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Editors
V.N. Pillai and N.G. Menon

Central Marine Fisheries Research Institute
(Indian Council of Agricultural Research)
Tatapuram P.O., Cochin-682 014
Kerala, India

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20 Whitebaits

G. Gopakumar and N.G.K. Pillai

ABSTRACT

The present status of exploitation of whitebaits and information on their biology and stock position are reviewed. Encrasicholina devisi and Stolephorus waitei together account for major share of the whitebait catch. Aspects of fishery, size distribution in the fishery, size at first maturity, spawning season and seasons of young fish abundance for both the species at different observation centres are presented. Food of these species comprised chiefly of copepods and other zooplankters. The exploitation rate for S. waitei were 0.48 and 0.38 and for E. devisi 0.29 and 0.15 respectively along the east and west coasts. E. devisi is poorly exploited along both the coasts. E. devisi and E. punctifer are hardy, and can survive in captivity for one to three months and could therefore be utilised as live baits in the tuna pole and line fishery.

Introduction

Whitebaits or the whitewait anchovy is the common name applied to the fishes of the genera *Stolephorus Lacepede* 1803 and *Encrasicholina* Fowler, 1938. This group has wide distribution in the Indo-Pacific region. They constitute one of the important pelagic fishery resources contributing to about 3.5% of the total marine fish catch of India. Andhra Pradesh, Tamil Nadu, Kerala and Karnataka landed 60-90% of the total anchovy catch. Our knowledge on the resource potential and aspects of biology of whitebaits of India is largely due to the investigations of UNDP/FAO Pelagic Fishery Project (1971-75) along the southwest coast of India extending from Ratnagiri along the west coast (17°N) to Tuticorin along the east coast (8° 8'N) (Anon, 1947 a, b; 1976 a, b; Menon and George, 1975, Luther 1989, Luther *et al* 1992). Other works carried out at selected centres namely, Vizhinjam (Luther, 1972, 1979; Luther *et al* 1984), Mangalore and Cochin (Rao *et al* 1982; Rao 1988 a, b) are worth mentioning.

Material and methods

Data on the present status of exploitation of whitebaits taken from the National Marine Living Resource Data Centre (NMLRDC) of CMFRI was used to describe the whitebait fishery along the Indian coasts. Catch, effort and biological data collected on whitebaits at Mangalore, Cochin, Vizhinjam on the west coast, Madras and Visakhapatnam on the east coast were utilised for studies on biology and population dynamics. The length frequency data (total length) were used to estimate Lœ and K by ELEFAN I programme (Pauly and David, 1981). The length converted cohort analysis (Jones, 1984) was employed for estimating stock size and fishing mortality coefficient of the species. The natural mortality (M) was estimated by using Pauly's empirical equation (Pauly, 1980). The exploitation rate E was computed as E=F/Z, where F = Fishing mortality and Z=total mortality. The method proposed by Thompson and Bell (1934) was used to assess the MSY and biomass and also to forecast long-term yields. The analysis of data was accomplished with the help of LFSA package (Sparre, 1987).

Fishery

Craft and gear: In Andhra Pradesh, Tamil Nadu and Kerala, the most common artisanal gears in which whitebaits are caught are the boat seines (cod end mesh size, 10 mm) and shore seines (cod end mesh 10-20 mm). On the west coast, south of Quilon, gill nets known as *Netholi vala* (mesh size, 15 mm) are specially employed for catching whitebaits. All these gear are operated from catamarans and small country crafts, many of them fitted with outboard motors in Kerala. In shrimp trawls (cod end mesh 15 mm), whitebaits form a small fraction of the catch. Purse seines (common mesh size 14-18 mm) are in operation since 1970 in Maharashtra, Goa, Karnataka and Kerala coasts. Ring seines (mini purse seine with mesh size 8 mm) operated from plank built boats fitted with outboard motors are employed along the coasts of Kerala and Karnataka. The operational depth of these gears generally ranges from 15-50 m.

