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Status of non-penaeid prawn fishery of India and stock assessment of *Acetes indicus* Milne Edwards off Maharashtra

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ABSTRACT

The non-penaeid prawns, with the average annual catch of 57 000 tonnes, formed 3.7% of the total marine fish production in India. Maharashtra contributed nearly 78%, followed by Gujarat (11.45%), and Andhra Pradesh (4.68%). In Maharashtra, *Acetes indicus* with the average annual catch of 24 275 tonnes in 1980-82, was the most abundant species. It formed 74.4% of the *Acetes* landings and 51.2% of the total non-penaeid prawn catch. In Gujarat and Andhra Pradesh *Acetes* spp. formed 41 and 48.74% of the non-penaeid prawn catch respectively.

Stock assessment of *A. indicus* was done for Maharashtra using length-based methods. The von Bertalanffy growth parameters, $L\infty$ and K for the species are 31.1 mm and 39.65 mm, and 3.19 and 3.22 for males and females respectively. The high instantaneous natural mortality coefficient (M) — 10.87 for the males and 8.22 for the females — are attributed to the short lifespan and the lower trophic position of the species. The total instantaneous mortality coefficient (Z) is 13.43 and 10.62, and the exploitation rate is 0.19 and 0.23 for the males and females respectively. The MSY and the mean biomass for the species are 52 000 tonnes and 6 736.7 tonnes respectively. To reach the MSY, effort will have to be increased by a factor of 24, which however does not seem to be possible, as *A. indicus* is a by-catch in the *dol* net, the target fish being Bombay duck. Since the Bombay duck fishery is facing overfishing problem it is advised not to increase the effort of *dol* nets for the further exploitation of *A. indicus*.

Non-penaeid prawns constitute one of the important fishery resources in India, contributing 4.47% to the total marine fish production of the country. This resource is very characteristic of the north-west coast, particularly in Maharashtra where with the average annual catch of 52,400 tonnes it accounts for 24.4% of the total fish production and 65% of the prawn production (Srinath *et al.* 1987). The non-penaeid prawn resource is multispecies, mainly constituted by the tiny species of prawns, viz. *Acetes indicus* Milne Edwards, *Nematopalaemon tenuipes* Hendersen and *Exhippolysmata ensirostris* Kemp. Among these prawns the sergestid prawn *Acetes indicus* is the most abundant and occurs almost all along the coastline of India.

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Investigations on the stock assessment of commercially important species are essential for the rational exploitation and management of the fishery. The information on *Acetes* stocks is scarce (Omori, 1975). George (1973) estimated the biomass of non-penaeid prawns in Maharashtra. Except for this there is no information on the population dynamics and stock assessment of *Acetes indicus*.

Information on the fishery of *Acetes* spp. in India is available from the work of Kunju (1967) and Aravindakshan and Karbhari (1988). The biology of *Acetes* *indicus* was studied by Pillai (1973), Deshmukh and Kagwade (1987) and Deshmukh (1988). The present work relates to the fishery and stock assessment of *Acetes indicus*.

Data base

The basic data on catch and effort of non-penaeid prawns in different states were collected by the Fishery Resources Assessment Division (FRAD) of CMFRI by employing stratified multi-stage random sampling method. These data were obtained from various publications of CMFRI (CMFRI, 1981, 1983, 1986) and unpublished data sheets issued by the FRAD. The data on species composition were collected by visiting the landing centres once a week. The species composition for the entire state was arrived at by selecting 2-3 major landing centres of the states.

MATERIALS AND METHODS

Weekly samples of *Acetes indicus* were collected during 1980-82 from the major *dol* net landing centres, Sassoon Dock and Versova at Bombay, in Maharashtra. These two centres together contributed 10-15% of the total non-penaeid prawn catch of the state. The samples were preserved in 5% formalin and analysed for the size within 1-2 days of preservation. Sexwise size in total length was measured from the tip of the rostrum to the end of telson by keeping the prawn dorsoventrally flattened on the scale graduated at 0.5 mm interval. The tiny prawn was measured with the help of a magnifier with 4 X magnification and self illumination. The total weight by sex was recorded for sexwise estimation of the catch. For length-frequency analysis the sizes were grouped into 2 mm class interval and raised to the total estimated catch of each landing centre to obtain combined size-frequency which was raised to the estimated monthly catch of the state.

