

Status of Bombay duck *Harpodon nehereus* (Ham.) resource off Saurashtra coast

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ABSTRACT

The Bombay duck *Harpodon nehereus* (Ham.) landings along the Saurashtra coast showed a declining trend with an average catch of 32 645 tonnes/year during 1984-89. Basic food consisted of its own young ones, *Acetes* spp., *Nematopalaemon tenuipes*. The species breed throughout the year with peaks during December-January and June. The size at first maturity was 232.5 mm. Individual fish spawned once a year and fecundity varied between 17 075 and 79 631. Average fecundity was 340 ova/g body weight.

The growth parameters L_{∞} and K were estimated. The fishing mortality coefficient (F) for the period was 1.009 while natural mortality was 1.535. The MSY was estimated as 34 668 at F_{\max} 1.119.

Bombay duck *Harpodon nehereus* (Ham.) resource along the Saurashtra coast is heavily concentrated and highly localized. It formed 24% of the catch landed during 1980-84 (Balan *et al.* 1987). Dol net is the primary gear used in the fishery. Bombay duck fishery is very labour intensive; large number of people are engaged in capturing, sorting and drying operations. Accounts on the craft and gear employed, distribution (Bapat 1970, Zafar Khan 1983) and fishery and biology (Zafar Khan, 1985, 1986 and 1987a, b) are available. The studies on the economy of fishing operations were conducted by Sehara and Karbhari (1987). The maximum sustainable yield was estimated at 44 066 tonnes (Zafar Khan 1989). This study deals with the status of the fishery based on the continuous moni-

toring of the Bombay duck resource as a part of programme of the Institute.

MATERIALS AND METHODS

The basic data on the effort and catch were collected as per Sekharan (1965). The data were processed by the method of Zafar Khan (1989).

The gut contents were identified up to the species level. The volume (displacement method), total number and frequency of occurrence of each item were noticed. The Index of Relative Importance (IRI) method of Leopinkas *et al.* (1971) was adopted for the analysis of food. Accordingly $(N + V)F = IRI$, where N , V , and F represent percentage of number, volume and frequency of occurrence respectively.

To study the peak feeding activity a slight modification was adopted.

$$\frac{\sum (N + V) \sum F}{n} = IRI/Fish$$

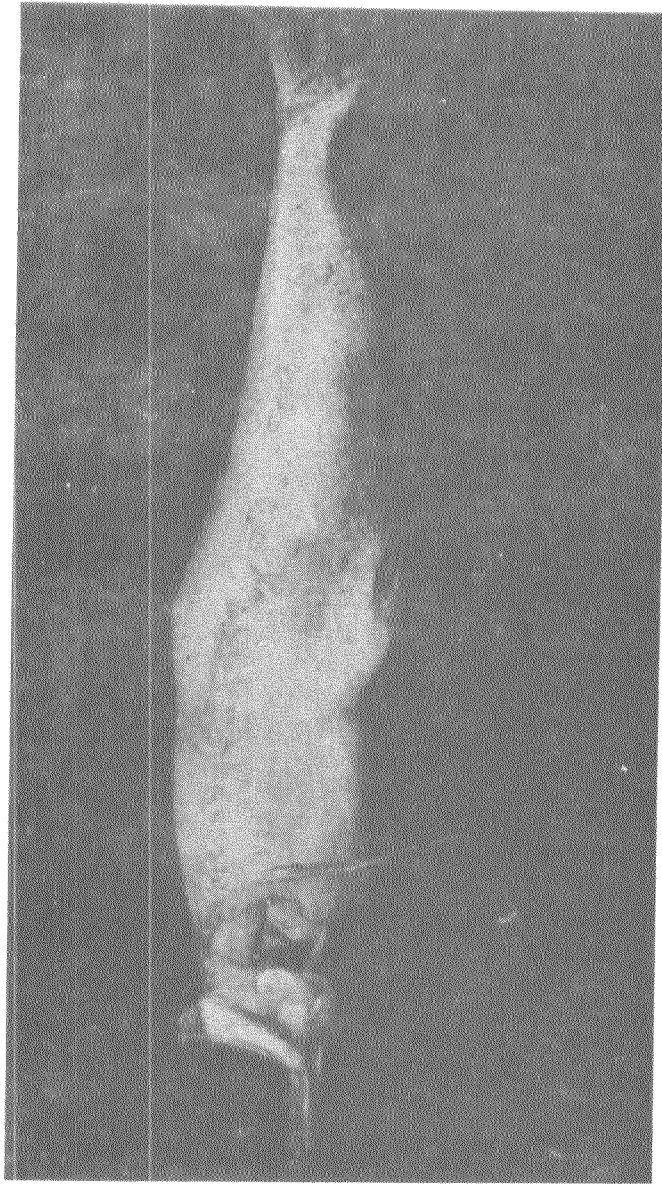
Where, n is the number of fish observed.

