

CEPHALOPOD RESOURCES OFF THE GULF OF KUTCH IN GUJARAT COAST*

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ABSTRACT

Areawise and depthwise cephalopod catches of the chartered fishing vessels of Taiwan, which conducted exploratory fishing in offshore areas off Gulf of Kutch have been presented and discussed. The catch comprised of three species each of cuttlefishes and squids of which, *Loligo duvaucelii* Orbnigny dominated. The highest catch rate of cephalopods recorded was 254.53 kg/h during March, 1984. A distinct pattern in the distribution of cephalopods was noticed according to the depth of the area fished. Whereas cuttlefishes were mostly collected from the area 18°-21°N, squids were common in the area 22°-23° N.

The percentage composition of cephalopods in total fish catches varied from 3.13 to 20.28. The maximum catch of cephalopods per haul was 585.03 kg. *Loligo duvaucelii* accounted for 47,949.5 kg of the catches in March, constituting 68.25% of the total cephalopod landings.

Detailed analysis of the catch data indicated that the depth zone below 33 m, especially zone between the Latitude 23° 00'N and 23°11'N is rich in cephalopod resources.

INTRODUCTION

IN INDIA squids and cuttlefishes are caught as by-catch mostly in shrimp trawl nets and exported to various countries. In the inshore belt, shore seines and boat seines also land some quantity. The reports of Bapat (1982), EFP (1979 a, b), Silas (1986) have brought to light the immense potentialities of Northwest coast of India, particularly areas off the Gujarat Coast. It is in this background that in 1983-84 when an opportunity arose to participate in a fishing cruise organised by a Taiwanese enterprise in the zone between Latitude 17°-23°N and Longitude 67°-72° E, the author collected data for 4 months and studied the catch composition of the trawler with particular reference to the cephalopods. The present paper gives

details of monthwise, areawise, depthwise and specieswise composition of the cephalopod catches of commercial pair-trawling conducted by one of the Taiwanese chartered vessels HWA KUO No. 2.

But, for the co-operation extended by the Golden Fisheries Private Ltd., Tuticorin permitting the author to go on board their chartered Taiwanese vessel the study would not have been possible. The crew members of the vessel also fully co-operated thus enabling successful completion of the mission undertaken. The author is grateful to Dr. E. G. Silas, former Director and Dr. P. S. B. R. James, Director, Central Marine Fisheries Research Institute, Cochin for their valuable guidance and encouragement in the above work. Thanks are also due to Shri. S. Mahadevan, Molluscan Fisheries Division for offering constructive criticism in the preparation of the manuscript and Shri M. Selvaraj, for all help.

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MATERIAL AND METHODS

Fishing vessel and gear used

Under a liberalised chartered vessel fishing policy of the Government of India, several Taiwanese trawlers operated in the Indian shelf waters, concentrating their efforts in the deeper waters beyond 19 km off the coast. 36 pairs of Taiwanese vessels were thus permitted fishing licenses. Of these LI CHANG, YUE JOU, KWA KUO, KWA WEI, CHIEH FA, HSIEH SHIN, NOLI CHANG, SAN SHUNG, TONG YUH, SHANG DAH, etc. were engaged in fishing. HWA KUO No. 1 and 2 units conducting pair trawling off Bombay and Gujarat Coasts during December 1983 — March 1984 covering depths ranging from 24-72 m. The trawl net used measured 68 m long and 24 m broad having a belly and cod end made of 55 mm meshes and top and lower wings of 94 mm mesh size webbings. Heavy otter boards were employed. The complements of fishing crew was 17-19 in each of the two vessels. Shooting out the net took 10 minutes and hauling the net 25-30 minutes. The catches of the hauls were received alternatively between No. 1 and No. 2 vessels. Permitted fish hold capacity of the vessel was 150 t, but invariably empty diesel tank was also utilized as additional storage area for storing double the permissible quantity. Except quality fishes all others (constituting 74.34%) were thrown overboard.

Area fished

The area between Lat. 17°-23° N and Long. 67°-72° E was covered. The depth ranged between 24 m and 72 m. It should be mentioned that fishing effort was mostly concentrated in 24-33 m depth zone off Gujarat Coast in the Gulf of Kutch (Lat. 21°18'-23°10' N and Long. 67°30'-69°40' E) since initial fishing done in 34-72m depth zones off Bombay (Lat. 17°48' - 20°10' N and Long. 70°56' - 72°14' E) proved uneconomic. In all 288 hauls were received by HWA KUO No. 2 alone of which 274 were off Gujarat Coast and only

14 off Bombay Coast. The total fishing hours for the period of 4 months was 597.30 out of which 569 h were utilized for fishing off Gujarat.