For the estimation of growth parameters von Bertalanffy growth formula (VBGF) ELEFAN I computer programme (Pauly and David 1981) was used in which the length asymptote (L) and the growth coefficient (K) are estimated and the third parameter considered zero.

The instantaneous natural mortality coefficient (M) was estimated by using the concept given by Sekharan (1975). In this method, the natural lifespan of fish species is considered as the age at which 99% of a cohort dies if it is exposed to natural mortality only. The 'M' is then expressed by

$$M_{1\%} = - \ln (0.01/T_m)$$

Where, T_m is longevity and $M_{1\%}$ is natural mortality corresponding to 1% survival of the stock. In the present context however the species being very small in size with extremerly short, ephemeral life-span, 'M' was estimated at 0.1% survival.

The total instantaneous mortality coefficient (Z) and the instantaneous fishing mortality coefficient (F) were estimated by employing the length-based computer programme (LCOHOR) of Sparre (1987). In this programme, the average number of prawns landed during the 3-year period, 1980-82, by their length groups, the natural and mortality coefficient (M) arrived by the Sekharan's method (1975) and growth coefficient (K) obtained from the ELEFAN programme were used as inputs. Using the values generated in the cohort analysis, current state of the stock and the potenital biomass (MSY) were assessed by Thompson and Bell analysis given by Sparre (1987). Males and females were combined in a mixed fishery analysis using MIXFISH computer programme of Thompson and Bell (Sparre 1987) to have predictions of

Acetes indicus Milne Edwards

biomass and MSY for the species in Maharashtra.

Fishery

The catch of non-penaeid prawns in India during 1979-88 ranged from 36 303 to 71 985 contributing 2.18-5.04% to the marine fish production of the country. With the average annual catch of about 57 000 t these prawns formed 3.7% of the total marine fish production and constituted 31.6% of the total prawn production. They are found all along the Indian coast but are of commercial importance only along the north-west and north-east coasts. The northern coast of Maharashtra, around Bombay, is particularly very rich, contributing more than three-fourths of the total production of the country. The bulk of the landings comes from Maharashtra (77.9%, 445.11 t), followed by Gujarat (11.43%; 6 537 t), Andhra Pradesh (4.67%; 2 669 t) and West Bengal (3.69%; 2 114 t). In Tamil Nadu, Kerala, Karnataka, Orissa, Andaman and Pondicherry they occur in small quantities and form negligible percentage, whereas in Goa and in Lakshadeep they are not found in notable quantity.

Gear: The non-penaeid prawns are generally caught as by-catch in the bag nets and stake nets. In Maharashtra and Gujarat, these prawns are mainy caught by fixed bag nets, locally called '*dol*' nets. During monsoon months (from June to September) when *dol* net fishing is suspended due to inclement weather in Maharashtra and Gujarat, a smaller version of *dol* net, called *bhokshi*, is used in creeks and backwaters (Kunju 1967). In West Bengal, in the deltaic estuarine regions, bag and stake nets are used (Muthu and Ramamurthy 1969). In Godavary estuarine system, around Kakinada in Andhra Pradesh, besides the fixed stake nets, scoop nets, shore seines, boat seines and drag nets are used (Rao. 1975). The cod-end mesh size of the *dol* nets used in Maharashtra varies from 10 to 40 mm and in Gujarat from 20 to 30 mm.

State-wise catch, effort and species composition

Maharashtra, Gujarat and Andhra Pradesh together contributed 94.12% to the total non-penaeid prawns production of the country. In Maharashtra and Gujarat the number of *dol* net units operated has been taken as the effort. In Andhra Pradesh there is a multitude of gears, hence a total of them has been considered for the estimation of effort and catch per unit of effort (cpue).

