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Estimation of mortality and exploitation rate of Cobia, *Rachycentron canadum* (Linnaeus, 1766) occurring in North West coast of India

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Specimens collected from resource survey vessels and commercial vessels from Mumbai were utilized for the study. Growth parameters; asymptotic length (L_∞), growth coefficient (K) and age of fish at length zero (t_0), estimated were 194.25, 0.24 and -0.615 respectively. Natural mortality coefficient estimated following Cushing and Pauly methods were 0.354 and 0.416 respectively. Total mortality value obtained following Beverton and Holt model was 0.77 against 0.76 obtained by catch curve method. Fishing mortality (F) and exploitation ratio (E) estimated were 0.36 and 0.47.

[**Keywords:** Mortality of cobia; Stock assessment; cobia fishery; Population dynamics of cobia; Cobia fishery]

Introduction

Information on mortality rate is essential for formulation of exploitation strategy and thereby exploit and mange the fishery resources at optimal levels. Mortality estimates have been done in almost all major exploited fish stocks with a view to arrive at optimum levels of exploitation. Mortality estimates of Cobia inhabiting Chesapeake Bay[1], Gulf of Mexico[2] and Australia[3] were carried out by Richards (1967), Williams (2001) and Fry and Griffiths (2010) which provided basic information on the dynamics of the Cobia stock. However, no information is available on mortality and exploitation of cobia occurring in Indian waters. In India, there is no target fishery for cobia, they are mostly caught as bycatch from trawlers, hook and line and gill nets[4].Compare to other major pelagic resources, cobia landings were very less in quantity. However, fast growth rate, high demand in market and high unit prize make cobia an important resource. Hence an attempt has been made to estimate the mortality and exploitation rate of cobia occurring in North West coast of India.

Materials and Methods

Cobia specimens caught during the fishery resource survey of the vessel *MV MatsyaNireekshani* (Survey vessel belonging to the Fishery survey of India, Mumbai) for the period January 2008 to December 2009 were utilised for the study. To ensure representation from commercial fishery, specimens collected from Mumbai landing centers were also utilized for the study. A total of 1261 specimens having total length ranging from 22.6 cm to 181cm of cobia were grouped in to length classes of 10 cm interval and analysed using FAO-ICLARM Stock Assessment Tools (FISAT)[5]. Growth parameters, namely asymptotic length (L_∞) growth coefficient (K) and age of fish at length zero (t_0) were estimated following Ford Walford plot[6-7] and von Bertalanffy plot[8] were used as input parameters[4].

The instantaneous rate of natural mortality (M) was estimated following Pauly's empirical formula[9-10] and Cushing formula[11-12]. The age of longest fish, calculated following Von Bertlanfy Growth Function (VBGF) equation of the fish and Length maximum

(L_{max})[13] were utilised as input parameters for the Cushing formula[11-12]. The instantaneous rate of total mortality (Z) was estimated following the Beverton and Holt model[14] and length converted catch curve method[10, 15]. Following estimation of Z, the routine was used to estimate fishing mortality (F) following Pauly's M equation and Z following F = Z – M. The exploitation ratio (E) was estimated from the formula E = F/Z.

Results and discussion

Growth parameters, namely asymptotic length(L_∞), growth coefficient (K) and age of fish at length zero (t_0), estimated following Ford Walford plot and von Bertalanffy plot were 194.25, 0.24 and -0.615 respectively. The mean annual habitat temperature recorded during the study was 28°C, which was substituted in the Pauly's empirical formula. Natural mortality thus obtained as per Pauly's empirical formula was 0.416. Length maximum (L_{max}) estimated was 185 cm and natural mortality coefficient thus estimated following Cushing formula was 0.354.

Values obtained estimated following Cushing[11-12] and Pauly's empirical formula [9] were found to be very close and were less than 0.5. However, value obtained by Pauly's empirical formula was used for further calculation, as the same is considered as more reliable and are based on interrelationship between VBGF parameters and mean habitat temperature.

All natural mortality coefficient values below 0.5 were considered as law. Hence, natural mortality of cobia estimated by the present study is an indication of law mortality rate and further indicates that more fishing effort is needed to achieve maximum sustainable yield.

Mortality rates of *Rachycentroncanadum* reported by various authors from different localities are furnished as Table 1. Natural mortality rate reported by different authors were below 0.5 which ranged from 0.2- 0.41. Mortality rate reported from Chesapeake Bay[1] and Gulf of Mexico[2] are comparable with the result of the present study. As showed in Table. 1, natural mortality of cobia occurring along North West coast of India was estimated by earlier study[17] was 0.36. Present study estimated natural mortality at 0.41 from the same area. Differences in the mean habitat temperature (25^0 C by earlier study[17] and 28^0 C by the present study) may be the reason for differences in the mortality rates estimated by both studies.

Total mortality value obtained following Beverton and Holt model was 0.77 while value computed by catch curve method was 0.76. Total mortality value obtained following Beverton and Holt model and catch curve method were almost closer; this indicates the reliability of the estimation. However, value estimated by catch curve method was considered as the best as this method is based on more input parameters than Beverton and Holt model. Total mortality value estimated by the present study is in agreement with the results of earlier studies [2, 18-19].

Table 1. Mortality rates of *Rachycentron canadum* reported by various authors from different localities

Mortality			Location	Author/s
Natural (M)	Fishing (F)	Total (Z)		
0.2-0.4	-	-	Chesapeake Bay	Richards (1967)
0.24	-	-	Gulf of Aden	Edword *et al.* (1985)
-	-	0.75	Northeastern Gulf of Mexico	Franks *et al.*(1999)
0.36	-	-	North west coast of India	Somvanshi *et al.* (2000)
0.2-0.4	-	0.72	Gulf of Mexico	Williams (2001)
0.35	-	0.85	North and eastern Australia	Fry and Griffiths (2010)
0.41	0.36	0.76	North west coast of India	Present study

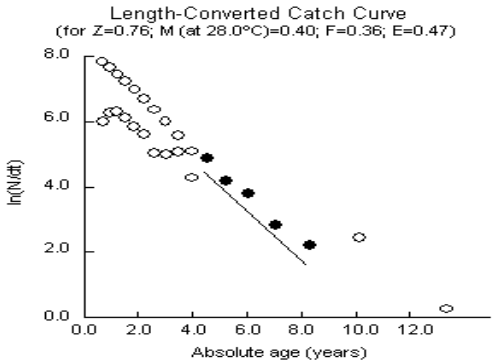

Fig.1. Length converted catch curve of *Rachycentroncanadum* inhabiting along North West coast of India

Length converted catch curve of Cobia made by plotting relative age against ln (N/Dt) is shown in Fig. 1. As showed in the Fig. 1 Fishing mortality (F) was estimated at 0.36 while exploitation ratio (E) as 0.47.

Results of Relative yield per recruit and biomass per recruit study carried out[4] showed that the present exploitation ratio (0.47) is an indication of optimum or fully exploited state of the stock. Any further increase of fishing effort wills leads to over exploitation and subsequently leads to the collapse of the fishery.

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