Stock assessment of Indian scad, *Decapterus russelli (*Ruppell, 1830*)* off Malabar

P.P. Manojkumar

Calicut Research Centre of Central Marine Fisheries Research Institute, West Hill, Calicut – 673005, India
Email: manojppin@yahoo.com

Abstract

Stock assessment of Indian scad, *Decapterus russelli* (Ruppell, 1830) off Malabar was carried out. The L_α and K values were 271.2 mm and 1.22 y^{-1} respectively. The length-weight relationship can be described by the equation Log W = -3.2706 +2.6317 Log L. The estimated mortality rates Z, F and M in the species were 3.79 y^{-1}, 1.71 y^{-1} and 2.08 y^{-1} respectively. Recruitment of this species was continuous with two peaks per year. The length at first capture and length at recruitment were taken as 145 mm and 55 mm respectively. The current exploitation ratio (0.49) is below the optimum (0.69) indicating that the resource is under-exploited.

Keywords: Stock assessment, Indian scad, *Decapterus russelli,* Malabar Coast, management brief

Introduction

Northern part of Kerala, known as Malabar is one of the major fishing areas along the southwest coast of India. The Indian scad *Decapterus russelli* is an important pelagic fish contributing to the marine fisheries of this region and also all along the southwest coast of India. The species is caught as by-catch in shrimp trawls almost throughout the year.

Studies on *D. russelli* along the Indian coast are few. Sreenivasan (1981 and 1982) studied length-weight relationship and age and growth of this species and Murty (1991) reported on some aspects of biology and population dynamics in the trawling grounds off Kakinada. Reuben *et al.* (1992) studied the fishery, biology and stock assessment of carangids including *D. russelli* from the Indian seas. Balasubramanian and Natarajan (1999) studied the resource characteristics of scads including this species from Vizhinjam.

While reviewing the publications, it was found that *D. russelli* is the least studied marine resource in Malabar region, except for an account on the unusual fishery by Yohannan and Balasubramanian (1987). The growth, mortality and recruitment studies are of prime importance for the assessment and management of a fish stock since these parameters determine the quantum of catch that can be exploited year to year in a fishery. The present study was undertaken to assess the annual stock and the impact of fishing pressure on this important marine resource exploited along this region.

Materials and methods

The data on length frequency distribution collected during September, 2000 to August, 2002 from the trawl landings at Puthiappa and Beypore in Calicut formed the material for the study. The length-weight relationship was studied following Le Cren (1951). Length frequencies were raised to corresponding weight of the catch assessed for the day and subsequently for the month, following Sekharan (1962). The growth, mortality, recruitment pattern and yield per recruit were estimated using FiSAT programme (Gayanilo Jr, *et al.*, 1996). For estimation of the natural mortality the t_o was considered as '0' (Sparre *et al.*, 1989) and the surface seawater temperature was taken as (28^0 C). The exploitation rate 'U' was estimated by the formula $U = F (1-e^{-Z})/ Z$. The annual total stock and standing stock were estimated by Y/U and Y/F respectively, where 'Y' is the annual average catch of this species.

Results

Length-weight Relationship: A total of 374 fishes in the range 65-242 mm total length and 4-118 g weight were used for determining the length weight relationship. The relationship was estimated by the least square method and the regression equations for both the sexes were:

Female: Log W= -4.22012 +2.98 Log L (r= 0.9998)

Male: Log W = -2.44594+2.32 + Log L (r = 0.9650)

The analysis of covariance showed that there was no significant difference at 5% level between sexes (Table 1).

The common equation for both sexes is

Log W = -3.2706 +2.6317 Log L (r=0.9770)

Growth parameters: For estimation of growth and mortality parameters, the raised length frequency data corresponding to each month pooled over the years 2000-01 and 2001-02 were used. The length frequency data analysis using the FiSAT programme showed a distinct brood originating in April (Fig.1).The growth curve originating in April indicated that the juveniles started entering the fishery by May-June and it continued up to February. The recruitment patterns also agreed with this result. The values of L_α and K were estimated as 271.2 mm and 1.22 y^{-1} at an Rn value of 0.210. This brood would have probably persisted until September to October of the succeeding year. These 16-17 months can be considered as the fishable life span of *D. russelli*.

