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STOCK ASSESSMENT OF *LOLIGO DUVAUCELII* (D'ORBIGNY) IN BOMBAY WATERS*

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ABSTRACT

Loligo duvaucelii forms 7.8 % of the trawl landings at Bombay. The von Bertalanffy growth parameters are $L_{\infty} = 323$ mm, $K = 0.448$ (annual) and $t_o = 0.0244$ years. The total mortality coefficient for the years 1980-'84 is 1.83 and the estimated natural mortality is 1.1. The standing stock and the annual stock in the present fishing ground is 990 tonnes and 2,150 t respectively. The yield is 721 t, which indicates that there is further scope for the exploitation of *Loligo duvaucelii* by the trawlers.

INTRODUCTION

THE CEPHALOPODS comprising squids and cuttle fishes are one of the important marine fish resources of India. With 4,398 tonnes of landings of cephalopods, Maharashtra ranks second in the production (CMFRI, 1987). At Bombay, a major trawling centre of Maharashtra, cephalopods form 7-8 % of the total marine fish landings.

Investigations on the stock assessment and dynamics of cephalopods have been carried out by Okutani (1977), Caddy (1983), Chikuni (1983) and Lange and Sissenwine (1983). In Indian waters, the stock assessment has been made by Silas *et al.* (1985) for the stocks of *Loligo duvaucelii, sepia aculeata* and *Sepia pharaonis* from Cochin, Madras and Vizhinjam waters.

An attempt has been made in this investigation to study the stock of *L. duvaucelii*, which forms 43.5 % of total cephalopod landings in Bambay waters.

MATERIAL AND METHODS

At Bombay, cephalopods are landed by the shrimp trawlers as by-catch, at Sassoon Docks and New Ferry Wharf. The trawlers operating from these landing centres use 22-25 m otter trawl, with 25 mm cod end mesh size. The fishing grounds extend from Ratnagiri in South to Dahanu in North (17° to 20° N and 72° to 73° E) within the depth range of 40-80 m.

The data on catch and effort were collected weekly and monthly estimates were made using the method given by Sekharan and Dhulkhed (1963). Weekly samples for size were analysed for dorsal mantle length and then the length frequency was raised to observation day, further raising the same for the month using sample weights and sampling day'e catch.

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The growth was estimated using monthly modal class progression. The parameters of the von Bertalanffy growth equation were L_∞ = 323 mm, $K = 0.448$ on annual basis and t_o — 0.0244 years (Kuber, MS). The total mortality coefficient 'Z' was estimated using Alagaraja's method (1984). In this method the length frequency distribution resembling the right limb of the catch curve only was considered for estimation of 'Z'.

The natural mortality coefficient 'M' was estimated using Au's expression (1975) given for the squids :

$$M = t^{-1}$$

where t is the mean age of the population.

The exploitation rate 'U' was estimated using the expression of Ricker (1975) :

$$U = \frac{F}{Z}. \quad (1-e^{-z})$$

The maximum sustainable yield (MSY) was estimated using Gulland's (1979) expression for the lightly exploited stocks :

$$MSY = Z. \quad (Y/F). \quad (0.5)$$

Results

The estimated catch, effort and percentage of *L. duvaucelii* in total fish are given in Table 1. The catches of *L. duvaucelii* indicate an increasing trend, from 1980-81 to 1983-84.

The estimated values of total mortality showed an increasing trend from 1.69 ± 0.19 in 1980-81 to 2.09 ± 0.68 in 1983-84 with mean value of 1.83 ± 0.28 for the four year period.

The mean age of *L. duvaucelii* in the population is 0.91 years. Using this, the natural mortality coefficient 'M' is 1.1 by Au's (1975) method.

The fishing mortality coefficient 'F' for the four years estimated using the expression $F=Z-M$, also showed increasing trend with an average of 0.73.

The exploitation ratio 'E' for the four years was arrived by the expression $E=F/Z$, also shows an increasing trend, with an average of 0.39.

The average standing stock of *L. duvaucelii* in Bombay waters is 987.79 t and the total stock is 2,153.03 t. The present exploitation rate is 33.49% with an average yield of 721.09 t. The MSY, for the stock of *L. duvaucelii* under the present condition of fishing by Gulland's method worked out to be 903.83 t.

Discussion

Difficulties were encountered in arriving at the value of natural mortality and the present estimate (M = 1.1) may appear to be on the higher side. Silas *et al.* (1985) therefore, instead of deriving the value of 'M' assumed the

Table 1. *Efforts, total landings of* L. duvaucelli, *percentage of cephalopod and* L. duvaucelii *in total fish catch*

Years	Efforts (Units)	Landings of *L. duvaucelii* (Kg)	Percentage of *L. duvaucelii* in total fish catch	Percentage of cephalopod in total fish catch
1980-81	21,677	3,73,216	2.00	2.76
1981-82	19,602	3,19,294	2.87	5.51
1982-83	22,766	9,37,792	2.12	6.87
1983-84	24,338	12,54,042	3.11	7.31

M/K ratio to be 1.5 for the stocks of *L. duvaucelii* at different places. Mohn (1981, 1982) has stated from his studies on various species of squids that natural mortality in squids due to cannibalism alone would be 0.6. Beverton and Holt (1959), Holt (1962) and Tanaka (1960) demonstrated relation between maximum age and length as well as between '*M*' and *k* for different groups of fishes. Saville (1977) made use of relationships between maximum age (t_{max}) and '*M*' and developed a nomogram which can be used for obtaining the value of '*M*'. The value of natural mortality obtained by this nomogram is also found to be 1.1. Therefore, the value of '*M*' estimated for the present study by using Au's (1975) method seems to be reasonable.

The average standing stock at Bombay during the four year period was 987.8 t and the total annual stock was 2,530 t. Silas *et al.* (1985) estimated 1,800 t of standing stock and 18,203 t of total stock for *L. duvaucelii* in Indian waters. This shows the standing stock in Bombay waters alone is about 50% of the standing stock of the Indian waters. This is rather unlikely, therefore, the estimates of Silas *et al.* (1985) appear to be modest. The probable reason or the lower estimate may be that the natural mortality coefficient '*M*' considered by them is on the higher side.

The present exploitation ratio is 0.39, hence the stock does not show signs of over-exploitation. It is based on the assumption that the optimal value of *E* (opt) is about equal to 0.5; the use of $E \approx 0.5$ as optimal value for the exploitation ratio itself resting on the assumption that sustainable yield is optimized when $F \approx M$ (Gulland, 1971). The present yield is also lower than the standing stock therefore exploitation may be stepped-up further by 0.11. However, it is difficult to suggest management measures to step up the catch as cephalopods form by-catch of trawl fishery, where the target fish is prawns.

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