RESULTS

In all 70,256 kg of cephalopods were stored constituting 31.34% of the catches stored in the vessel. Catch-per-haul was 243.94 kg and the catch rate was 117.58 kg/h (Table 1). Cephalopods constituted 8.04% of the entire fish catch of the trawler HWA KUO No. 2.

Species composition of cephalopods

As a whole squids constituted (58,703.5 kg) 83.56%; whereas the cuttlefishes (11,552.5 kg) formed 16.44%. Among squids, *Loligo duvaucelii*, Orbigny constituted 68.25%, *Doryteuthis singhalensis* (Ortmann) 14.97% and *Loliolus investigatoris* Goodrich 0.33% (Table 1). Among cuttlefishes, *Sepia aculeata* Orbigny was recorded as 8.00%, *S. pharaonis* Ehrenberg 7.95% and *Sepiella inermis* Orbigny 0.50% (Table 1).

For future planning for exploitation it was thought worthwhile to ascertain the relative importance and usefulness of the areas off Bombay and Gujarat Coasts; separate analysis of data on the lines presented below showed some interesting results.

Gujarat Coast

Duration of fishing: January, 1983 — March, 1984.

Area fished: 21°18'—23°11' N and 67°24'—69°49' E.

Depth range: 24-36 m.

Total number of hauls: 274.

Total fishing hours: 569.

Total cephalopod catch: 68,511 kg (97.52%).

Percentage composition of cephalopods: 7.84%.

Catch-per-haul: 250.04 kg.

Catch-per-hour: 120.41 kg.

TABLE 1. *Monthwise and specieswise catch, catch-per-haul and catch rates of cephalopods caught by the chartered Taiwanese fishing vessel HWA KUO No. 2*

Month	No. of hauls	Fishing hours	SQUIDS			CUTTLEFISHES			Total (kg)	% composition	C/haul (kg)	C/h (kg)
			<i>Loligo duvonealii</i> (kg)	<i>Doryteuthis singhalensis</i> (kg)	<i>Loliolus investigatoris</i> (kg)	<i>Sepia aculeata</i>	<i>Sepia pharaonis</i> (kg)	<i>Sepiella inermis</i> (kg)				
December 83	23	47	1178 (20.14%)	148 (2.53%)	49 (0.84%)	1755 (30.01%)	2523 (43.14%)	195 (3.35%)	5848	5.11	254.26	124.43
January 84	99	199	2478.5 (26.98%)	497 (5.41%)	154 (1.68%)	3319 (36.12%)	2611.5 (28.42%)	128 (1.39%)	9188	3.13	92.81	46.17
February 84	99	197.30	12328 (76.94%)	3116 (19.45%)	32 (0.2%)	286 (1.78%)	246 (1.53%)	15 (0.10%)	16023	5.88	161.85	81.13
March 84	67	154	31965 (81.55%)	6758 (17.24%)	..	257 (0.66%)	205 (0.52%)	12 (0.03%)	39197	20.28	585.03	254.53
Total	288	597.30	47949.5 (68.25%)	10519 (14.97%)	235 (0.33%)	5617 (8.00%)	5585.5 (7.95%)	350 (0.50%)	70256			

Species composition of cephalopods

Among the cephalopods squids constituted 85.1%, of which *L. duvaucelii* formed 69.6%, *D. singhalensis* 15.3% and *L. investigatoris* 0.3%. Cuttlefishes formed only 14.9%, of which *S. aculeata* accounted for 7.1%, *S. pharaonis* 7.3% and *S. inermis* 0.4%.

Squids were dominant in Gujarat Coast especially at lower depths (24-33 m).

Bombay Coast

Duration of fishing : December, 1983.

Area fished : 17°48' — 02°10' and
70°56' — 72°14' E.

Depth range : 34-72 m.

Total number of hauls : 14.

Total number of hours : 28.30

Total catch of cephalopods : 1745 kg
(2.48%)

Percentage composition of cephalopods :
0.20%.