Status of fishery: Whitebait is highly variable in occurrence in time and space. The annual whitebait landings in the country during the period 1985-93 ranged between 50,847 t (1987) and 1,00,048 t (1988) with the average at 70,486 t (Fig.1). The contribution of whitebaits to the total fish catch in the country ranged from 2.7% (1990) to 5.6% (1988) and averaged to 3.6%.

Whitebaits formed 40-97% of the total anchovy landings in the four southern maritime states while the other anchovies (genera: *Thryssa, Setipinna, Coilia and Thrissina*) formed the dominant component in the other maritime states of India. About 97% of the country's whitebait is produced by the southern states - Kerala (44%) followed by Tamil Nadu (23%), Karnataka (16%) and Andhra Pradesh (14%). The annual whitebait landings of these states during 1985-93 and the quarterwise catch trends are given in Figs.2 and 3 respectively.

Along the east coast, the main fishery season differs. In Andhra Pradesh the peak period is during October to March, accounting for 77% of the annual catch. In Tamil Nadu the main fishery season is from April to December (90%), the peak period being July-September (41%) and the lean period during January to March. Along the west coast, the main fishery season in Karnataka is during October to March (79.9%). In Kerala, the main fishery season is from July to December (71%).

Gearwise contribution: In Andhra Pradesh, 82% of the whitebait catch was obtained by shore seine followed by trawl net (13%), boat seine (4%) and

