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Carangid Fishery of Veraval Coast with Notes on the Biology and Population Dynamics of *Megalaspis cordyla* (Linnaeus)

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Abstract

Annual average carangid landing was 304.2 t which constituted 0.9% of the total fish catch in Veraval during 1981-84. The trawlers landed 172.3 t (56.6%) and the drift gillnet units 131.9 t (43.4%). The carangid fishery by trawlnet was sustained by *Atropus atropus* (34.5%), *Caranx spp.* (27.9%), *Decapterus russelli* (15.7%), *Chorinemus spp* (12.9%) and *Megalaspis cordyla* (8.9%) and in the drift gillnet by *M. cordyla* (67.2%), *Chorinemus spp.* (30.0%), *Caranx spp.* (2.1%) and *A.atropus* (0.6%). The results on morphometric relationship, length-weight rlationship, sex ratio, stages of maturity, food and feeding of this species is also discussed. The $L\infty$, K and t_0 of M. cordyla have been estimated to be 554 mm, 1.0337 (annual basis) and - 0.0078 yr respectively and it atains 216, 358, 438, 485 and 515 mm of fork length in 0.5, 1.0, 1.5, 2.0 and 2.5 year respectively. The estimated average annual standing stock is 167.1 t and the average standing stock is 38.8 t. The MSY is estimated to be 81.8 t. Higher fishing mortality rates and exploitation rates indicate that this species is exposed to higher fishing pressure by both the gears. bait used by a boat, biology of baitfishes to understand their recruitment and culture potential are some of the management options discussed.

Introduction

Carangid resource is considered as one of the important pelagic fishery resources in the absence of major pelagic fishery resources such as mackerel and oil sardine in Saurashtra region. Information on the fishery, biology and population dynamics of the component species of carangid resource in Saurashtra waters are scanty. Though many species sustain the carangid fishery, *Megalaspis cordyla* (Linnaeus) is one of the dominant species specially in drift gillnet landings.

A detailed study has been carried out during 1981-84 on this resource in general and more specifically on the population dynamics of *M. cordyla.* Present account is the first report on carangid resource from this region and it endeavours to provide detailed information on the catch statistics of carangids exploited by trawl and drift gillnet units, with estimates on age and growth, mortality rates, yield per recruit, optimum age of exploitation, potential yield per recruit and stock assessmetn of *M. cordyla.*

Materials and Methods

The data on catch, effort, species composition and length frequency of *M. cordyla* were collected every week and were initially raised to the sample day and then to the month. Total, fork, standard lengths in mm and wet weight in g of individual fish were obtained and subjected to regression analyses. Integrated method of Pauly (1980) was used to trace the progression of the modes and the avrage size attained by this species in subsequent months by the method of George and Banerji (1968). The growth in length and weight were estimated as per Alagaraja (1984). The natural mortality rate (M) was estimated as per Sekharan (1974) and Pauly (1980) and the total mortality rate (Z) as per Beverton and Holt (1956). The yield per recruit was estimated as per Beverton and Holt (1957). Th optimum age of exploitation and the potential yield per recruit were estimated as per Krishnankutty and Qasim (1968).

Results and Discussion

Catch statistics: Estimated annual total catch of carangids fluctuated from 236.9 t in 1982-83 to 378.6 t in 1983-84 with an annual average of 304.2 t which formed 0.9% of total fish landings in Veraval during 1981-84. The carangid landings by trawl net declined from 194.3 t in 1981-82 to a mere 67.0 t in 1982-83 and increased to 255.6 t in 1983-84. Similar declining trend during 1979-80 to 1981-82 due to poor abundance of the resources was reported by Rao and Kasim (1985). The annual average catch per trawl net unit during 1981-84 was 172.3 t. The carangid catch by gillnet exhibited a different trend that the catch increased from 102.7 t in 1981-82 to 169.9 t in 1982-83 and then declined to 123.0 t in 1983-84 with an annual average catch of 131.9 t whereas, Kasim and Khan (1986) have reported an increasin trend in the catch of carangids by drift gillnet units from 48 t in 1979-80 to 167 t in 1981-82.

During 1981-82, though the abundance of carangid was not as good as in 1983-84 the effort expended by trawl net units was commensurate with the abundance in all the months except in October, 1981. If the effort has been in consonance with better abundance during October-December 1983, the catch would have increased further more in 1983-84. The poor catch in 1982-83 was mainly due to poor abundance of carangids in the trawling grounds during that year. The gillnet effort was higher enough to be in consonance with the better abundance of carangids during July and September in 1981, and June and August in 1982. Whereas in all other months the effort was higher and the abundance was poor.