Catch-per-haul : 124.64 kg

Catch-per-hour : 61.23 kg

Species composition of cephalopods

The cuttlefishes constituted 79.1% among cephalopods in which *S. aculeata* formed 43.7%, *S. pharaonis* 32.0% and *S. inermis* 3.4%. But squids constituted only 20.9%, of which *L. duvaucelii* recorded as 15.9%, *D. singhalensis* 4.2% and *L. investigatoris* 0.8%. In area 19°20' N — 71°55' E, cephalopods were not caught.

Catch data

Monthwise catches of cephalopods during December, 1983 to March, 1984 by the chartered Taiwanese fishing vessel HWA KUO No. 2, a single vessel out of a pair-trawler are given in Table 1. Taking the zone fished as a whole during this period 288 hauls were taken for a fishing total time of 597.30 h. The total

cephalopod catches was 70.3 t at an average of 17.6 t per month.

The monthly average catch-per-haul was 243.94 kg at a catch rate of 117.58 kg/h. The catch-per-haul of cephalopods ranged between 92.81 kg and 585.03 kg minimum in January and the maximum in March, 1984. *Loligo duvaucelii* constituted the major catch (68.25%) among the cephalopods followed by *Doryteuthis singhalensis* (14.97%); *Sepia aculeata* (8.00%); *S. pharaonis* (7.95%); *Sepiella inermis* (0.50%) and *Loliolus investigatoris* (0.33%).

Monthwise distribution

Regarding monthwise occurrence and landing the highest catch (39.2 t) was recorded during March, 1984 and the minimum catch (5.8 t) during February, 1984. The catch rate of cephalopod was very high (254.53 kg/h) in March, 1984 and it was low (46.17 kg/h) in January, 1984. Squids dominated the catches in February and March 1984, constituting 96.59% and 98.79% respectively. Cuttlefishes dominated in December, 1983 (76.48%) and in January, 1984 (65.93%). Of the cuttlefishes, *Sepia aculeata* accounted for 0.66-36.12% except in December, 1983, when *S. pharaonis* was predominant (43.14%). *Loligo duvaucelii* is the dominant cephalopod during the period of trawling in the northwest coast of India and it ranged between 20.14% in December 1983 and 81.55% in March, 1984. The percentage composition of cephalopods in the total landings ranged from 3.13 in January 1984 to 20.28% in March 1984 (Table 1).

Areawise distribution

Only seven areas were covered during December 1983 - March, 1984 of which six areas except one were fished in all the four months (Fig. 1, Table 2). The catch rate of cephalopods was very meagre (7.92 kg/h) in the area 20-70 and it drew blank in 19-71. Eventhough the maximum effort (233.5 h)

was expended in the area 22-67 the catch was very poor (12,049 kg) and the catch rate recorded was only 51.55 kg/h. Fishing for cephalopods was very productive in the area 23-67, landing 46,858 kg with an effort of 233.15 h at a catch rate of 200.89 kg/h. This area appears to be a potential zone for cephalopod production particularly for squids (98.48%) of which *Loligo duvaucelii* constituted 80.52%.

Cuttlefishes were dominant (77.59-90.0%) in the areas between 17-72 and 21-69, but the former appears to be more productive. The availability of squids is restricted in this region (10.00-22.41%).

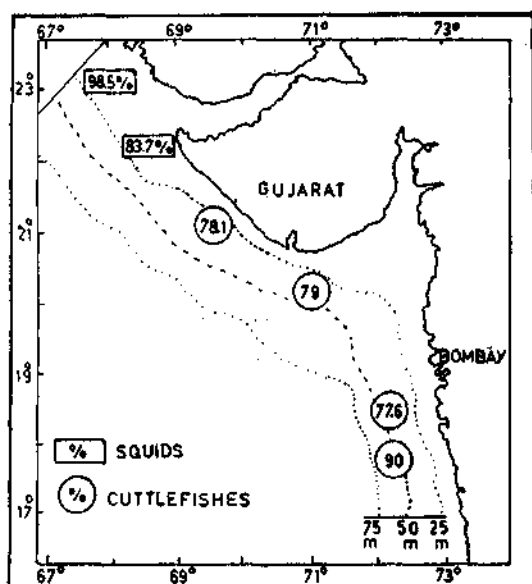


Fig. 1. Area-wise and depth-wise catch composition in percentage of cephalopods by the chartered Taiwanese fishing vessel HWA KUO No. 2.

