Seafood

export journal

Vol. VII No.1 1975

White Bait Resources of the SOUTH WEST COAST OF INDIA

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THE investigations of the Pelagic Fishery Project over the past three years have thrown up several extremely interesting findings on the pelagic fish resources of the S. W. coast of India. The most important finding is that there exists in the sea between Ratnagiri and Tuticorin a sufficiently large resource of *Anchoviella** spp. (Whitebait), which is at present exploited to a small extent only. The whitebait resources are also fairly close to the shore and can easily be exploited by developing suitable fishing methodologies and using to a great extent many of the mechanised boats of the existing fleet after small modifications. The seasonal whitebait resources have been estimated as ranging from 0.23 to 0.52 million tonnes depending on fluctuations and constitutes about 40 to 78% of the total biomass in this region.

Whitebait, as a significant fishery, in the commercial marine fish catches of India, occurs in the coastal waters, off the States of Kerala, Tamilnadu and Andhra. The fish forms only 3 to 4% in the total marine fish landing of India (vide table 1). The estimates of the Pelagic Fishery Project reveal that the total resource of whitebait at the time of its highest availability is about $\frac{1}{2}$ million tonnes (0.52 million) which is over 50% of the total annual marine fish landings in India. Yet, in

TABLE I.
*** Annual Landings of ANCHOVIELLA spp. in India (in tonnes)**

1950	24620
1951	59563
1952	41659
1953	29097
1954	31811
1955	25662
1956	26998
1957	12700
1958	29346
1959	24477
1960	35885
1961	22103
1962	19168
1963	28672
1964	25199
1965	24377

* The generic name *Anchoviella* created by Fowler (1941) is used here for denoting the fish complex popularly called whitebait.

1966	26679
1967	31590
1968	20254
1969	31436
1970	24400
1971	19516
1972	18699
1973	25394

* The figures for the period from 1950 to 1956 have been estimated on a proportionate basis from the combined figures for *Anchoviella* and *Thrissocles*. The figures given in Table I and II are from the records of the Central Marine Fisheries Research Institute.

The authors thank the Director, Central Marine Fisheries Research Institute for making available these figures.

the actual commercial catches it has contributed to only 3 to 4%. This paradoxical situation is the possible result of low exploitation of the resources, which could be because of various factors, the main ones of which are the following :

(a) The low price it fetches in fresh condition at the time when other fisheries of sardine, mackerel etc. take place.

(b) The inability to handle large catches during the period of highest availability as the time coincides with the S. W. monsoon when salting and sundrying are difficult propositions.

Anchoviella is a very much relished item as a dried product in the south Indian market. This commodity has also a fairly attractive market in south east Asia. In fact, of all the dried fish exported from India to Srilanka and other markets in S. W. Asia, *Anchoviella* fetches a good price which is second only to dried seer without head. For the past nearly four years, dried *Anchoviella* has fetched a steady price of Rs. 148.00 per cwt. while seer without head has fetched a price of Rs. 168.5 per cwt. From economic standards, the price of Rs. 148.00 per cwt. (ie. Rs. 2.96 per kgm) may not be an attractive price to create any boost in *Anchoviella* fishing with the existing mechanised fishing fleet, as this price will be equivalent to only Rs. 0.40 per kgm. of fresh fish. But it has to be remembered that the existing methodology of salting and drying or merely sundrying is a fairly crude one and the salted and dried or dried fish carries not too insignificant a proportion of sand with it. With improvements brought in the methodology of drying and packing, it must be possible to get a much better and more economical price for the dried product. Some virile market promotion work in the emerging nations of the world may also yield rich dividends.

It is also to be pointed out that in the dried form the fish can contribute to a great extent to help meet the malnutrition or protein requirement or to quote the latest fad, the calorie deficiency which is prevalent in a major part of the country.

Species of *Anchoviella* have a very wide range of distribution in the tropical waters of the world. They mostly prefer coastal waters, especially in regions where there is a high flow of fresh water. They form recognisable fisheries in Indonesia, Malayasia, Srilanka and India. To a small extent, they contribute to the fisheries in East African waters. In many parts in the tropical zone, within this region, they ascend the estuaries of rivers and contribute to a significant portion to the fisheries of the estuaries.