The peak period of abundance of carangids in the trawl fshery is during the post monsoon season from June to September. The trawl nets landed more carangids (56.7%) than the gillnets, as more trawlnets were operated; whereas the catch

rate of carangids was better by dirft gillnet units than the trawlets. As suggested by Kasim and Khan (1986) the increasing abundance of carangids in the drift netting grounds indicate that the landings of carangids may be increased further by incrasing the effort of drift gillnets.

Species composition: Catch compositon of different species of carangids indicate that the order of abundance of different species in trawl net landings was *Atropus atropus* (34.5%), *Caranx spp* (27.9%) *Decapterus russelli* (15.7%) *Chorinemus spp* (12.9%) and *M. Cordyla* (8.9%). In gillnet landings, the average percentage compositon of different species was *M. cordyla* 67.2%, *Chorinemus spp* 30.0%, *Caranx spp* 2.1% and *A. atropusa* mere 0.6%.

Morphometric Relationship: The multiple regression equations which describe the relationship of total, standard, fork lengths and weight with each other are given below.

Log TL = 0.0396 + 0.1800 Log FL + 0.8150 Log SL + 0.0071 Log Wt
Log FL = 0.0787 + 0.0779 Log TL + 0.8986 Log SL + 0.0045 Log Wt
Log SL = 0.0171 + 0.2787 Log TL + 0.6824 Log FL + 0.0096 Log Wt
Log Wt = -4.0771 + 0.3860 Log TL + 0.6843 Log FL + 105994 Log SL

The standard partial regression coefficient (SPRC), "t" and "p" values obtained from the four different comparisons indicate that among the four factors the standard length has got a very high sgnificant relationship with the other three factors ie., fork length (p = <0.001) total length (p = <0.001) and weight (p = <0.002); the fork length has a high significant relationship with total length (p = <0.550) and total length (p = <0.600) is just significant. Similar study on *Caranx carangus* by Ameer Hamsa and Kasim (1989) from Tuticorin waters has revealed a different degrees of significance among morophometric characters indicating these relationships are species specific.

Length-weight relationship: The regression equations describing the relationship of weight with three different lengths of this species are given below along with the standard deviation of the regression coefficient (sb), correlation coefficient (r), test of significance of the b value (t).

Regression equations	sb	r	t
Log Wt = -3.9314 + 2.5419 Log TL	0.0645	0.9660	39.40**
Log Wt = -4.1824 + 2.6926 Log FL	0.664	0.9679	40.55**
Log Wt = -4.0501 + 2.6847 Log SL	0.0656	0.9685	40.93**

The results indicate that the weight has a very high significant relationship with all the three lengths independently and the degrees of significance is in the order Wt vs SL, Wt vs FL and Wt vs TL as already seen in the multiple regression analysis.

Sex ratio: The over all average sex ratio indicates that males were dominant (55%) in the population. Sreenivasan (1981) observed that females of *M. cordyla* were dominant in most of the months in Vizhinjam waters.

Stages of Maturity: The mature specimens occurred in November, 81, January, March, April, September and October, 82. Running specimens were totally absent during 1981-82 and spent fish were recorded only in January, 1982. The non-availability of running specimens throughout the year has hampered the accurate prediction of the spawning season and it is assumed that spawning takes place in deeper waters beyond the commercal fishing area.

Feeding intensity: The total volume of the stomach content varied from 0.1 to 18.6 ml and the average volume of food content was 11.5 + 2.9 ml in gorged, 6.8 + 0.8 ml in full, 5.0 + 0.7 ml in 3/4 full, 3.6 + 0.6 in 1/2 full, 1.9 + 0.4 ml in 1/4 full, 0.6 + 0.2 ml in little and 0.2 + 0.03 ml in traces. The first four conditions from gorged to 1/2 full are considered as indications of active feeding and the rest four conditions as poor feeding. The occurrence of fish with empty stomach was high only in June, 82. The period of active feeding was during January (60%) and March (80%).