Sepia aculeata constituted the major catch (37.69 - 60.00%) in these areas followed by *S. pharaonis* (18.95 - 38.10%), *L. duvaucelii* (7.50 - 18.46%), *Sepiella inermis* (2.31 - 10.00%), *Doryteuthis singhalensis* (2.63-4.48%) and *Lololus investigatoris* (0.69-4.21%). But in the areas 22 - 67 and 23 - 67 off the Gulf of Kutch in Gujarat Coast, squids were predominant (83.72 -

98.48%) especially *L. duvaucelii* (67.79-80.52%) followed by *Doryteuthis singhalensis* (14.78 - 17.95%). The cuttlefishes landed were *S. pharaonis* (0.63 - 8.92%), *S. aculeata* (0.86 - 6.92%), *Lololus investigatoris* (0.01 - 1.15%) and *Sepiella inermis* (0.03-0.44%).

Off Bombay Coast only 14 hauls were received. Out of 28.30 h of fishing effort a total of 1745 kg of cephalopods were caught by covering the areas between 17°-22° N. and 70°-72°E at depths of 34-72 m. The catch was very poor in these areas and the percentage composition of cephalopod was only 0.20. The catch-per-haul recorded was 124.64 kg at a catch rate of 61.23 kg/h. Very high percentage (79.08%) of cuttlefishes were recorded in this region when compared to squids (20.92%).

From the above analysis it becomes apparent that cuttlefishes are dominant off Bombay Coast while squids abound off the Gulf of Kutch in the Gujarat Coast.

Depthwise distribution

Table 3 shows the depthwise distribution of cephalopods based on five depth zones from 24-33 m to 64-72 m. Fishing was conducted in all the five zones. Maximum fishing effort (294.30 h) was put in the depth zone 24-33 m which yielded cephalopods (54,155 kg) at the highest rate of 183.89 kg/h. This may be considered to be the most productive zone for the yield of cephalopods (15.08%) especially squids(14.82%). *L. duvaucelii* constituted 80.36%. Minimum fishing effort (49.15 h) was in the depth zone 64-72 m. The catch-per-haul was only 46.80 kg at a catch rate of 23.76 kg/h. The availability of cuttlefishes was very poor (1.72%) only in the depth zone 24-33 m. The percentage of cuttlefishes was high in the depth zones from 34-43 m to 64-72 m varying from 58.24 to 72.56 ; minimum was recorded in the depth zone 54-63 m while the maximum was from 44-53 m,

TABLE 2. *Areawise catch data*

Area	No. of hauls	Fishing hours	SQUIDS			CUTTLEFISHES			Total (kg)	Percen-composition	C/haul (kg)	C/hr (kg)
			<i>Loligo duvauce- lii</i> (kg)	<i>Doryteu- this singha- lensis</i> (kg)	<i>Loliolus investi- gatoris</i> (kg)	<i>Sepia aculeata</i> (kg)	<i>Sepia pharaonis</i> (kg)	<i>Sepiella inermis</i> (kg)				
<i>Bombay Coast</i>												
17°N 72°E	1	2.00	15 (7.50%)	5 (2.50%)	..	100 (50.00%)	60 (30.00%)	20 (10.00%)	200	5.11	200.0	100.0
18°N 72°E	8	16.45	250 (17.24%)	65 (4.48%)	10 (0.69%)	605 (41.72%)	481 (33.17%)	39 (2.70%)	1450	53.74	181.25	86.57
19°N 71°E	1	2.15	..	..	..	..	..	..	..	..	..	..
20°N 70°E	4	7.30	12 (12.63%)	4 (4.21%)	4 (4.21%)	57 (60.00%)	18 (18.95%)	..	95	2.20	23.75	7.92
<i>Gujarat Coast</i>												
21°N 69°E	50	102.00	1773.5 (18.46%)	253 (2.63%)	78 (0.81%)	3620 (37.69%)	3657.5 (38.10%)	222 (2.31%)	9604	4.27	192.08	94.16
22°N 67°E	117	233.45	8168 (67.79%)	1781 (14.78%)	138 (1.15%)	834 (6.92%)	1075 (8.92%)	53 (0.44%)	12049	3.72	102.98	51.55
23°N 67°E	107	233.15	37731 (80.52%)	8411 (17.95%)	5 (0.01%)	401 (0.86%)	294 (0.63%)	16 (0.03%)	46858	14.94	437.93	200.89