As may be seen from Table II, major landings of *Anchoviella* take place in India off the coasts of Kerala, Tamilnadu and Andhra

TABLE II.

Annual Landings of ANCHOVIELLA spp. in the various states from 1956—1973 (in tonnes)

	Gujarat	Maha-rashtra	Goa	Mysore	Kerala	Tamil-nadu	Pondi-cherry	Anda mans-	Andhra Pradesh	Orissa & West Bengal
1956	—	—	—	408	9611	8287	—	—	7441	242
1957	—	—	—	401	2867	4647	—	—	7757	723
1958	—	—	—	295	7309	19907	—	—	1755	616
1959	—	—	—	272	5276	12782	—	—	3900	212
1960	—	1	—	1408	14164	12507	—	—	7519	286
1961	8	223	—	94	6112	10831	—	—	4367	468
1962	8	336	—	86	5231	7861	—	—	5953	577
1963	1	145	—	256	12084	9998	—	—	5040	532
1964	—	77	—	23	10461	8046	—	—	5779	797
1965	—	—	—	103	2718	7970	—	—	11200	2011
1966	—	520	65	103	8816	11405	1370	32	3817	551
1967	—	170	62	336	11606	9308	703	41	8769	595
1968	—	165	100	137	5652	7858	142	36	5480	744
1969	—	68	35	236	10486	11990	2284	38	5399	900
1970	—	484	34	142	7948	7726	2480	41	5035	510
1971	—	990	44	97	10842	5162	697	36	1332	316
1972	9	209	123	124	10654	4378	439	67	2005	673
1973	—	573	123	235	8940	9105	695	67	4838	768

Pradesh, with Kerala accounting for 34%, Tamil Nadu for 38% and Andhra Pradesh for 22% of the annual catches.

The following species are mainly involved in the *Anchoviella* fishery in India (Fig. I)

A. bataviensis
A. heteroloba
A. baganensis
A. zollingeri
A. commersonii
A. indica

A. tri. reported by different authors from Indian coasts does not appear to be however, a major component in the whitebait catches. Two species of whitebaits *(Anchoviella)* described as *Stolephorus* sp. A Whitehead (1967, 1967 b) and *S. andhraensis* Baburao (1966) are also reported in the fisheries at Vizhinjam and central part of the east coast.

Stolephorus sp. A resemble *Anchoviella heteroloba* but possess a longer head and less number of lower gill rakers. *S. andhraensis* resemble *Anchoviella baganensis* but is slender and has no double pigment line on the back. The identities of the major species involved in the whitebait fishery of India are fairly clear, eventhough nomenclatural changes of the species have been frequently made.

The following summary on the systematics of the major species is based on George (1958).