Food composition in relation to season and size: The food of *M. cordyla* was constituted by three major groups ie., fishes 59.2%, crustaceans 23.0% and molluscs 1.2%. The rest 16.6% was fully digested matter. The fishes *Apogon* spp (10.5%), *Secutor insidiator* (10.4%), *Sphyraena* spp (6.6%), ribbon fish (4.9%), *Caranx* spp (0.3%), *Platycephalus* spp (0.2%), youngones of sciaenids, carangids and clupeids, were observed to occur as dominant food of this species. The crustacean portion of the food was constituted by *Acetes indicus* (12.8%), *Metapenaeus stylifera, M., hardwikii, Solenocera indica* (4.5%), phyllosoma larvae, alima larvae (1.0%) etc., and the molluscs were squid *Loligo duvaucelii* (1.2%) and cuttlefishes *Sepiella inermis* and *Sepia elliptica* (0.4%).

Fishes occurred throughout the year as dominant food except in May and June, *Acetes indicus* occurred during October to December and in May and April and crustacean larvae occurred in September only. The squid ws recorded in December and cutlefishes in April. The percetage composition of different food items in relation to different size indicates that *Apogon spp* occurred in the size range above 330-339 mm. *Secutor insidiator* in size ranges less than 400-409 mm, molluscs occurred in less than 300-309 mm, *Acetes indicus* occurred in almost all the size ranges and prawns in size ranges above 420-429 mm. However, there appear to be definite preference to particular type of food by fishes of 240 mm and above and this may be that the entire lot examined were either maturing and matured specimens.

Index of preponderance: Except *Acetes indicus,* semi or fully digested matter, crustacean remains and larvae and cuttlefish, the percentage occurrence of all other items was lower than the percentage volume. The order of preference as per the index of preponderance is semidigested fish (43.6%), *Acetes indicus* (28.5%), *Apogon spp* (19.8%), fish young ones (3.0%), semi or fully digested matter (2.7%), *Secutor insidiator* (1.3%), ribbon fish (0.5%), prawns (0.3%), squid (0.06%), crustacean remains (0.04%) and other.

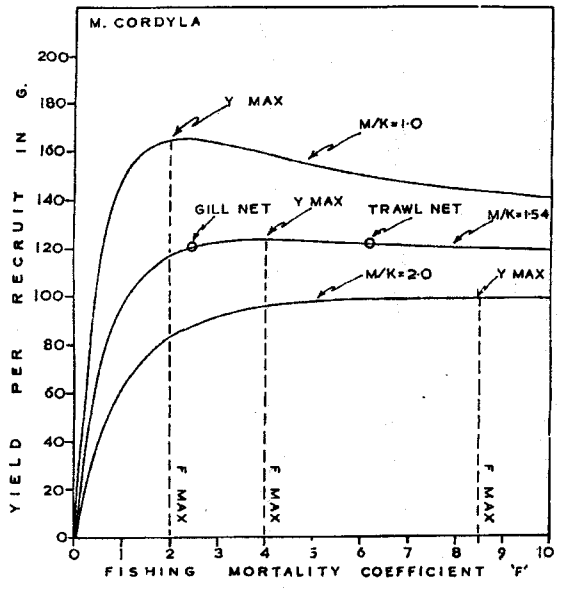

Figure Legends Fig. 1. Yield per recruit of *Megalaspis cordyla* obtained at different fishing mortality rates and prevailing age at first capture for three different M/K ratios in Veraval waters.

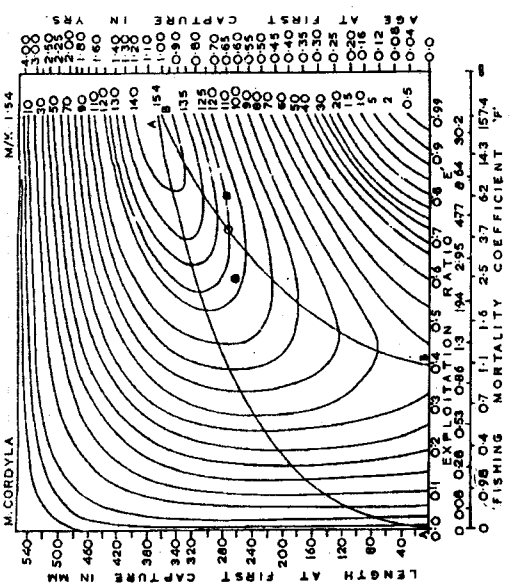

Fig. 2. Yield isopleth diagram of *Megalaspis cordyla* drawn from the estimates of yield per recruit obtained at different combinations of fishing mortality rates and age at first capture.

Relative condition factor (Kn): There is a high correlation between the trend of Kn and feeding intensity values in all the months except in June and this may be attributed to reason other than feeding. The influence of active feeding on the Kn values is evident from January to March when the Kn values also attain a highest peak.