The standard maturity scale adopted by the international council for exploration of

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Horpodon nehereus

the sea was followed, however, for presentation the same was classified into four stages viz. resting, developing, gravid and spent stages. The procedure of Prabhu (1956) was used for determining the periodicity of spawning. To determine the minimum size at maturity, the percentage of fish in immature, resting, developing, gravid and spent condition were computed.

The growth parameters L_{∞} and K were estimated using ELEFAN I programme (Gayanilo *et al.* 1988). The estimates of stock size and fishing mortality were obtained by length cohort analysis (Jones 1984). Relative yield per recruit (Yw/R) and biomass were predicted for various level of F/Z using the ELEFAN II programme (Gayanilo *et al.* 1988).

The programme packages of LFSA and statographic were used in the analysis of data.

RESULTS

Fishery:

Bombay duck landings in Gujarat varied between 28 870 tonnes and 55 877 tonnes during 1980–88 with an average catch of 41 747. Saurashtra contributed about 86.2% of the catch while south Gujarat 10.2% (Fig. 1). The Bombay duck landings of Saurashtra coast came down from 44 064 tonnes (average between 1979 and 84) to 29 089 tonnes (dur-

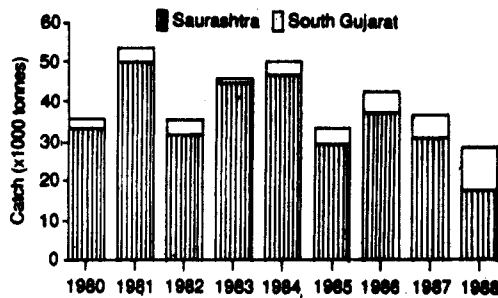


Fig. 1. Estimated Bombay duck landings at Gujarat during 1980-88.

ing 1985–88). The catches in south Gujarat indicated an increasing trend during the period.

It was observed that in the beginning of fishing season the catch rate was high but later it came down due to fishing. The lowest catch was recorded during February–March. From April onwards the catch tended to rise (Zafar Khan 1985).

Experimental studies indicated 6 and 9% higher yield from 25 and 27 mm cod end net respectively (Zafar Khan 1989). At Satpati (Maharashtra), dol net with cod end of 25–27 mm are in vogue similarly at Versova (Bombay) cod end mesh is changed depending upon the availability of the species (Raje and Deshmukh 1989). When Bombay duck is in abundance 40 mm cod end is used.

Biology

Food and feeding habits: Total 3 072 specimens in the size range of 35–330 mm were examined for food and feeding habits during 1976–79. The food of *H. nehereus* included 15 species of fish, 8 species of prawns, crabs, squilla and its larval forms, and young ones of cephalopods. The basic food consisted of its own young ones, *Acetes* spp. and *Nematopalaemon tenuipes*. Young Bombay ducks of size 35–120 mm feed mainly on *Acetes* spp.

Monthly feeding activity indicated high feeding rate during post-monsoon and low during monsoon.

Spawning habits: Sex-ratio was 1:0.9 between male and female. Most of the females were observed with resting or developing stages of ovary (Fig. 2). Gravid females were observed throughout the year except May. Their percentage was more during December–January and June indicating two peak spawning seasons.

Young ones (45–60 mm) were available

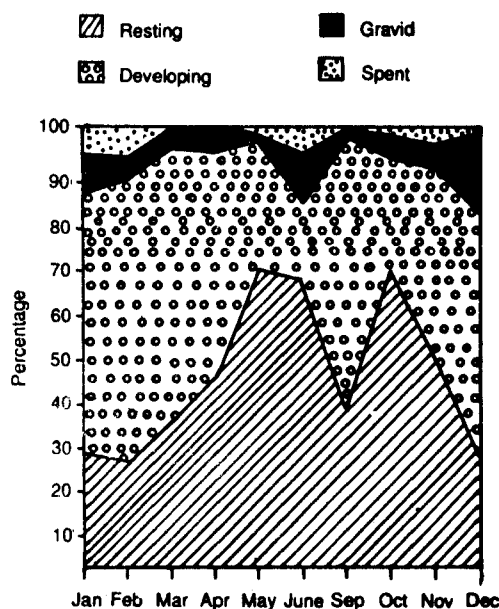


Fig. 2. Average monthly gonadal condition of female Bombay duck (Saurashtra).

throughout the year with two peaks, February-March and November (60–75 mm), indicating that the fish breeds throughout the year with two peaks.