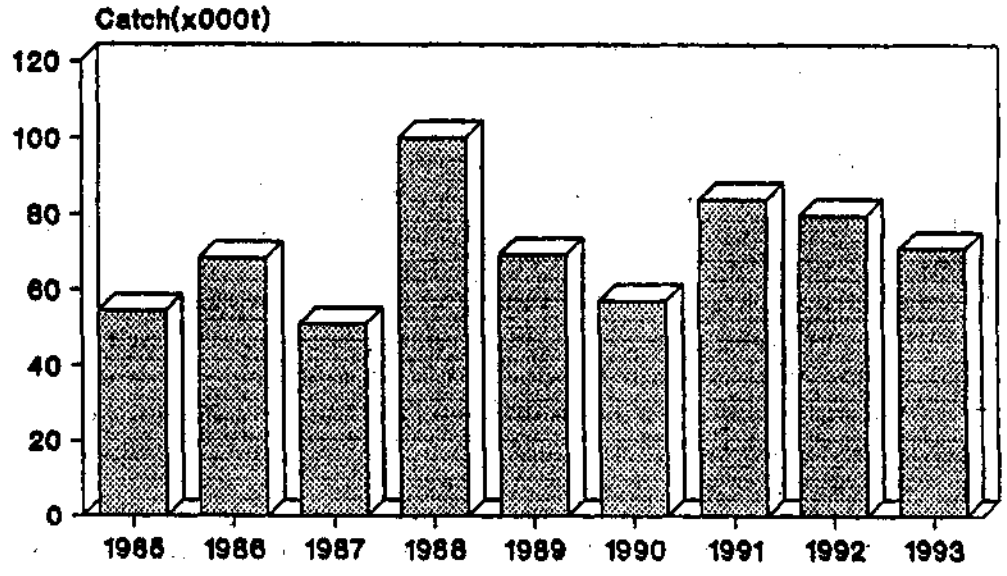

Fig.1. **Annual whitebait landings in India during 1985-1993.**

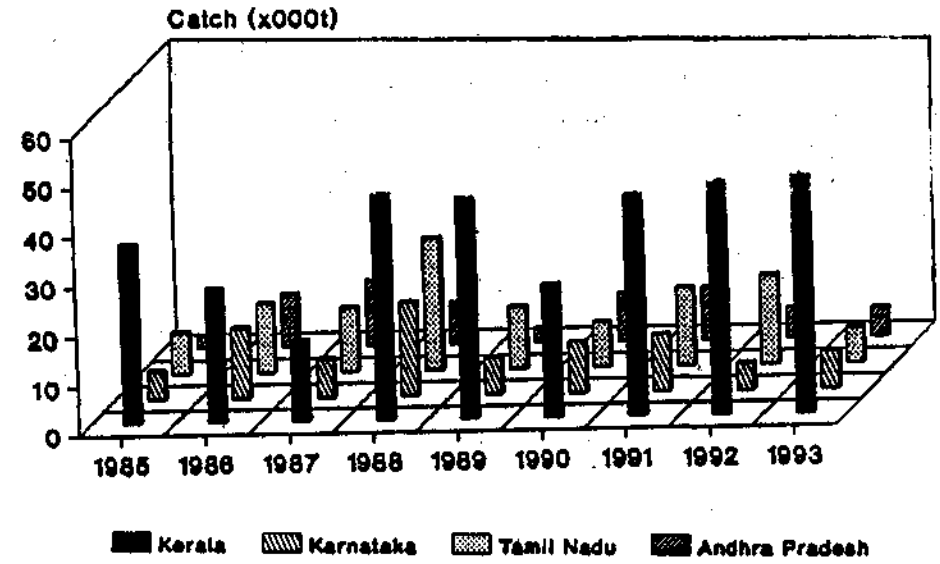

Fig.2. **State-wise whitebait landings in India during 1985-1993.**

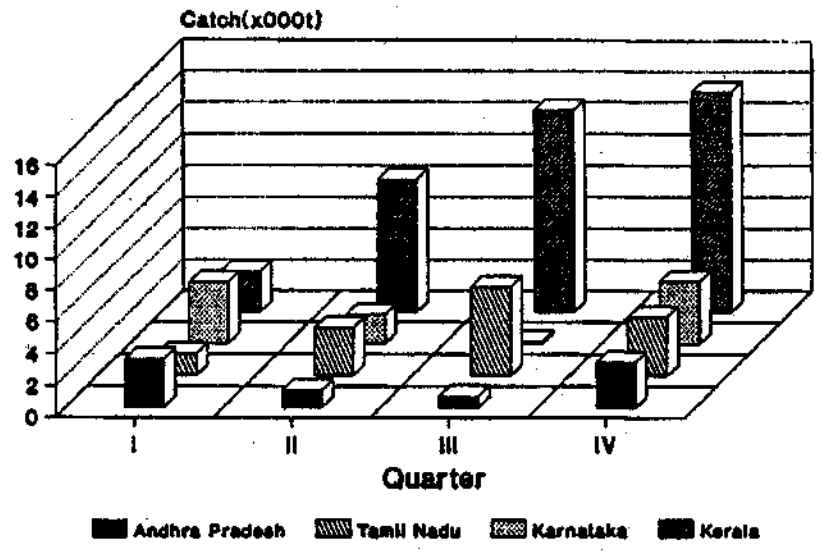

Fig.3. **Quarter-wise average whitebait landings in India during (1985-1993) in Andhra Pradesh, Tamil Nadu, Karnataka and Kerala.**

gill net (1%) with catch per unit effort at 67 kg, 5 kg, 3 kg and 1 kg respectively. In Tamil Nadu, gill net, boat seine and shore seine together accounted for 83% of the total annual catch followed by trawl net (17%) with C/E of 3 kg and 6 kg respectively. In Karnataka, purse seine's contribution was the highest (93%) with C/E at 221 kg followed by trawl net (6%) with C/E at 4 kg and others (1%). In Kerala, boat seine landed the bulk (65%) of the catch with C/E of 78 kg for crafts fitted with outboard motor and at 14 kg for non-motorised units (NM units) followed by gill net (11%) with C/E 7 kg, shore seine (9%) with C/E at 27 kg, ring seine (OB units) (3%) with C/E 16 kg and others (1%).

Species composition: According to Whitehead, *et al* (1988), ten species of whitebaits occur in the Indian seas. They are *E. devisi, E. heteroloba, E. punctifer, (=S. buccaneeri, S. andhraensis, S. baganensis (=S. macrops), S. commersonii, S. dubiosus, S. indicus, S. insularis and S. waitei (=S. bataviensis,* *E. devisi* and *S. waitei* are the two dominant species in most parts of the Indian coast: *E. punctifer* and *S. indicus* are the other important species in the fishery.

