that the jig is a highly selective gear and only medium and large sized squids are hooked by it. However, Roper *et al.* (1984) are of the opinion that two sympatric species are known under the name *S. oualaniensis*, a large one with a dorsal photophore on the mantle, and a smaller one without photophore. Unfortunately this aspect was not studied here, one reason being that larger squids above about 200 mm were extremely rare. More number of squids have to be observed for further studies on this aspect.

The length at first maturty obtained here, 100 mm for males and 110 mm for females, is more or less comparable to 136 mm for males and 107 mm for females of the species without dorsal photophore, given by Roper *et al* . (1984) ; however,

according to these authors the female squids with dorsal light organ mature at about 180 mm. This also is an aspect that has to be studied for ascertaining whether similar phenomenon occurs in *Symplectoteuthis* of the Indian waters.

Silas (1969) has observed that the Rhynchoteuthis larvae of *S. oualaniensis* were present in planktonic collections off the southwest coast of India beyond the continental shelf throughout the year with abundance in March to May and November- December. In the present study, mature squids were observed in March (Bay of Bengal), August, September and October (Arabian Sea), and this suggests that spawning might have followed in the subsequent months. This is in partial agreement with the earlier observation, and both these observations suggest that spawning may also take place within the Exclusive Economic Zone. Again, this aspect needs further investigation to understand more about the spawning periods, intensity and areas.

Symplectoteuthis is known for its strong positive phototaxis, and this makes the squids to aggregate near the surface of the sea at night, often seen attracted by the lights of the ship. One squid of 268 mm was taken in hand-jig from Stn. 242 during Cruise 9, and many were seen in small schools near the surface. This behaviour of the squid is taken advantage of in the commercial fishery by hook and line in the waters around Okinawa to Taiwan, using lights as an aggregating device (effectively used in jigging at night for many species of squids).

The purpleback flying squid is noted for its diel migration. The squids remain at about 120-200 m depth at day time and move to the surface at night (Chikuni , 1983). This is well corroborated by the preponderance of squids caught in night hauls over those taken in day hauls. About 91% of the total number of squids taken during the surveys was in the night hauls of pelagic trawl.

The present study is only a beginning, and much remains to be understood on aspects such as stock abundance, biology and behaviour for developing suitable catching devices and making feasibility study on commercial fishing. The future strategy should be planned for working in these directions.

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