Maharashtra: The catch of non-penaeid prawns in Maharashtra during 1980-88 ranged from 26 454 tonnes to 57 387 tonnes contributing 9.3 - 20.4% to the marine fish production of the state (Fig.1)

In Maharashtra the fishery is mainly supported by *A. indicus*, *N. tenuipes* and *E. ensirostris*. There are 4 species of *Acetes*, viz. *A. indicus*, *A. johni*, *A. sibogae* and *A. japonicus* (Aravindakshan and Karbhari 1988) among which *A. indicus* is the dominant species. During 1980-82 (Table 1) with the average catch of 24.275 tonnes, *A. indicus* formed 51.2% of the total non-penaeid catch and 74.4% of the total catch of *Acetes* spp. Species composition of non-penaeid prawns averaged for 1979-88 was *Acetes* spp.76.38%, *N. tenuipes* 21.23% and *E. ensirostris* 2.39%.

Gujarat: The catch of non-penaeid prawns ranged from 3 347 tonnes in 1979 to 9 961 tonnes in 1986 with the average catch of 6 527 tonnes (Fig.1). These prawns contributed 3.89% to the total marine fish landings of the state. The *dol* nets landed

Table 1. Species-wise catch and percentage composition (in parentheses) of non-penaeid prawns in Maharashtra during 1980-82

Year	*A.indicus*	Total of *Acetes* spp.	*N. tenuipes*	*E. ensirostris*	Total penaeid prawns
1980	23,304	31,082	15,390	837	47,309
	(49.26)	(65.70)	(32.53)	(1.77)	
1981	27,378	35,401	16,570	883	52,854
	(51.80)	(66.98)	(31.35)	(1.67)	
1982	22,143	31,398	7,975	1,436	40,809
	(54.26)	(76.94)	(19.54)	(3.52)	
Average 1980-82	24,275	32,627	13,312	1,052	46,991
	(51.66)	(69.43)	(28.33)	(2.24)	

an average of 4 433 tonnes which formed 67.8% of the total non-penaeid prawn catch of the state.

In Gujarat, the non-penaeid prawn catch is constituted by *A. indicus* (41%), followed by *N. tenuipes* (33.22%) and *E. ensirostris* (25.78%)

Andhra Pradesh: The catch of non-penaeid prawns (Fig.1) during 1979-88 ranged from 956 to 5 851 t with the average catch of 2 669 t it formed 2.1% of the total marine fish production of the state. In Andhra Pradesh the major landing of non-penaeid prawns takes place only in the deltaic estuarine zone of the rivers Godavary and Krishna.

The fishery is supported by a large number of species, viz. *A. indicus, A. erythraeus, A. japonicus* and *A. sibogae* (Ravindranath 1980). The other species are *Nematopalaemon tenuipes. Exhippolysmata ensirostris, Macrobrachium rude, M. malconsoni, M. lamarrie* and *Leptocarpus potamiscus* (Rao 1975). *Acetes* spp. dominated the catch (48.74%) followed by *N. tenuipes* (38.80%), *E. ensirostris* (10.10%) and other species (2.3%).

Seasonal variations

In Maharashtra the peak period of abundance is during the second quarter (April-June) while in Gujarat it is during the last quarter (October-December). In Andhra Pradesh the major landing takes place during the third quarter (July-September).

In Maharashtra, *Acetes* spp. dominate throughout the year constituting more than 80% of the total non-penaeid prawn catch in the post-monsoon period. *A. indicus* shows 2 peaks — during Septermber and in February-April. *N.tenuipes* shows only one– during March-May. Although catches of *E. ensirostris* are relatively less, the species appears in significantly higher proportion during July-September and in December.

In Gujarat *A. indicus* dominates during February-May, *N. tenuipes* during January and *E.ensirostris* during September and December-January.

Biology

Despite great abundance in fishery the biological investigations on the species of *Acetes* are few, probably due to their small size. Deshmukh (1988) carried out detailed investigations on the biology of *A. indicus*.