The variations in the species composition in different gears at the five observation centres were as follows: At Visakhapatnam, *E. devisi* and *S. waitei* accounted for 36% and 57% respectively of the whitebait catch. However, their relative composition varied in the different gears: shrimp trawl 23:74, shore seine 54:8 and boat seine 49:22. The rest of the catch was formed by six other species, namely *S. indicus, S. commersonii, S. andhraensis, E. heteroloba, S. baganensis and E. punctifer.* At Madras, *E. devisi* and *S. waitei* occurred in the ratio 73:20 in the whitebait catch. However, in purse seine their relative composition was 77:17. In shrimp trawl *S. waitei* formed the dominant catch (64.5%) followed by *E. devisi* (27.7%) and *S. baganensis* (7.7%). At Cochin, *E. devisi* and *S. waitei* occurred in the ratio 50:39 in shrimp trawl and 79:1 in purse seine and ring seine. At Vizhinjam *E. devisi* (40%) and *S. waitei* (34%) and *E. punctifer* (22%) were the most dominant whitebaits met with in the fishery. In boat seine, *S. waitei* (36.7%), *E. devisi* (33.8%) and *E. punctifer* (24.5%) formed the dominant catch, in gill net *E. devisi* formed the dominant catch (84.8%) followed by *S. waitei* (15.1%) and in shore seine *E. devisi* formed the dominant catch (70.7%) followed by *S. indicus* (12.4%), *S. waitei* (10.4%) and *E. punctifer* (6.2%).

Distribution and migration: Results of UNDP / FAO Pelagic Fishery Project along the southwest coast (Anon, 1974 a, b: 1976 a, b) indicate that

whitebaits are distributed mostly in areas with bottom depths of 10-50 m. They exhibit typical diurnal vertical migration. Generally *E. devisi* is abundant between 15 and 45 m bottom depth. *S. waltei* is a shore dwelling species being found mostly in waters less than 20 m depth.

Distinct seaward migrations of whitebait were also observed in the above survey. In November/December almost the whole whitebait stock is spread along the southwest coast. In April a southward movement begins and the stock starts accumulating in the Gulf of Mannar during June-August/ September. After the monsoon (June-August) the whitebaits again disperse along the coast north of Quilon during September-October/December. These seasonal movements of the whitebait stock have been found to be directly related to transport of water masses along the west coast. *E. devisi* and *S. waltei* seem to exhibit difference in their vertical distribution. In purse seine, ring seine, shore seine and gill net which are operated at or near the surface waters *E. devisi* constituted 70 to 84% of the total whitebaits catch, whereas *S. waltei* formed 1-16%. On the other hand, in shrimp trawl *E. devisi* formed 23-28% and *S. waltei* constituted 65-74% of the whitebait catch, except at Cochin where the former species dominated. But in boat seine which is operated nearer to the surface or in mid water, the relative percentage composition of *E. devisi* and *S. waltei* was 34:27. Hence deployment of small meshed mid water trawls may help to harvest both these species more effectively and in equal proportion.

Biology

The food and feeding, size range of fish and dominant size groups in the fishery, size at first maturity, spawning season and season of young fish abundance for *E. devisi* and *S. waltei* at the different centres have been studied.

Food and Feeding: Luther (1972) reported that the food of *E. devisi* and *S. waltei*, mainly comprised of copepods and other zooplankters. Generally larger food items were found in *S. waltei* than in *E. devisi*. Rao (1988 a and b) confirming the above observations stated that phytoplankton comprising *Coscinodiscus* was also found occasionally in the stomach contents.

