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Fishery and some aspects of population dynamics of goatfish *Upeneus vittatus* (Forskal) off Visakhapatnam

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Abstract

The average annual estimated catch of goatfishes at Visakhapatnam was 1,511 t during1997-03, which formed 7.4 % of the total landings of small-mechanized units including small trawlers and *Sona* boats. *Upeneus vittatus* was the dominant species. The fish attained maturity at 138 mm length. The spawning period extended from July to October. The growth parameters of this species were L_{∞} = 245 mm, K = 0.67 yr^{-1} and t_0 = - 0.146. The mortality rates Z, F and M were 5.49, 4.06 and 1.43, respectively. The exploitation rate is estimated to be 0.74, indicating overexploitation of the stock.

Key words: Goatfish, *Upeneus vittatus*, maturity, population dynamics

Introduction

The goatfishes are widely distributed in the tropical and subtropical Indo-Pacific and Western Atlantic regions. Nineteen species of goatfishes have been reported from the seas around India. Kumaran and Randall (1984) reported 18 species of goatfishes from the Western Indian Ocean. Thomas (1969) gave a detailed account of the taxonomy, osteology, fishery and biology of these fishes. These fishes, though the intensity of abundance varies, are common representatives in any ground fish fishery. Small trawlers and *Sona* boats operating off Visakhapatnam catch them throughout the year. The catch mainly is constituted of three species viz., *Upeneus vittatus*, *U.sulphureus* and *U.molluccensis*. Information on the fishery, biology, growth, mortality and population dynamics of these species is limited to the studies of Reuben *et al.* (1994), Ameer Hamsa and Narayana Rao (1997) and Vivekanandan *et al.* (2003). The present paper deals with the fishery of the goatfishes, some aspects of biology and population parameters of *U.vittatus* off Visakhapatnam.

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Material and methods

Data collected on the landings of commercial small-mechanized units (small trawlers and *Sona* boats) at Visakhapatnam for the years 1997-2003

were utilised for the study. Field observations were made twice a week and data on catch, effort, species and length composition were collected. As a conservation measure, the Government of Andhra Pradesh has enforced a trawl ban during May, every year. The estimates of landings were obtained from the Fisheries Resource Assessment Division (FRAD) of Central Marine Fisheries Research Institute. The length- weight relationship was estimated applying the formula $W = a L^b$. The pooled length frequency data was subjected to ELEFAN package of FiSAT program (Gayanilo Jr. *et al.*, 1995) for estimation of growth parameters L_∞ and K. The t_0 was estimated by plotting $-\ln(1-lt/L_\infty)$ against "t", the age (Sparre *et al.*, 1989). Longevity was estimated from $t_{max} = 3/K$ (Pauly 1983a).

The size at first maturity was determined based on 538 fishes and by plotting the percentage of mature specimens (stage IV and above) against the length. The size at first maturity was taken as the length at which 50 % of the specimens are in mature condition. The monthly percentage occurrence of gravid and running stages (V and VI) in 650 specimens were considered for determining the spawning season. The total mortality (Z) was estimated from the length structured catch curve method (Pauly, 1983b) and the natural mortality (M) was estimated from the empirical formula (Pauly, 1980). The value of surface temperature considered here was 27 ^{0}C. The fishing mortality (F) was estimated as Z-M and exploitation rate from the ratio of F/M. Yield / recruit was estimated based on the relative yield /recruit model of Beverton and Holt (1957).

Results and discussion

Fishery

About 500 small-mechanized boats (300 small trawlers of 9.6 to 11.2 m OAL, 63 - 93 H.P., and 200 *Sona* boats of 13.1 m OAL, 102 H.P) are in active operation off Visakhapatnam. These wooden boats operate four-seam shrimp trawl at a depth ranging from 10-100 m. The small trawlers and *sona* boats conduct voyage fishing lasting for 3-5 and 10-15 days respectively. The cod-end mesh size varied from 15-20 mm. During the period the annual landings of goatfishes varied from a lowest of 359 t in 1999 to 3,262 t in 2003. The annual average catch was 1,511 t. The landings declined from 1997 till 1999 and increased sharply to 1,718 t in 2000 and then declined slightly in 2001 and again sharply increased to 2,749 t in 2002 and 3,262 t in 2003. The proportion of goatfishes in the trawler landings varied from 10 % in 2000 to 6 % in 1998 with an annual average of 7 %. The upward trend in catches from 2000 onwards may be attributed to the increase in effort input both in terms of units and hours and also because of addition of dry fish landings to the catches.