A. indicus occurs in surface water (0-5 m) in massive accumulations or swarms which are greatly influenced by the tidal currents, precipitation and winds. The size

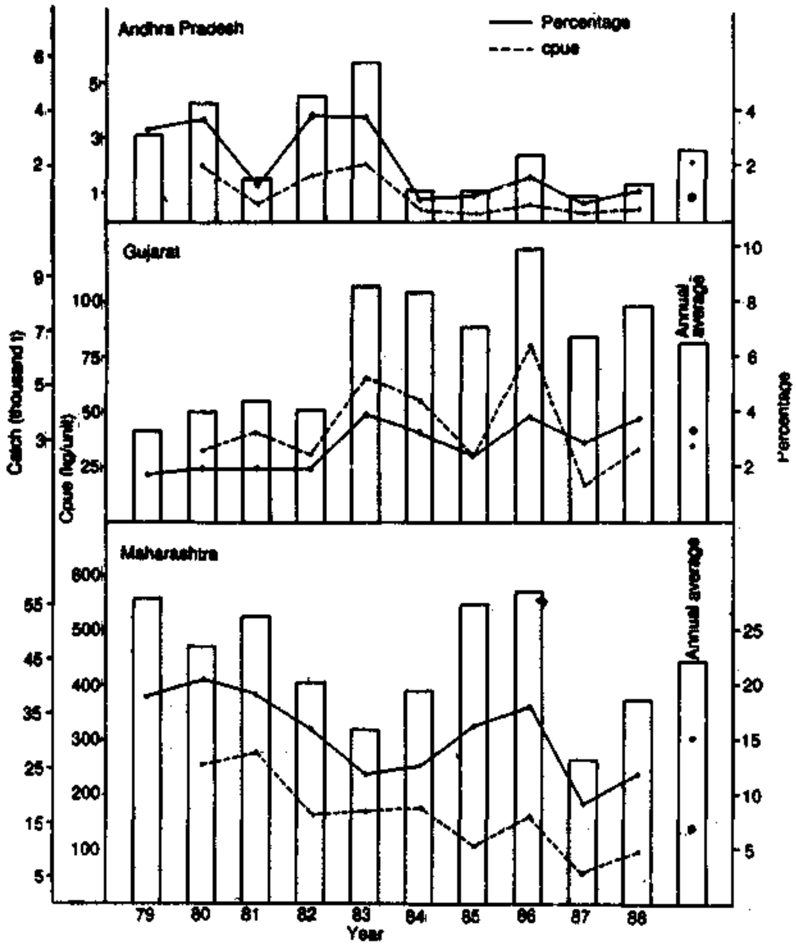

Fig.1. Catch, effort and cpue of non-penaeid prawns in important states during 1979-88.

range of the species, in the *dol* nets, is 6-38 mm but grows up to 40 mm (CMFRI 1975). The males are smaller in size reach in 27 mm in total length while the females grow up to 38 mm.

The length-weight relationship for males and females is:

Males : $W = 0.0000122\ L^{2.9068}$

Females : $W = 0.00001151\ L^{2.9370}$

Where length is expressed in millimetres and wieght in grams.

Deshmukh (1988) using scatter diagram technique, showed that the males and females exhibit growth rates of 6.15 mm and 5.96 mm per month and the fishable life span of the species is about 6 months. It breeds throughout the year with peak spawning activity during October-January. The size at maturity is 14-15 mm for males and 24.4 for females. The minimum size of maturity for females is 17 mm and an individual female spawns twice during its short span of life. The fecundity is 4 333-10 300 eggs for the females of 19-33 mm in total length. *A.indicus* forms a feeding basket with the help of setose oral appendages and subsists mainly on detritus and planktonic organisms by filter feeding mechanism.

A. indicus is a common food item of the prawns, cephalopods and juveniles of almost all the pelagic and demersal fishes occurring in shallow coastal waters around Bombay.