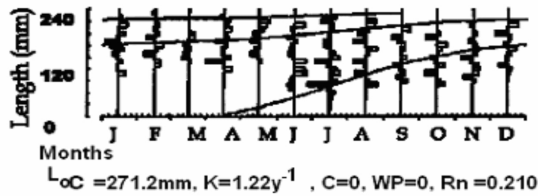*Mortality parameters*: The total mortality rate Z was estimated from the length converted catch curve (Fig. 2).

Fig.1. Growth curve *of D.russelli* (pooled data)

The value estimated using the growth parameters of April brood was 3.79 y^{-1} and the coefficient of correlation (r) was 0.96.The natural mortality M estimated following Pauly's empirical formula (Pauly, 1980) was 2.08 y^{-1} for an average temperature for 28° C. The value of natural mortality was deducted from the total mortality and fishing mortality (F) obtained was 1.71 y^{-1}.
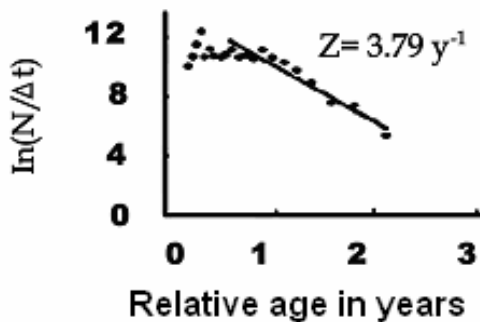

Fig.2. Catch curve analysis estimating Z of *D.russelli*

Recruitment pattern: Two distinct peaks were observed with maximum recruitment during April – May and a second one in August-October (Fig. 3). In May, the recruitment was 38 %, while in April 15.2 %. The recruitment during April-May alone was 53 %. During the second phase, highest recruitment has taken place in August (6 %).

Fig.3. Recruitment pattern in *D.russelli* off Malabar

Length at first capture (L$_c$) and length at recruitment (L$_r$): The length at first recruitment was taken as the smallest length in the length frequency distribution and the length at first capture was obtained as the mid length of the first peak in length frequency distribution. The length at first capture (L_c) and length at recruitment (L_r) of *D. russelli* were taken as 145 mm and 55 mm respectively.

Yield per recruit: The yield/recruit was estimated following the model of Beverton and Holt (1957). It can be inferred that relative yield per recruit (Y/R) is maximum for an exploitation ratio (E) of 0.69 (Fig.4). The current exploitation ratio (E) is estimated as 0.49, which is lower
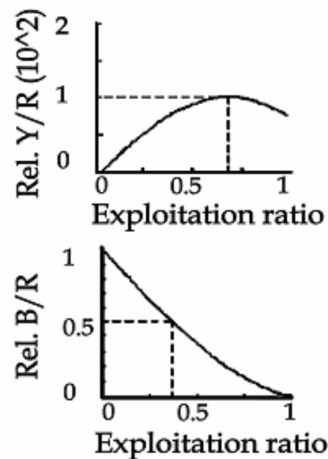

Fig.4.   Yield per recruit – *D.russelli* off Malabar

Table 1. *Comparison of regression lines of length-weight relationship in* D.russelli

SOURCE	DF	SS-X	SP	SS-Y	b	DF	SS	MS	F
Female	179	29.0535	86.6777	258.5929	2.98	178	0	0.00000	
Male	193	33.4192	77.7589	194.2817	2.32	192	13.355	0.06956	
Total						370	13.355	0.03609	
Pooled W	372	62.4727	164.4366	452.8746	2.63	371	20.055	0.05406	
Difference between slopes						1	6.701	6.70078	185.65*
Between1		0.0012	-0.0215	0.3749					
W + B	373	62.4739	164.415	453.2495	2.63	372	20.552	0.05525	
Difference between corrected means						1	0.497	0.49684	9.19*

* Not significant at 5% level

than the optimum exploitation rate estimated by the Beverton and Holts method. This means that the current level of exploitation ratio is below the MSY level. Hence, the effort can be increased for getting higher yield of *D. russelli*.