TABLE 3. Depthwise catch data

Depth	No. of hauls	No. of hours	SQUIDS			CUTTLEFISHES			Total (kg)	Percentage composition	C/haul (kg)	C/h (kg)
			<i>Loligo duvaucelii</i> (kg)	<i>Doryteuthis singhalensis</i> (kg)	<i>Loliolus investigatoris</i>	<i>Sepia aculeata</i>	<i>Sepia pharaonis</i> (kg)	<i>Sepiella inermis</i> (kg)				
24—33	137	294.30	43519 (80.36%)	9707 (17.92%)	—	498 (0.92%)	411 (0.76%)	20 (0.04%)	54155	15.08	395.29	183.89
34—43	26	54.45	1348 (29.76%)	224 (4.95%)	83 (1.83%)	1098 (24.24%)	1647 (36.37%)	129 (2.85%)	4529	4.43	174.19	82.72
44—53	43	86.45	1505 (22.78%)	250 (3.78%)	58 (0.88%)	2586 (39.13%)	2098 (31.75%)	111 (1.68%)	6608	4.28	153.67	76.17
54—63	57	112.15	1261.5 (33.25%)	251 (6.62%)	72 (1.90%)	1075 (28.33%)	1081.5 (28.50%)	53 (1.40%)	3794	1.90	66.56	33.80
64—72	25	49.15	361 (27.01%)	87 (7.44%)	22 (1.88%)	360 (30.77%)	348 (29.74%)	37 (3.16%)	1170	2.02	46.80	23.76

The most intensively fished depth zone was off Gujarat coast at 24-33 m, where a fishing effort of 294.30 h was spent for a catch of 54,155 kg of cephalopods at the rate of 183.89 kg/h. *L. duvaucelii* constituted the major catch (80.36%) followed by *D. singhalensis* (17.92%), *S. aculeata* (0.92%), *S. pharaonis* (0.76%) and *Sepiella inermis* (0.04%).

It is of interest to mention that *Octopus vulgaris* Cuvier, was occasionally caught in 24-33 m (23° N 67° E; March, 1984) weighing 0.85 kg totally.

REMARKS

Silas (1986) indicated that the perspective consumption for cephalopods in 1990 for 'Other Asian Countries' (excluding Japan) is significantly high which might scale to a dimension of 3,60,000 t over the present level. While this is an indicative projection, it also points out to the possibility of the important role that India can play in filling up the gap of 1,89,000 t by restoring to directed fishing operations in areas of abundant cephalopod resources. The findings of Rao *et al.* (1966, 1972), Bapat (1982), EFP (1979 a, b) and Silas (1986) indicate the rich cephalopod resources potentiality of the northwestern coastal waters of India. The present communication broadly confirms their opinions and findings and indicates that directed cephalopod fishing, if undertaken in depth zone 24-33 m off Gujarat Coast for squids like *Loligo duvaucelii* and for cuttlefishes like *Sepia aculeata* and *S. pharaonis* in deeper waters

(34-72 m) off Bombay Coast would prove to be very productive.

Indications are that squids are common in January to June in these areas and cuttlefishes from September to December (Silas, 1986). The present paper also shows the probability of an identical pattern of cephalopod abundance though the data collection was restricted to a four month period. Depthwise also there appears to be probable of zones of abundance of *Sepia aculeata*, *S. pharaonis* and *L. duvaucelii*, the highest yield registered was in 24-33 m depth zone (183.89 kg/h). EFP (1979 a, b) vessels recorded an yield of 50 kg/h in the depth zone 40-49 m, 110 kg/h, in 50-59 m and 76.40 kg in 60-69 m almost. This observation on distribution with slight variation in the percentage of occurrence holds good for the present studies also.

It is to be admitted and emphasized again that our knowledge on the cephalopod abundance in Indian waters touches only the fringe of the problem. This needs adequate supportive data to be collected in the next few years to have a comprehensive idea in planning our future exploitation strategy towards increased cephalopod landings. Neritic, mesopelagic and epipelagic species survey needs to be done, keeping in mind the pattern of vertical migration of different species and their behaviour as suggested by Roper and Young (1975). This involves studies on the influence of light, temperature, productive and competition which play a key role in limiting or regulating the species abundance seasonally. A positive and dynamic approach is therefore called for.

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