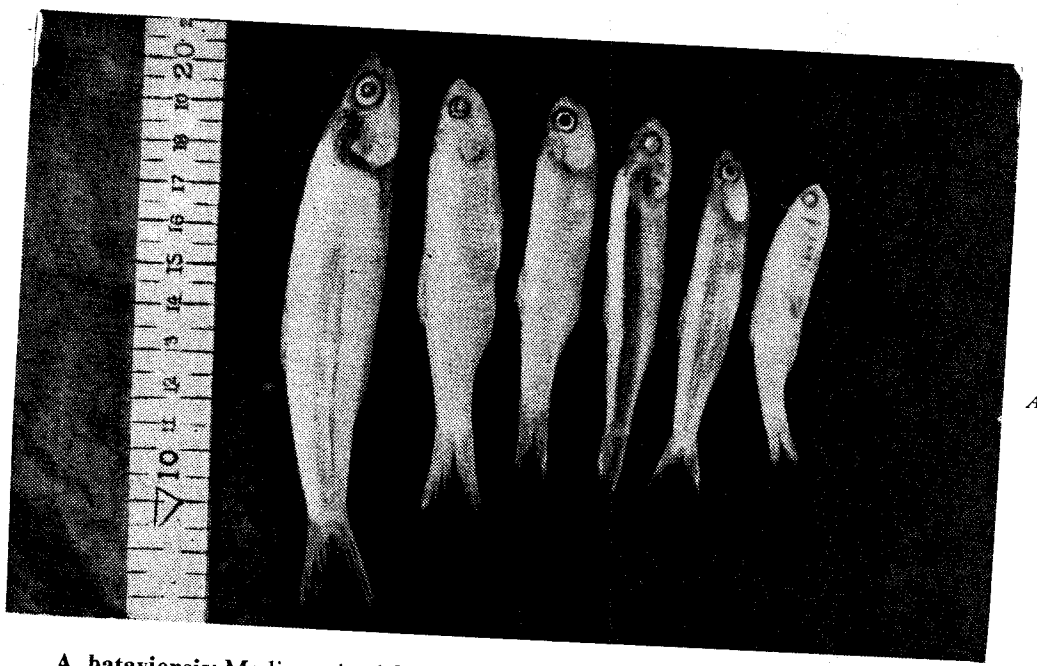

FIG. 1
The common whitebait species of the southwest coast— from left to right *Anchoviella indica*, *A. commersonii*, *A. bataviensis*, *A. zollingeri*, *A. heteroloba* and *A. baganensis*

A. bataviensis: Medium sized fish. Laterally compressed than rounded. Maxillaries reach gill openings. Origin of anal before end of dorsal. Abdominal scutes 4–7 usually 6, vertebrae 39–40. Ripe ovarian eggs bottle shaped.

A. heteroloba : Small sized and slender fishes with a prominent snout, not much compressed laterally. Maxillaries reach the preopercula. Origin of anal behind the end of dorsal. Abdominal spiny scutes generally 5—6. Gill rakers 23—25. Vertebrae 42—43; usually 42. Mature ovarian eggs oval-shaped without a knob.

A. baganensis : Small sized laterally compressed fish. Maxillaries reach gill opening. Origin of anal before end of dorsal. Abdominal scutes 6—7, vertebrae 39—41, usually 40. Mature ovarian eggs are oval shaped without knob.

A. zollingeri : Small sized slender fishes, not much compressed laterally. Maxillaries with rounded posterior, reaching mandibulary joints. Origin of anal behind end of dorsal. Abdominal spiny scutes 4—5. Gill rakers 25—28. Vertebrae 41—43, usually 42. Mature ovarian eggs oval shaped and without knob.

A. commersonii : One of the big-sized fish of the genus. More or less compressed laterally. Maxillaries reach gill openings. Origin of anal before end of dorsal. Abdominal spiny scutes usually 4. Gill rakers 22-25. Vertebrae 39.40. Mature ovarian eggs oval shaped and with knob. A characteristic broad paired pigment line on back from head to dorsal. Pigments greenish black in very fresh specimens otherwise black.

A. indica: Another big-sized whitebait. Elongated and rounded than laterally compressed. Maxillaries reach preopercula. Origin of anal before end of dorsal. 3—4 abdominal spiny scutes, usually 4. Gill rakers 21—25. Vertebrae 41—42, usually 41. Mature ovarian eggs oval shaped, with a knob.

A. tri : Medium sized laterally compressed fish resembling *A. baganensis.* Origin of anal before end of dorsal. 4—7 abdominal spiny scutes. Paired pigment lines from head to dorsal and also from dorsal to caudal.

George (1958) has given the following field key for identifying the species commonly met with in the whitebait fishery of S. W. coast of India.