The landings of small trawler and *Sona* boat followed a similar trend over the years though the quantum of catch was more in the latter units. The average catch rate is almost same and in fact lower till 2001. The average number of *Sona* units

Table 1. *Catch and effort data of the goatfishes in small-mechanised units off Visakhapatnam*

Years	Units (x 000)		Hours (in lakh)		Catch (t)		CPUE (kg)		Cph (kg)		% in total	
	Small	*Sona*	Small	*Sona*	Small	*Sona*	Small	*Sona*	Small	*Sona*	Small	*Sona*
1997	10.7	4.2	1.59	2.77	202	434	19	24	1.3	0.4	7	2
1998	11.6	3.2	2.41	2.89	252	244	22	35	1.0	0.4	6	3
1999	8.2	2.7	2.26	2.77	284	75	35	16	1.3	0.2	11	2
2000	13,9	5.0	5.07	6.47	704	1014	51	108	1.4	0.8	11	5
2001	10.7	4.1	2.93	4.78	515	840	48	87	1.8	0.8	8	3
2002	11.1	7.0	5.29	11.37	782	1967	71	281	1.5	1.7	7	7
2003	13.7	8.2	7.13	11.31	1240	2022	90	246	1.7	1.8	7	6
Avg.	11.4	4.9	3.81	6.05	568	942	50	192	1.5	1.6	8	7

operated during the period were lesser, but the effort in hours was higher by 59% compared to small trawlers (Table1). This was because the *Sona* units were involved in voyage fishing lasting for 10-15 days. The species composition was similar in both the gears.

The catch rate of goatfishes ranged from 1.1 (February) to 2.1 (in November) kg/ hr (Fig.1). The average monthly catches were higher with reasonably high catch rate during July – November, which can be considered as favourable season for goatfishes. The data from 1999-03 was considered for working out the seasonal abundance as May is declared closed season from 1999. Luther *et al.* (1988) observed June-August as the peak period of abundance of goatfishes off Visakhapatnam.

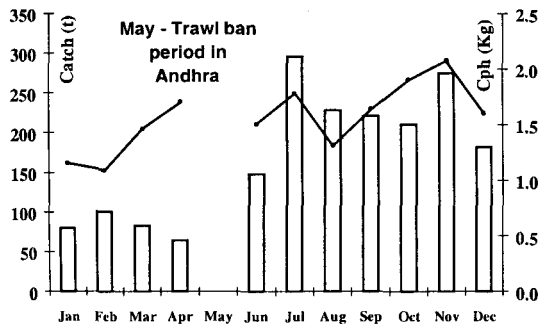

Fig. 1. *Seasonal abundance of goatfishes in small-mechanized units off Visakhapatnam during 1997-'03.*

Species composition

Among the goatfishes landed at Visakhapatnam, *Upeneus vittatus* was the dominant species forming 65% followed by *U.sulphureus* (29%) and *U.molluccensis* (6%). Apart from the above *U. tragula* occurred in small quantities, which did not form a fishery. It is interesting to note that *U. sulphureus* was the dominant species in the 1980's (Luther *et al.*, 1988), however, during 1990's *U.vittatus* started to dominate (Fig.2).

Length - weight relationship

A total of 440 specimens (260 females and 180 males) ranging from 65-215 mm in total length were used for estimation of length weight - relationship. Initial plotting of the data indicated that the single equation could explain the length - weight relationship for both the sexes. The length

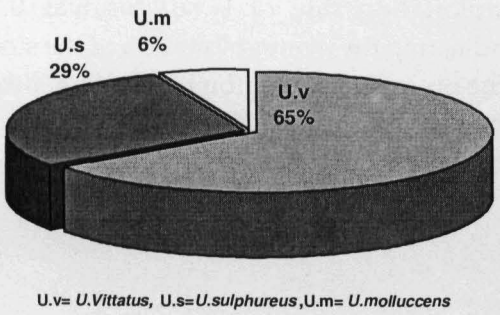

Fig. 2. *Species composition of goatfishes in small-mechanized units off Visakhapatnam.*

weight relationship obtained for *U. tittatus* was:

$$W = 0.013969 \times L^{2.99} \quad (r = 0.980).$$

Earlier authors (Reuben *et al*; 1994 and Ameer Hamsa and Narayana Rao, 1997) also reported a single equation for the length - weight relationship in *U.sulphureus* and *U.vittatus* respectively. Ali and Gopalakrishnan (1998) reported different equations for both sexes of *U.vittatus* off northeast coast.

Age and growth

A total of 4401 fishes in the range of 65 - 215 mm in total length were used for estimation of growth parameters. The number of specimens in the monthly samples ranged from 50-100. The growth parameters of VBGF obtained were L_∞ = 245 mm, K = 0.67 yr^{-1} and t_0 = - 0.146. Thus the VBGF for *U.vittatus* can be written as

$$L_t = 245\ (1\text{-}e^{-0.67\ (t\ -(-0.146))})$$

The length of fish at the end of first and second year was 131 and 187 mm respectively. The longevity of *U.vittatus* was estimated to be 4.5 years. Ali and Gopalakrishnan (1998) reported slightly lower estimates (L_∞ =214 mm, K=0.63 yr^{-1} and t_0 = - 0.05) for the species along the northeast coast. Chen (2003) reported lower growth parameters for *U.vittatus* (L_∞ =202mm, K=0.53 yr^{-1}) off Nansha Island in China. Similar estimates of L_∞ and K (245 mm and 0.71) were reported by Ingles and Pauly (1984) from Philippine waters.