The length range in fishery varied from 20 to 105 mm for *E. devisi*, the dominant size varying between 60-80 mm on the east coast and 65-90 mm in the west coast. The size range of *S. waltei* was between 35-133 mm, the

dominant size varying between 60-90 mm in the east coast and 65-95 mm in the west coast. Sexes are equally distributed. Size at maturity is 64.5 mm for *S. devisi* on both the coasts. The size at maturity varied and was 77.5 mm on the east coast and 74 to 74.5 mm in the west coast for *S. waitei*. The percentage of spawners among adult fish varied between localities. At Visakhapatnam for *E. devisi*, spawners formed 88%, at Madras 14%, Mangalore 66%, Cochin 17% and 81% at Vizhinjam. In respect of *S. waitei* spawning fish formed 72% at Visakhapatnam, 12% at Madras, 66% at Mangalore, 25% at Cochin and 14% at Vizhinjam. *E. devisi* at Visakhapatnam spawns almost throughout the year with a peak during February to March and July, and at Madras during April-September with intense periods during April to June. At Vizhinjam the spawning of *E. devisi* occurs almost throughout the year with peak periods during March to May and November to December, at Cochin during October to June with peaks in October, March and May and at Mangalore during September to May with intense periods during November-February and May. In respect of *S. waitei* at Visakhapatnam the spawning takes place almost throughout the year with peaks during February to March and June-July and at Madras during April to September with peaks in April and July. At Vizhinjam the spawning season is during March and May to September with peaks in March and August, at Cochin during November-May with peak in February and at Mangalore spawning is from October to May with peak periods during November to February and May.

Spawning frequency and fecundity: Luther (1990) states that an individual fish would shed three batches of eggs in quick succession at one multiple spawning and could effect the second set of multiple spawning after a period of about three and four months in the case of *E. devisi* and *S. waitei* respectively. Taking into consideration, the size at first maturity as 64.5 mm for *E. devisi* and 77.5 mm for *S. waitei* and the growth rates, the second set of multiple spawning would take place when the former is around 85 mm length along both the coasts and when the latter species is around 92 mm length in the east coast and around 95 mm length in the west coast. Regarding fecundity, Luther (1990) gives the range as 1698-6785 eggs for *E. devisi* of 60-95 mm length and 303-4812 eggs for *S. waitei* of 80-120 mm length at Vizhinjam during the course of one multiple spawning.

Whitebait larvae: Sreekumari (1977), George (1979) and Girijavallabhan and Gnanamuthu (1982) reviewed the work done on the whitebait larvae of Indian waters. According to UNDP/FAO Pelagic Fishery Project reports (Anon.

1974b, 1976a) mixed species of whitebait larvae are the most numerous of the clupeids along the south west coast of India and are met within almost all the months, with the dominant period of occurrence from March to July and a secondary dominance in November. Relatively dense concentrations of the larvae are seen in the area south of Kasargode to the Gulf of Mannar with maximum values over the outer shelf in the area from 7 30'N to 11 30'N. According to these reports *S. heterolobus* and *S. zollingeri* occur in large numbers. Larvae of whitebait formed 12-13% of the total fish larvae in the International Indian Ocean Expedition samples (Shomura, 1970).

Survival in captivity: Results of the holding experiments by Luther *et al* (1984) on the four species of whitebait indicate that *E. punctifer* is very hardy and can withstand captivity for about three months. *E. devisi* survived for about two months. *S. waitei* and *S. indicus* did not survive for more than a few hours in captivity. Initial mortality was low in the case of *E. punctifer* and *E. devisi* if the fish were transferred immediately after capture to low saline water (21-28%). Species of the genus *Encrasicholina* appears to be promising as effective live bait for tuna in the Indian seas.

Stock Assessment

Growth parameters: The growth parameters of von Bertalanffy equation estimated by ELEFAN I programme were as follows:

	$L\infty$ (mm)	K
E. devisi		
East coast	103.5	1.6
West coast	103.5	1.6
S. waitei		
East coast	134.5	1.2
West coast	130.0	1.4

t_0 was taken as - 0.01 per year

Length-weight relationships : The estimates of a and b, the parameters in the length-weight relationship $W=aL^b$ were

E. devisi		
East coast	W=	0.00001143L 3.4136
West coast	W=	0.000003483L 3.147341
S. waltei		
East coast	W=	0.00000455L 3.106561
West coast	W=	0.000007287L 2.978259

Recruitment pattern: Two pulses of recruitment were evident from the recruitment studies - the major one around March and the minor one around December in the case of both *E. devisi* and *S. waltei*. In the west coast in respect of *S. waltei*, the major recruitment takes place around February and the minor one around November. The interval between the major and minor pulses of recruitment appears to be three to four months for both the species.