Testis in Bombay duck is very thin and hence it was not possible to fix stages of maturity.

Minimum size at maturity: Palekar and Karandikar (1952) and Bapat (1970) estimated the minimum size at maturity as 240 mm and 210 mm respectively. In this study also the ripe fish was first encountered in the size group of 200–209 mm. Cumulative percentage of fish above resting stage indicated size at first maturity as 244 mm. However, more than 50% of mature fishes were observed in the size range of 225–240 mm. Hence 232.5 mm can be considered as size at first maturity (Fig. 3).

Spawning : The ova-diameter studies indicated the presence of two batches of ova, a

batch of immature ova of mostly 0.1–0.29 mm and another batch of mature ova of 0.67–1.25 mm, depending upon the stage of maturity of fish (Fig. 4). It can, therefore, be concluded that individual fish spawns once in a year. This is in conformity with the earlier observations (Walford 1932, Hickling and Rutenberg 1936, Prabhu 1956 and Bapat 1970).

Fecundity: The number of ova produced varied between 17 075 and 79 631 in the fish of size range 195–315 mm. The number of ova produced increased with the size of fish. Average fecundity was 340 ova/g body weight of fish.

Stock assessment

Growth parameters: The size ranged from 30 to 367 mm. The growth parameters estimated by ELEFANI (Fig. 5) were: $L_{\infty} = 410$ and $K = 0.749$ (annual).

The method does not produce an estimate of t_0 . A number of workers earlier have estimated the growth parameters of Bombay duck which are given in Table 1.

Krishnayya (1968) seems to have over-estimated the L_{∞} as specimen above 410 mm has not been recorded from anywhere in

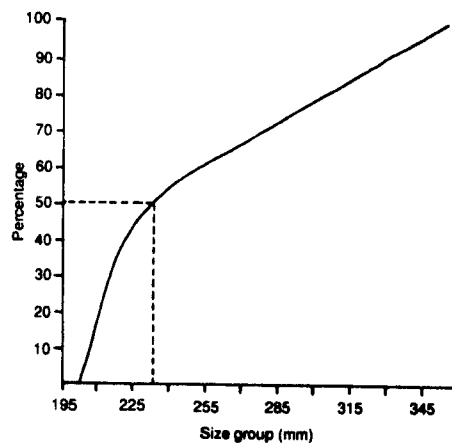


Fig. 3. Size at first maturity of Bombay duck (Saurashtra).

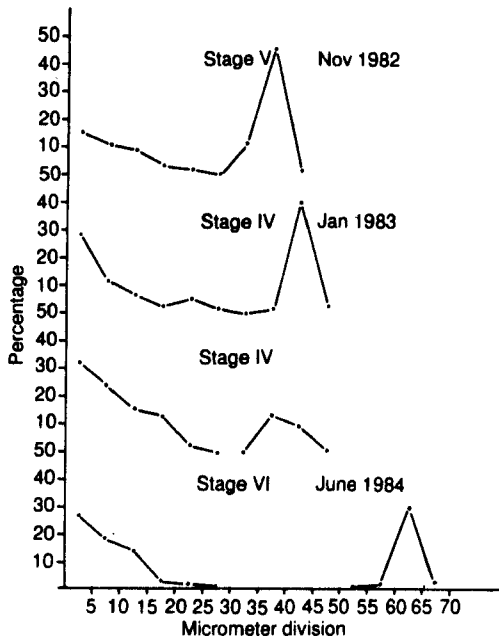


Fig. 4. Ova-diameter studies of Bombay duck (Saurashtra).

India.

Recruitment pattern: The length distribution showed that the young ones are recruited to the fishery throughout the year (Fig. 5). Peak recruitments observed during recruitment studies by ELEFAN are shown in Fig. 6.

Mortality and stock size: Total instantaneous mortality coefficient (Z) estimated by length converted catch curve analysis was 2.547 (Fig. 7) with correlation

Table 1. Growth parameters of Bombay duck estimated by various workers.