Field Key to common species of Anchoviella

1. Maxillary reaches gill opening

A. A small spine in front of dorsal. Paired, thin, pigment line from end of dorsal fin to caudal.

(a) Paired, pigment lines on dorsal profile from head to dorsal also ... *A. tri.*

(b) No paired pigment lines on the dorsal profile between head and dorsal. ... *A. baganensis*

B. No spine in front of dorsal. No pigment line from dorsal to caudal.

(a) Paired pigment lines from head to dorsal ... *A. commersonii*

(b) No regular pigment lines on the back. ... *A. bataviensis*

Maxillary does not reach gill opening

A. Origin of anal below dorsal ... *A. indica*

B. Origin of anal behind dorsal

(a) Maxillary tapering behind, reaching preoperculam. ... *A. heteroloba*

(b) Maxillary rounded behind, reaching mandibular joint. ... *A. zollingeri*

The whitebait fishery in the S. W. and S. E. Coasts consists mostly of *A. bataviensis, A. heteroloba* and *A. baganensis. A. zollingeri* is more common in the northern Karnataka and Maharashtra regions and to a less extent off the Trivandrum coast. *A. commersonii* and *A. indica* are more important in the catches north of Mandapam along the east coast, and these species are not found in large shoals as the others.

Diurnal and seasonal movements of *Anchoviella* are quite significant. During the day time, the fish forms distinct schools, extending from bottom up to about 15 metres above. With dusk they begin to ascend into the mid-water and at night form a diffuse layer in the water column. But during the breeding period they remain as distinct schools even at night (Fig. 2).

The Pelagic Fishery Project findings show that the seasonal movement of *Anchoviella* is directly related to the transport of water masses along the coast. (Progress Report No. 6). Starting with October, it is seen that the *Anchoviella* stocks remain distributed discontinuously in a narrow but elongated band south of Mangalore. The higher concentrations of the stocks during this period occur at the inner border of distribution. In the subsequent months they start spreading up north along the coast in a continuous wide belt.