Age at first maturity (T m) and longevity (T max) : The age at first maturity as derived from von Bertalanffy growth equation corresponding to the size at first maturity of *S. waltei* (77.5 mm) and *E. devisi* (64.5 mm) were 0.71 year for east coast and 0.64 year for west coast and 0.60 year for east and west coasts respectively. The longevity was estimated 2.49 years for east coast and 2.13 years for west coast for *S. waltei* and 1.9 years for *E. devisi* in the east and west coasts (Luther *et al* 1992).

Mortality: The natural mortality coefficient (M) as estimated by Pauly's method and corrected for the shoaling behaviour, as suggested by its author against an annual average temperature of 29° C for the east and 28° C for the west coast, as well as the size at first capture (Lc) and the corresponding mean fishing mortality (F), the total mortality (Z) and the exploitation rate (F/Z) were as follows (Luther *et al* 1992):

Species	L_c mm	M	F	Z	F/Z
E. devisi					
East coast	45	2.66	1.11	3.77	0.29
West coast	40	2.61	0.46	3.07	0.15
S. waitei					
East coast	55	2.04	1.91	3.95	0.48
West coast	45	2.25	1.35	3.60	0.38

The exploitation rate for *E. devisi* in the west coast (0.15) is the lowest indicating scope for further exploitation.

Maximum Sustainable Yield (MSY) : The results of Thompson and Bell analysis and Beverton and Holt yield per recruit analysis were as follows (Luther *et al*, 1992):

Species	F.max		Current F
	Beverton & Holt model	Thompson & Bell model	
E. devisi			
East coast	3.90	3.46	1.91
West coast	2.98	2.84	1.35
S. waitei			
East coast	8.32	4.91	1.11
West coast	2.76	3.95	0.46

The results indicate that there is scope for increasing the present ex-

ploitation rate especially in the case of *E. devisi* on the west coast.

Conservation and management options

The moderate fishing mortality of 0.46 in the west coast and 1.11 in the east coast for *E. devisi* and 1.35 for west coast and 1.91 for east coast for *S. waitei* indicate the possibility of increasing production since the exploitation rate obtained are only in the low to medium range. The results indicate that there is scope for increasing the exploitation rate. But, it could be observed that in respect of *S. waitei* in the west coast, an MSY of 14,091 t against an increase of 21% in effort would result in a gain of mere 30 t in the yield which is not appreciable. In the east coast, it is expected that the yield can be increased only by 5% by increasing the effort by 69% which runs the risk of decreasing considerably the catch per unit effort, for that MSY level it is expected that the CPUE will get reduced by 42%. However, for a healthy fishery it is advisable to maintain the statusquo.

When compared to *S. waitei*, *E. devisi* is poorly exploited as a three times increase in effort along the east coast and six times increase in the west coast is required to realize the corresponding MSYs, the consequent expected increase in the landings being 7.4% and 31.9% respectively. While the additional yield expected in the east coast is a meagre 7.4%, it is as high as 32% in the west coast. However, the increase of 32% in the yield would result in a reduction of 45% in the CPUE in the west coast, which evidently is not a tenable situation. As a compromise, if the effort is doubled, an increase of 21% is expected in the yield against a reduction of 19% in the catch per unit effort. In any case, there is scope for increasing the yield in the west coast.

Conclusion

Whitebaits are annually renewable resources and hence their periodic harvest during seasons of abundance is important to make full use of the fishery. Increasing the fishing pressure during the peak seasons of availability may be a practicable option to enhance the whitebait production in the country. However, since whitebait being the non-target species in most of the gears in which it is caught, the maximum sustainable yield and the effort required to obtain the MSY could be decided only in consideration with the stock position of other resources caught in the gears along with whitebaits. The utility of whitebaits as tuna live bait fish in pole and line fishing has gained importance

in recent years. Investigations on the effective methods of their capture holding in pens, transportation to tuna fishing areas of Lakshadweep may open up avenues for the large scale utilization of whitebaits as live bait in future years.

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