RESULTS

Growth

During January 1980 - December 1982 a total of 4 118 males in the size range 8-27 mm and 7 319 females in the size range 8-37 mm were measured for the size-frequency analysis to estimate the age and growth parameters. When weekly samples were pooled for the month and used to obtain growth parameters ($L\infty$ and K) from ELEFAN 1 computer programme analysis the resultant R_n values of the parameters were with L_∞ values much lower than the observed maximum sizes or with very low 'K' values leading to very slow growth rate and far longer lifespan. However, when weekly length-frequency data for males for June 1982-September 1982 were used (Fig.2), reasonably acceptable values of growth coefficient (K) and asymptotic length ($L\infty$) with fairly good values of R_n were obtained. These values were as follows:

K = 3. 19 (annual)

$L\infty$ = 31.1 mm

R_n = 0.377

Similarly for females when data for July 1982-December 1982 were used following growth parameters were obtained (Fig.3).

K = 3. 22 (annual)

$L\infty$ = 39.65 mm

R_n = 0.226

It is assumed in the ELEFAN 1 analysis that the value of the third parameter of the von Bertalanffy growth function, t_0 is zero (Pauly and David 1980). Therefore the sizes attained by the males of *A.indicus* are 17.09 mm, 24.79 mm and 28.26 mm, and those by females are 21.92 mm, 31.72 mm and 36.11 mm at the end of 3, 6 and 9 months of age respectively. The growth rates of both the sexes, however, appear lower than those observed by Deshmukh (1988).

Natural mortality coefficient: M

During the present investigation the largest sizes of the males and females were 27 and 37 mm. Their age using the modified von Bertalanffy growth expression was 7.62 and 10.08 months respectively. The natural mortality coefficients (M) of the two sexes at 0.1% survival estimated by Sekharan's method (1975) were 10.87 for the males and 8.22 for the females.

Total mortality coefficient : Z

The computational details of the estimation of total mortality coefficient (F) by the length cohort analysis are presented in Tables 2 and 3 for the males and females respectively. The terminal exploitation rate (F/Z) was chosen in such a way that the exploitation rate for the last few length groups became approximately the same. This approach is based on the assumption that the last 3-5 length-groups are all under full exploitation, have same mortality rates and therefore also have the same exploitation rate. The value was chosen after a few iterative trials. The fishing mortality for different length groups of males and females are shown in Fig. 4. The mean instantaneous fishing mortality coefficient is 2.56 for the males and 2.40 for the females, hence the total mortality coefficients were 13.43 and

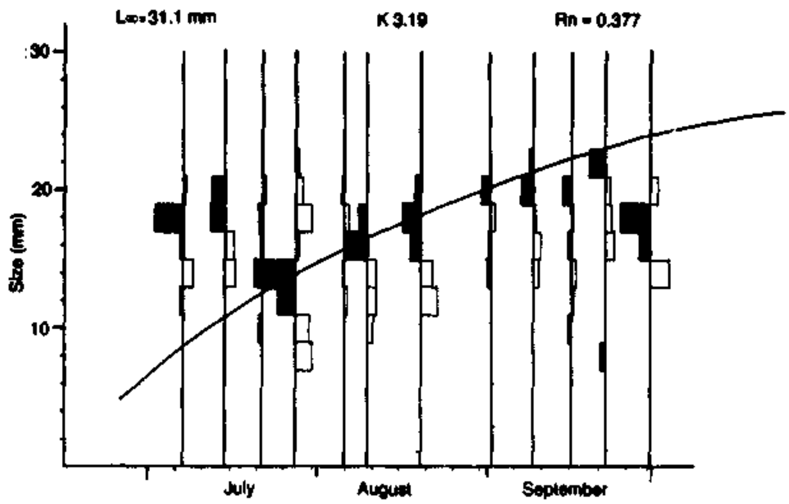

Fig.2. Growth curve of males of *A. indicus* based on ELEFAN I computer programme.