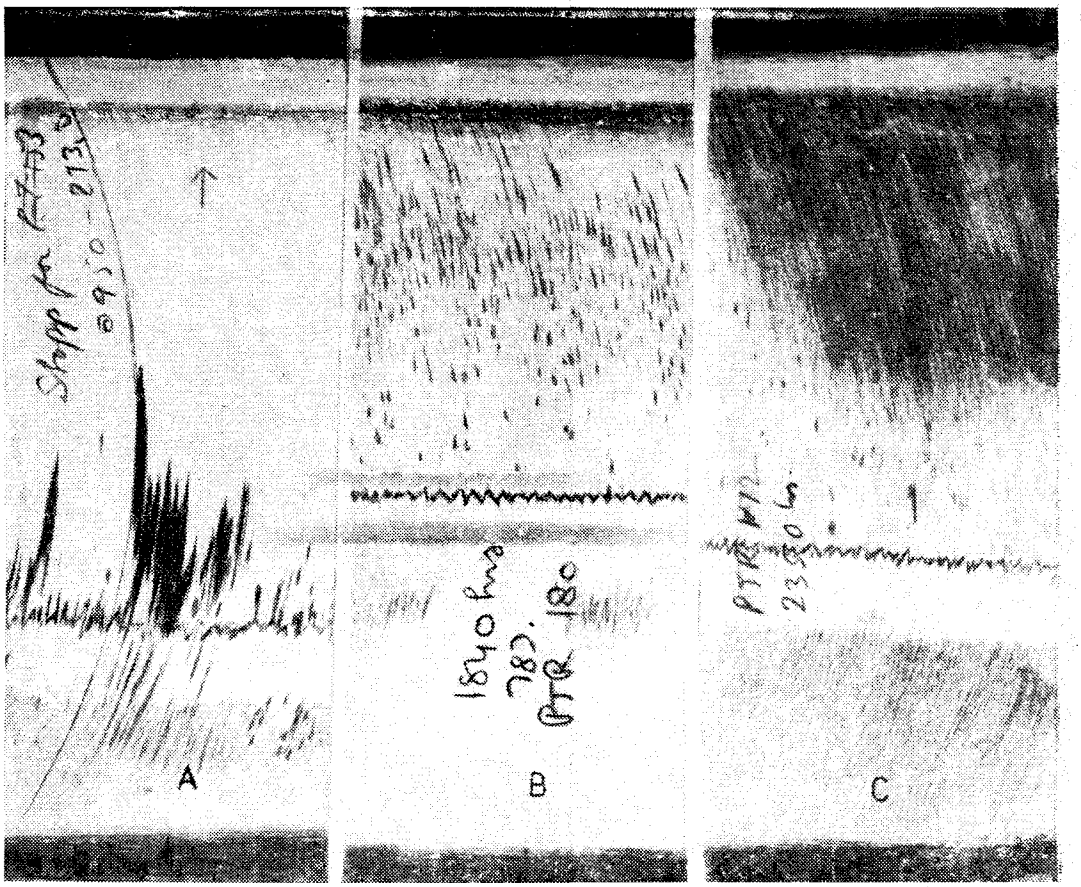

FIG. 2 — Echograms of whitebait shoals recorded by R. V. *Sardinella* at day time (A), dusk (B), and night (C).

During this period, high concentrations have been found generally in two areas, 9° to 11°N and 13° to 14°N, though in detail they vary from month to month. After May, the continuous distribution breaks up and a marked southward displacement of the major concentrations begins to take place. These processes start first in the north and later extend to the southern regions, beginning in March/April and culminating by August when the bulk of the whitebait stock is found to concentrate in the regions south and south-east of Cape Comorin (7°–8°N).

During the south-west monsoon period there is a strong southerly transport of the coastal water masses along the south west coast, coinciding with the upwelling of nutrient laden waters on to the shelf. From October onwards there is similarly a strong northerly current on the shelf. The northward transport and distribution of the whitebait stocks in the shallow shelf waters from October onwards and the southward displacement and distribution from March/April onwards are evidently governed by these two current systems, the dynamics of which are as yet insufficiently

understood. It is clearly conceivable that variations in the time, direction, strength and location of these two current systems both within and between years, greatly influence not only the distribution and abundance of the whitebait stocks, but also those of other pelagic fish living in the area, especially the young fish.

Information on the food of different species of whitebaits indicate that they are predominantly zooplankton feeders. Venkataraman (1960) observed that *Anchoviella tri* and *A. heteroloba* fed mostly on copepods, cladocerans, *Lucifer*, fish post larvae, larval crustaceans and bivalves and some phytoplankton like *Coscinodiscus*. Rabindra Nath (1966) noticed that over 60% of the food of *A. commersonii* consisted of common zooplanktonic organisms such as copepods, ostracods, amphipods, cladocerans, mysids etc. including occasionally fish eggs and larvae. The observations made at the Pelagic Fishery Project corroborate the above findings. Photograph (Fig. 3) of the stomach contents of *Anchoviella* spp. shows remains of copepods, shrimps and fish post larvae. Direct relation between zooplankton densities and *Anchoviella* distribution has also been noticed by the Project (Progress Report No. 7).

Table III gives the estimates of the Pelagic Fishery Project of whitebait biomass during the period 1972 October to August 1973 distributed in one degree latitudes.

The investigations also revealed that the various whitebait species show distinct differences in their depthwise distribution. It is seen that *A. bataviensis* is the most shoreward species and *A. zollingeri* the most seaward one.

FIG. 3
Some food items of the white-bait.

Concentrations of *A. bataviensis* are found mainly in waters of less than 20 metres depth. *A. heteroloba* is most abundant in waters of 15

TABLE III.

Distribution of *Anchoviella* biomass (in thousand tonnes) by coverage and one degree latitude

Coverage Latitude N	Oct. 1972	Nov.	Jan./Feb. 1973	Mar./Apr.	April	May./June	June/July	July/Aug. 1973
16°–17°	N.A.	N.A.	15	N.A.	N.A.		11	4
15°–16°	0	8	44	N.A.	N.A.	5	2	38
14°–15°	29	52	86	21	N.A.	25	4	18
13°–14°	8	19	78	52	N.A.	45	5	0
12°–13°	24	0	49	29	N.A.	12	21	32
11°–12°	17	98	35	107	14	29	47	32
10°–11°	54	77	37	24	58	205	39	47
9°–10°	100	37	11	11	84	69	23	10
8°– 9°		0		7	52	18	65 161x	33 181x
7°– 8°							28 114	2 43
Total	232	291	355	251	208	408	245 275	216 224

x East of 77° 30' E longitude
N.A. Data not available

metres to 45 metres while *A. zollingeri* dominates in waters beyond 45 metres depth.