Age and growth: The growh parameters L ∞, K and t_0 were estimated to be 554 mm, 1.0337 (annual basis) and -0.0078 yr respectively. The growth in length may be expressed as per Von Bertalanffy growth equation as follows:

$$It = 554\ (1 - e^{-1.0337}(t + 0.0078)).$$

Based on the length-weight relationship the growth in weight of theis species was estimated from the data on cube root of the weight attained by this species at an interval of 0.5 yr and the growth in weight of this species may be expressed as per the von Bertalanfy growth equation as follows:

$$Wt = 10.5672\ (1 - e^{-1.0801}(t + 0.0327)).$$

Total mortality coefficient (Z): Total mortality rate generated by trawl varied from 5.42 in 1981-82 to 9.61 in 1982-83 with an average of 7.78 and that of gillnet from 3.31 in 1983-84 to 4.60 in 1981-82 with an average of 4.04.

Natural mortality coefficient (M): The M is estimated to be 1.59 for this species from the T max. The independent estimate of M is 1.54 and the earlier estimate is taken as the value of M for further studies on this species.

Age at first capture and recruitment: The average size at first capture is 259 mm in trawl net and 280.9 mm in gillnet. The corresponding age at first capture is 0.6018 yr in trawl net and 0.6718 yr in gillnet and the average of thses two 0.6386 yr is taken as the age at first capture for *M. cordyla* for yield per recruit estimation. The minimum size at which the fish suffers mortality by the fishing gear, 200 mm is taken as the size at recruitment and corresponding age 0.4255 yr as the age at recruitment.

Yield per recruit: The yield per recruit estimated by keeping the age at first capture constant, at the prevailing level, and varying the fishing mortality rate (F) for three different M/K ratios are shown in Fig 1. The yield per recruit increases with the increase in F to a partcular level and then it tends to decline with higher F in all the 3 M/K ratios. For the prevailing M/K ratio of 1.54, the F_{max} which can produce the yieldmax of 124.4 g is 4.0. The respective F_{max} and Yieldmax are indicated in Fig.1 for all the three M/K ratios.

The yield isopleth diagram drawn from the estimates of yield per rcruit in gram at varying ages at first capture and different values of exploitation ratio E for the prevailing M/K ratio of 1.54 for *M. cordyla* is shown in Fig 2.

Optimum age of exploitation and potential yield per recruit: The optimum age of exploitation (t_y) and potential yield per recruit (Y^1) are estimated to be 0.9877 yr and 154 g for *M. cordyla.* The potential yield per recruit is indicated in the yield isopleth diagram.

Exploitation rate (U): The U is estimated from the relation U = F/Z (1 - e^{-z}) and the annual average exploitatation rate is 0.7953 and 0.5958 by trawl and gillnets respectively.

Stock assessment: The average annual standing stock P is estimated to be 167.1 t from the relation P = Y/U where Y is the annual yield in tonnes U is the exploitation rate. The average standing stock (B) is estimated to be 38.7 t from the equation B = Y/F.

Maximum sustainable yield: The MSY is estimated to be 81.8 t from the equation MSY = 0.5 x Y + (M x B).

The status of the fishery of *M. cordyla* by trawl net is that for the prevailing M/K ratio of 1.54, the annual average F is 6.19 with an yield of 123 g and F_{max} is lower ie., 4.0 with an yield of 124.4 g. The annual average exploitation rate by trawl net is very high 0.80 and the annual averge landing is also higher (104.1 t) than the MSY (81.1). However, the annual average exploitation rate by gillnet does not seem to be very high (0.6) and the prevailing F is also lower than the F_{max} indicatingthat the exploitation of this species by gillnet may further be intensified to match the F_{max} and corresponding yield to realise higher catch.

Easing the prevailing higher fishing pressure by trawl net on *M. cordyla* by reducing the effort is not possible as the main aim of the trawl net operation is for shrimps and fish form only a by-catch. An alternative to counter the excess effort input is to increase the prevailing age at first capture if not close to the optimum age of exploitation atleast to a considerable extent so as to realise higher yield also. The age at first capture can be increased by increasing the cod end mesh size. This suggestion is also not tenable as the target species is shrimp and the prevailing cod end mesh size is 20 mm. It may be possible that a part of the trawlers may be encouraged to operate fish trawl nets with larger mesh size. The regulatory measures for proper management of the fishery of *M. cordyla* by trawl net may be taken up with due consideration on the shrimp fisheries also. Since such limitations were not observed in the exploitation of *M. cordyla* by drift gillnet the effort may be increased so as to match the F_{max} and to ralise higher production also.

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