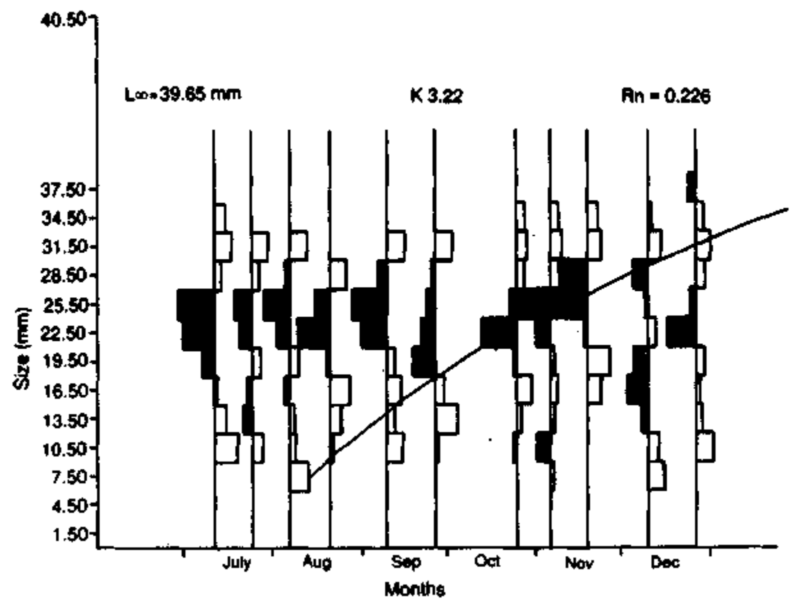

Fig.3 Growth curve of females of *A. indicus* based on ELEFAN I computer programme.

10.62 for the two sexes respectively. The independent estimates of total mortality by length converted catch curve method of Pauly (1980) for males were 13.46 and for females were 11.19. These are in conformity with the present estimates. The exploitation rates for the two sexes are 0.19 and 0.23.

Stock assessment

Using the results of the length cohort

analysis (Tables 2, 3) in the length converted Thompson and Bell model, the estimates of the current size of mean biomass and yield for the two sexes of *A. indicus* are given in Fig. 5. Initially the yield increased rapidly from the current level of 20 470 tonnes to about 49 000 tonnes when the effort increased by a factor of 10 of the present level; but subsequently the increase in yield was very gradual even though the effort was increased by a factor of 24. This flat-topped yield curve (Fig.5) showed that

Table 2. Length cohort of males of *A. indicus*

Length	C Nos. caught (in million)	$N-N_{\infty}$ - in the sea No. in million	F/Z	F	Z
5.50 - 7.50	262.189	2 297 176.00	0.0005	0.0051	10.87
7.50 - 9.50	892.656	1 740 830.25	0.0020	0.0214	10.89
9.50 - 11.50	2030.632	1 286 619.63	0.0056	0.0609	10.93
11.50 - 13.50	3663.055	922 255.31	0.0128	0.1409	11.01
13.50 - 15.50	4111.682	636 055.38	0.0189	0.2092	11.08
15.50 - 17.50	7422.832	418 330.63	0.0458	0.5216	11.39
17.50 - 19.50	8715.891	256 232.30	0.0765	0.9011	11.77
19.50 - 21.50	10743.150	142 371.31	0.1424	1.8049	12.67
21.50 - 23.50	7707.280	66 926.13	0.1839	2.4493	13.32
23.50 - 25.50	3732.405	25 014.37	0.2029	2.7667	13.64
25.50 plus	1389.750	6 617.86	0.2100	2.8895	13.76

Mean F (L = 19.50) = 2.5594; Terminal exploitation rate = 0.2100; L_{∞} = 31.1; l_0 mm ; K = 3.19/year; M = 10.87 / year ; a = 0.00001223 and b = 2.9068 in W = a L_b.

Table 3. Length cohort of females of *A. indicus*

Length	C Nos. caught (in million)	N Nos. in the sea (in million)	F/Z	F	Z
5.50 - 7.50	95.926	2 306 981.00	0.0003	0.0024	8.22
7.50 - 9.50	369.461	1 977 500.00	0.0012	0.0102	8.23
9.50 - 11.50	1110.354	1 678 115.75	0.0041	0.0339	8.25
11.50 - 13.50	2656.457	1 407 382.75	0.0109	0.0906	8.31
13.50 - 15.50	3712.884	1 163 601.38	0.0171	0.1429	8.36
15.50 - 17.50	6150.295	946 361.25	0.0319	0.2707	8.49
17.50 - 19.50	8540.361	753 447.94	0.0505	0.4368	8.66
19.50 - 21.50	9491.479	584 179.38	0.0654	0.5752	8.79
21.50 - 23.50	14709.490	439 050.25	0.1169	1.0881	9.31
23.50 - 25.50	14950.400	313 221.59	0.1461	1.4061	9.63
25.50 - 27.50	15,694.280	210 872.42	0.1940	1.9791	10.20
27.50 - 29.50	13296.680	129 993.99	0.2276	2.4217	10.64
29.50 - 31.50	10199.050	71 564.97	0.2656	2.9725	11.19
31.50 - 33.50	6113.794	33 161.93	0.2875	3.3161	11.54
33.50 - 35.50	2490.297	11 893.30	0.2754	3.1238	11.34
35.50 - 37.50	1032.335	2849.96	0.3735	4.9001	13.12
37.50 plus	21.463	85.85	0.2500	2.7400	10.96