In general *Anchoviella* seem to have a life span of about 2 years only.

The sizes to which the major species of whitebait of the S. W. coast grow and their respective sizes at maturity are furnished in the following table (Hardenberg, 1934)

Species	Maximum size to which they grow. cms.	Size at maturity cms.
A. tri	12	9
A. baganensis	10–11	7
A. indica	17.5	14
A. commersonii	12.5	10
A. heteroloba	9	6.5
A. zollingeri	10	7
A. bataviensis	11	7

Anchoviella species breed intermittently throughout the year (Prabhu, 1956 - *A. indica;* Dharmamba, 1960 – *A. commersonii* and *A. heteroloba).* The regular spawning surveys conducted by the Pelagic Fishery Project show the presence of larval whitebaits almost throughout the year; in larger numbers especially from March to August and November – December period. Post larval and early juveniles of whitebaits (Fig. 4) are abundantly caught in pelagic trawl during January to May and October-December period (Progress Report No. 7). Post larval whitebait *(A. commersonii)* constitutes a sizable component of the traditional 'NONNAVU' fishery along the Trivandrum coast in the winter months (Gopinath 1946). This prolific breeding of several species which together constitute the whitebait fishery help to stabilise the stock position of this resource at high levels, without steep fluctuations.

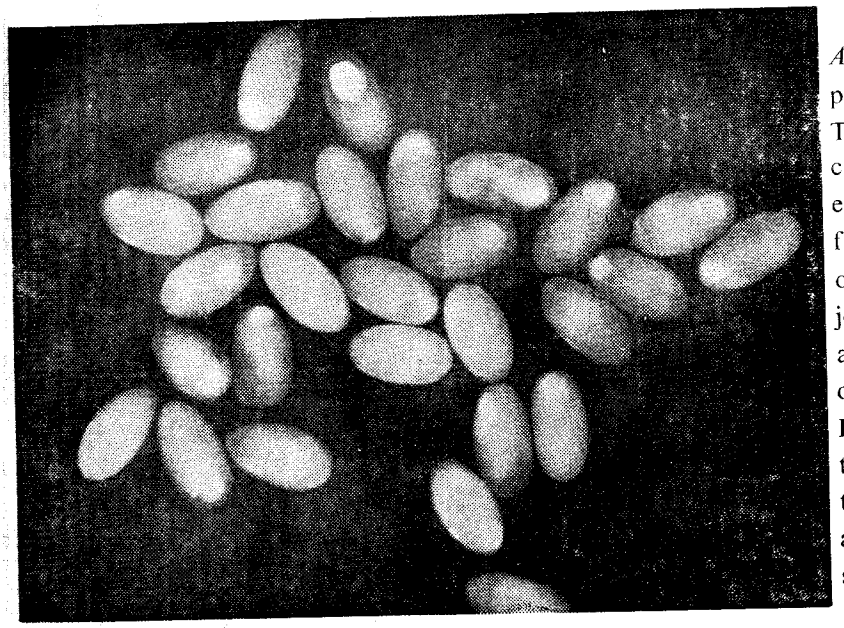

Fig 4 (A)