Size at first maturity

The length at maturity in *U.vittatus* was 138 mm (Fig. 3). The fish matures at the beginning of the second year. Luther *et al.* (1988) reported 125 mm as the length at first maturity of this species. The difference in size at maturity may be because of the influence of environmental factors and food availability.

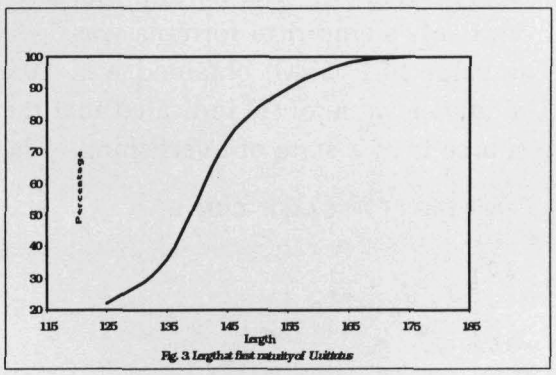

Fig. 3. *Length at first maturity of* U. vittatus.

Spawning

Spawning was observed from February to October indicating a prolonged season, but the peak was during July and October (Fig.4). Similar results were reported by Vivekanandan *et al.* (2003) off

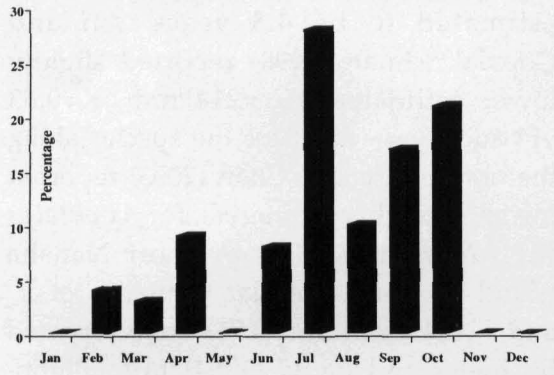

Fig. 4. *Occurrence of spawning population of* U. vittatus.

Visakhapatnam for the species. Luther *et al.* (1988) observed peak spawning from February- March for the species off Visakhapatnam.

Mortality and exploitation rate

The total mortality rate Z estimated from the length converted catch curve was 5.49 (Fig. 5). The natural mortality from Pauly's empirical formula was 1.43. The value of F (Z-M) obtained was 4.06. The higher value of 'F' indicated that the resource is in a state of overfishing. The

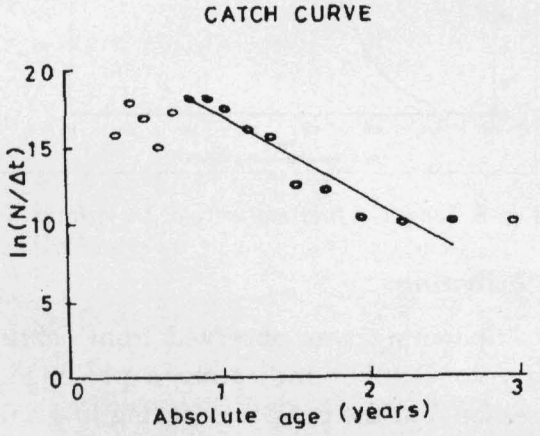

Fig. 5. *Length converted catch curve of* U. vittatus.

exploitation rate of *U.vittatus* was 0.74, indicating the overexploitation of the stock. The present exploitation rate is higher than the E max, 0.5020 (Fig. 6).

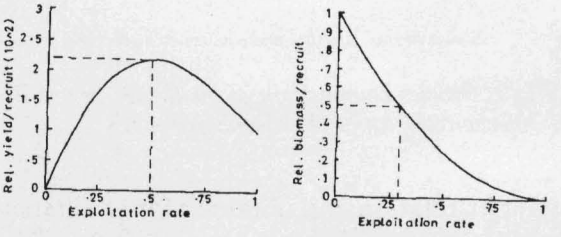

Fig. 6. *Yield/recruit and biomass/recruit of U. vittatus off Visakhapatnam.*

Yield/recruit

The relative yield / recruit curve indicated that the maximum sustainable yield could be obtained at the exploitation rate of 0.502. In the present study the exploitation rate was 0.74, more than the optimum '0.5'. This clearly indicated the overfishing / over exploitation state of the resource. The biomass / recruit was also very low, only '0.1', against the maximum 0.5 biomass / recruit at an exploitation rate of 0.29 (Fig. 6). The optimum yield and biomass/recruit could be maintained by reducing the exploitation up to 0.29. The status of the resource can be improved by maintaining the 'E' in between 0.29 to 0.50. There is thus the need for reduction in the effort.

The results suggest that the goatfish at Visakhapatnam area are subjected to overfishing. There is a possibility to improve the catches by reducing the fishing

effort and increasing the cod end mesh size to 25 mm. The increase of cod end mesh size will not affect the exploitation of major prawn resources except the non-penaeid prawns like *Acetes* spp., which is not an economically important item as observed by Rao *et al.* (1980).

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