Authors	L_{∞}	K	Region
Krishnayya (1968)	730.2	0.176	East coast of India
Zafar Khan M (1985)	367	0.761	Saurashtra
Pauly D (1982)	352	0.5	Bombay
Biradar RS (1987)	391	0.53	Bombay
Zafar Khan M (1989)	425	0.7618	Saurashtra
Present study	410	0.749	Saurashtra
Zafar Khan M (M.S)	413	0.73	Bombay

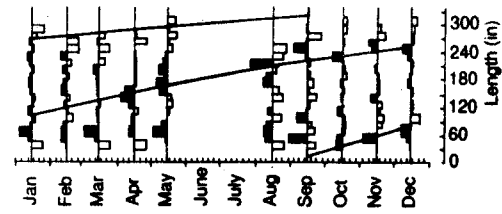


Fig. 5. The growth curve of Bombay duck (Saurashtra) identified by ELEFAN I. $L_{\infty} = 410$ mm, $K = 0.749$ (annual)

coefficient of 0.945 though during February–May Z was 4.158. Z obtained by length cohort analysis was 2.544 (Table 2) with M/K ratio of 2 and terminal F/Z as 0.75. Yield per recruit studies, by taking $L_c/L_{\infty} = 0.16$ and $M/K = 2.0$, gave E_{max} as 0.42 (Fig. 8). The exploitation rate E was 0.397 and the present yield 32 645 tonnes. MSY was estimated at 34 668 tonnes. However, by taking M/K ratio as 1 (Fig. 9) there was not much change in the estimated MSY (37 486 tonnes).

DISCUSSION

Growth in *H. nehereus* appears to be faster than that observed by earlier workers (Krishnayya 1968, Bapat 1970, Pauly 1982 and Biradar 1987).

The present exploitation ratio is lower

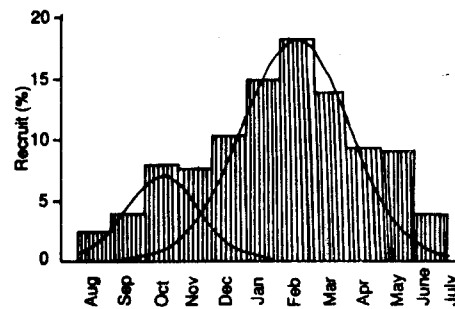


Fig. 6. Recruitment pattern of Bombay duck (Saurashtra).

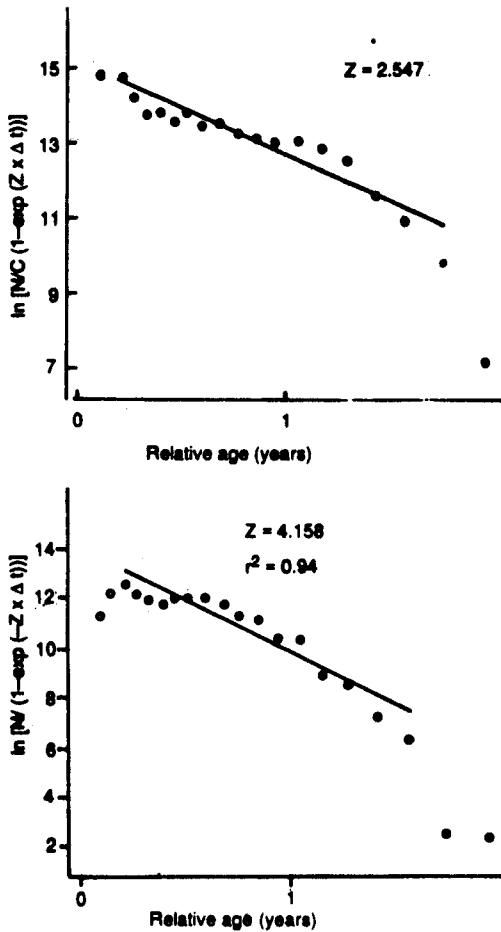


Fig. 7. Mortality estimates of Bombay duck by catch curve method for Saurashtra (above). The same during February to May (below).

(0.397) than observed during earlier studies (0.435). The Y_w/R curve was dome shaped taking M/K ratio as 2. However, there was no major change in E_{max} with lowered M/K ratio of 1 indicating that it is the age at first capture that determined the shape of yield/recruit curve in case of *H. nehereus*. The present MSY estimate is 34 668 which is comparatively lower than the earlier estimate of 44 066 tonnes by Zafar Khan (1989).