Mean F (L> = 25.50 mm); 2.4025 weighted by stock numbers. Terminal exploitation rate = 0.25 ; L_{∞} = 39.65 mm K = 3.22/year; M = 8.22; a = .00001151 and b = 2.937 in W = a L^b

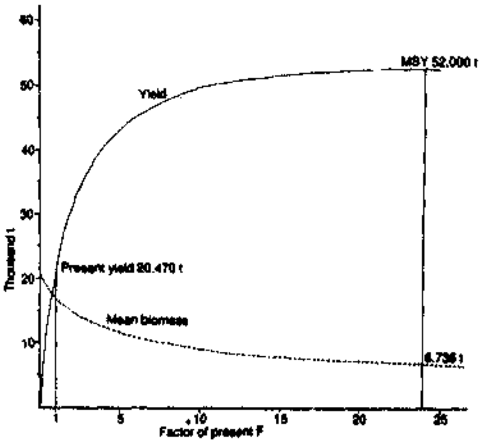

Fig.4. Fishing mortality rates (F) of *A.indicus* by sex and length groups, based on length cohort analysis.

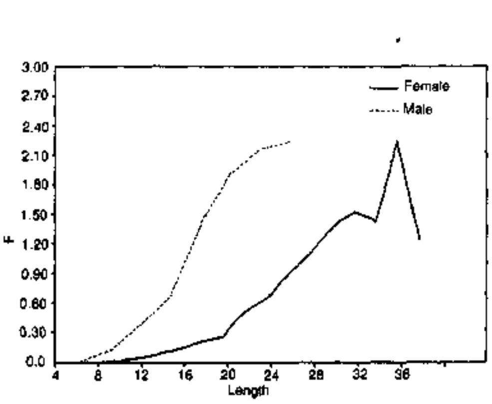

Fig.5. Yield and mean biomass curves to current level of fishing of *A. indicus*.

maximum sustainable yield (MSY) of about 52 000 t can be achieved if the effort is increased by a factor of 24. Consequently the mean biomass showed a decline from about 17 000 tonnes at present level of fishing to only 6 736 tonnes when MSY level would be achieved. To increase the production of *A. indicus* by 2.54 times of the present yield, the effort required would be enormous-24 times of the present level of fishing.

DISCUSSION

Estimation of natural mortality coefficient (M) is extremely critical to the study of population dynamics and stock assessment. Garcia and Le Reste (1981) remarked that correct estimation of 'M' in the absence of correlation between instantaneous total mortality coefficient (Z) and the effort expended poses great difficulties. In *A.indicus* the effort expended in *dol* net fishing is not directly intended to exploit this species. In fact *A. indicus* is allowed to escape through the cod-end of the net whenever the target species such as Bombay duck, pomfrets, penaeid prawns and other prime varieties of fish are available, by using larger cod-end mesh size (Raje and Deshmukh 1989). Therefore it would not be corrent to estimate 'M' by finding out the correlation between the *dol* net effort employed and the total mortality coefficient of the species.