Stock estimates: The average annual yield of *D. russelli* was 2166 t at an exploitation ratio (E) and exploitation rate (U) of 0.0.49 and 0.44 respectively. The average total and standing stocks were estimated as 4932 t and 1274 t respectively as compared to the present annual yield of 2166 t along the Malabar Coast.

Discussion

From Vizhinjam, Sreenivasan (1982) estimated L_α as 260 mm fork length (=288 mm total length from the conversion formula), K as 0.74 y^{-1} and t_o as -0.13 y^{-1}. Murty (1991) estimated the L_α, K and t_o values as 232.3 mm total length, 1.08 y^{-1} and -0.08 y^{-1} for *D. russelli* from Kakinada. Reuben *et al.* (1992) estimated varying L_α (221, 299 and 248 mm), K (0.71, 0.45 and 0.78 y^{-1}), M (1.35, 0.83, and 1.26 y^{-1}), Z (2.83, 2.85 and 3.88 y^{-1}), F (1.48, 2.02 and 2.68 y^{-1}) and E (0.52, 0.71 and 0.68) along the east coast, northwest coast and south west coast of India. Iqbal (1992) reported a very low L_α value of 19.4 cm with the K value as 0.75 y^{-1} for this species from Pakistan waters. But, from Philippines, Jabat and Dalzell (1988) reported a very high L_α value of 33.7 cm and low K value of 0.36 y^{-1}. Widodo (1988) from Indonesia and Silva and Sousa (1988) from Mosambique also observed values similar to that study. The result of the present study also showed some close similarity with the results of the growth parameters observed from Indian waters.

In the present analysis, two recruitment pulses were seen in *D. russelli*. The former was a major season compared to the latter. Various authors observed different types of recruitment patterns. Ingles and Pauly (1984) reported two pulses for *D. russelli* after studying the fishery in different parts of Philippines. Dalzell and Ganaden (1988) observed only one recruitment pulse in this species in their work in Philippine waters. Widodo (1988) and Atmaja (1988) also observed only one pulse for this fish from Indonesia. Thus, close similarities were observed in some of the earlier and present observations while some were slightly different. However, it was confirmed that there were two recruitment pulses in *D. russelli* off Malabar substantiating the observations made by Balasubramanian and Natarajan (1999) from Vizhinjam.

In the present analysis the natural mortality, *M* obtained for *D. russelli* was 2.08 y^{-1}. According to Beverton and Holt, (1959) K is associated with the life span of the fish. Tanaka (1960), Holt (1965) and Saville (1977) established the relationship of longevity to mortality. Beverton and Holt (1959) also found that the *M/K* values would normally range from 1.5 to 2.5. Rikhter and Effanov (1976) concluded that fish with a high *M* mature early in life and thus compensating this high value by starting to produce earlier. Sparre and Venema (1992) reported that since most biological process goes faster at high temperatures within a limit, natural mortality could be related to the environmental temperature. All these above conclusions are more or less in agreement with the findings arrived at in the course of present study. This is because, for this species K value is high (1.22 y^{-1}), longevity is less than four years, maturity is attained within one year and temperature is normally fluctuating around 27-29°C. *M/K* value was 1.71.

The current exploitation ratio is lower than the optimum rate estimated by the Beverton and Holts method. This means that the present fishing is below MSY level. Hence, there is a scope for increasing the effort from the present level for obtaining higher yield of *D. russelli* off Malabar.

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