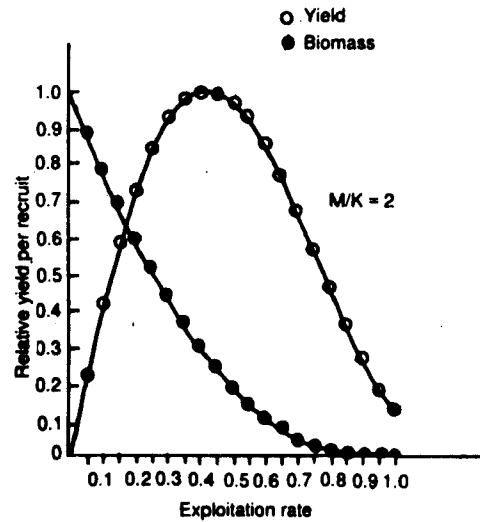


Fig. 8. Relative yield per recruit of Bombay duck for $M/K = 2$ (Saurashtra).

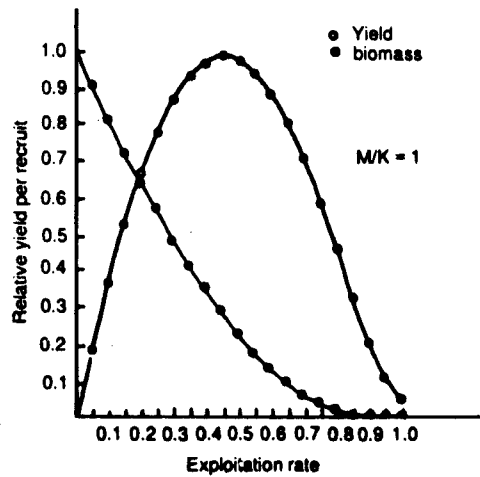


Fig. 9. Relative yield per recruit of Bombay duck for $M/K = 1$ (Saurashtra).

The effort of Bombay duck is regulated depending upon the catch per unit; in the beginning of fishing season only single haul is taken as the catch rate is high. Subsequently

Table 2. Results of length cohort analysis of Bombay duck (Saurashtra).

Length (mm)	C (million)	N (million)	F/Z	F	Z	C×W
37.5	238.53	263.85	0.37	0.9	2.44	42.02
52.5	398.63	210.93	0.55	1.89	3.42	211.63
67.5	230.70	173.12	0.46	1.33	2.88	279.18
82.5	132.36	148.39	0.37	0.89	2.43	309.26
97.5	81.85	130.68	0.29	0.63	2.16	330.73
112.5	91.12	115.68	0.34	0.79	2.32	588.62
127.5	71.93	101.99	0.31	0.7	2.24	700.36
142.5	86.49	89.09	0.39	0.97	2.5	1 212.76
157.5	72.96	76.70	0.38	0.95	2.49	1 420.36
172.5	72.05	65.26	0.42	1.1	2.64	1 889.99
187.5	58.88	54.75	0.47	1.07	2.61	2 030.21
202.5	60.57	44.98	0.5	1.35	2.88	2 687.84
217.5	54.90	35.63	0.61	1.54	3.07	3 079.18
232.5	64.15	26.24	0.67	2.44	3.98	4 477.38
247.5	53.90	17.12	0.74	3.15	4.68	4 618.33
262.5	42.01	9.50	0.71	4.44	5.95	4 364.77
277.5	16.96	4.55	0.78	3.73	5.26	2 114.16
292.5	10.60	1.94	0.83	5.45	6.99	1 569.77
307.5	3.81	0.45	0.75	7.71	9.25	665.27
322.5 plus	0.30	0.06	0.75	4.6	6.14	60.98
						32 652.8

Mean F(L) > = 67.5): 1.009

as the catch rate comes down, 2–3 hauls are taken. However, whenever the catch is very poor the fishing is suspended due to economic reasons.

The whole fishing season can be divided into two parts: September–January which is more productive and with less juveniles, and February–May which is less productive with juveniles forming most part (Zafar Khan 1985). During this study, Z was high during February–May (4.158) compared to the annual average (2.547). A similar observation was made earlier by Zafar Khan (1989).

Two basic regulatory measures suggested earlier (Zafar Khan 1989), to increase the yield, should form the basic management strategy in future for the Saurashtra stock of Bombay duck. These were (i) switch over to 25–27 mm cod end net and (ii) closing of fishing season during February–May.

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