Ursian (1967) stated that natural mortality is greatly influenced by environmental components such as the activity of predators. Cushing (1968) also suggested that the natural mortality depends on the trophic position of the organism in the food chain. *A.indicus* is a tiny prawn predated by majority of fishes in the coastal waters. Bapat and Bal (1952) investigated food habits of young ones of 26 species of fishes occurring in coastal waters of Bombay and commented that *Acetes* is their major food item. Bapat (1970) reported that in certain months of the year the food of Bombay duck entirely consisted of *A. indicus*. Similarly Suseelan and Nair (1969) commented that prawns in genral and *A.indicus* in particular were the common food item in the stomach of 17 species of demersal fishes of Bombay, ranking at the top of the food index. Deshmukh (1988) also showed that in coastal waters of Maharashtra *A.indicus* is the major food item of fishes, prawns and cephalopods. These investigations therefore suggest that due to high predation the natural mortality of *A.indicus* must be very high and hence the present estiamte of M – 10.87 for the males and 8.22 for the females – by Sekharan's method (1975) would not be overestimates.

With the present estimates of natural mortality coefficient, the exploitation rate of 0.19 for the males and of 0.23 for the females appear to be small, and fishing mortality does not seem to be of great concern. Similar observations were made by Simpson *et al.* (1970). Tiew (1978) also stated that for the small-sized caridean prawn, *Crangon crangon* the mortality due to predation is several times greater than the same owing to fishing.

George (1973) attempted stock estimation of the non-penaeid prawns in Maharashtra. He estimated the annual biomass of all the 3 species of non-penaeid prawns at 79,600 tonnes and their exploitation rate at 52.2%. The potential biomass (MSY) of *A.indicus* is about 52,000 tonnes which is 65.3% of the total biomass given by George (1973) for all the species together. At present, *A.indicus* forms nearly 73.4% of the *Acetes* landings and 52.2% of the total non-penaeid prawn landings in Maharashtra. Therefore the present estimate of the potential biomass (MSY) of *A. indicus* appeared to be not very far from that given by George (1973).

The long-term forecast analysis by Thompson and Bell model indicates that although yield of *A.indicus* can be enhanced from the present level of 20 470 tonnes to the MSY level of 52 000 tonnes, the effort required to achieve it would be enormous, to the tune of 24 times of the present level. This increase in effort is not only excessive but also un-reasonable from the point of view of the target species of the *dol* net, i.e the Bombay duck. Bapat and Alawani (1973) studied the Bombay duck fishery in late sixties and suggested reduction in effort of *dol* net to reverse the overfishing problem the fishery was facing. Thus increasing the *dol* net effort for exploitation of *A.indicus* may prove detrimental to the target fish of the net.

Raje and Deshmukh (1989) noticed that *dol* nets in Maharashtra are operated with varying cod-end mesh sizes. The fishermen use larger cod-end mesh (25-40 mm) during September-December and April-May when Bombay duck, silver pomfrets, *Coilia* and penaeid prawns are abundant so that the small-sized *A.indicus* together with other non-penaeid prawns can escape through and the commercially important varieties are caught more efficiently. During the lean months (January-March) of these varieties, the fishermen use smaller cod-end mesh (10-12 mm) to harvest *A.indicus* which is abundant during this period. This indicates that greater effort can be made to exploit *A.indicus* during January to March. However, Bapat and Alawani (1973) pointed out that during this period juveniles of Bombay duck are abundant and suggested that operation of small meshed *dol* nets should be reduced. Khan (1986, 1989) also reported that this period coincides with the juvenile abundance of Bombay duck, silver pomfret and other commercially important fishes in Gujarat. He further suggested that allowing non-penaeid prawns and penaeid prawns to escape from *dol* net will increase available food supply and may also reduce natural mortality of Bombay duck due to cannibalism. Sehara and Karbhari (1987) investigated economics of *dol* net fishing and pointed out that fishermen in Maharashtra incur lossess during December-March. Thus increasing the *dol* net effort even during January-March for further exploitation of *A.indicus* is not advisable.

A.indicus is a low-priced prawn, generally consumed after sun drying by the poor people. Due to small size and delicate nature the catch gets easily decomposed resulting in paste form which has very poor consumer acceptance. Therefore, it would be beneficial to develop proper processing techniques, to make suitable products of consumer preference so that the quantities which are caught at present are utilized to the maximum extent possible.

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