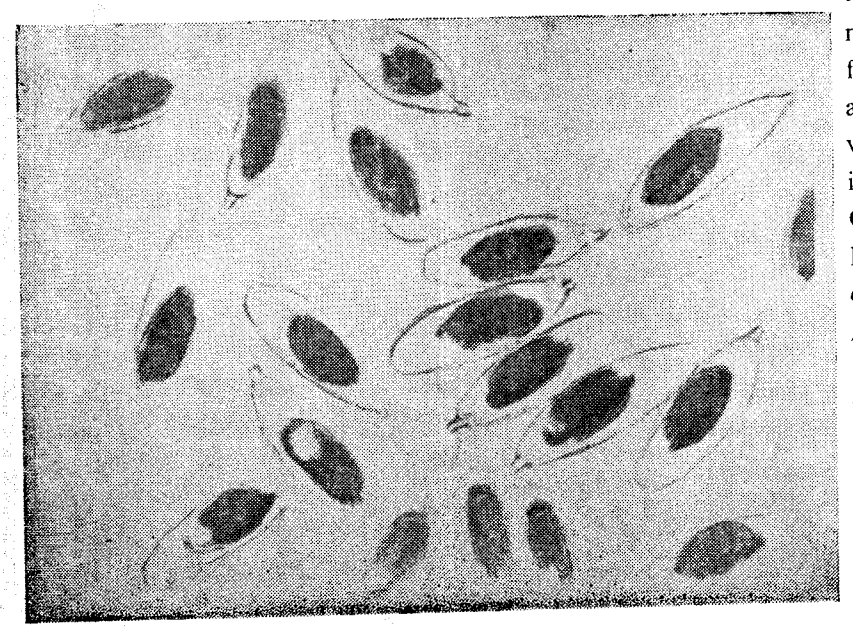

Fig. 4 (B)

Figures 4 (A & B) Two types of Eggs

The exploitation of the *Anchoviella* stocks does not pose much of a problem. The fishing experiments conducted by the Integrated Fisheries Project as a follow-up of the findings of the Pelagic Fishery Project have shown that they are easily amenable to different kinds of fishing. During the period October to February – March when the shoals are distributed all along the coast in shallow coastal waters of depth of 15 to 30 metres, they can be effectively fished with a high opening bottom trawl or high opening mid-water trawl operated from a pair of 32' mechanised boats of the conventional type now in use in the shrimp fleet. Catches as high as 800 kgms. per hour have been obtained in such fishing. A 54' boat operating a 6 fathom x 6 fathom mid-water trawl has systematically caught whitebait during this period yielding catches as high as 2½ tonnes per hour. Dispersed whitebait shoals can easily be aggregated or chummed by light attraction at night when they can be caught by small purse-

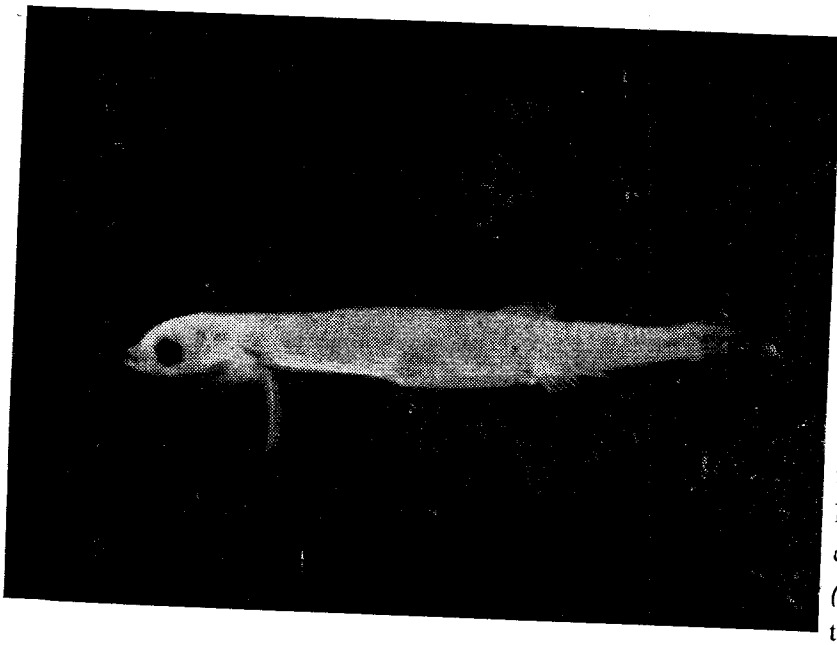

Fig. 4 (C) Larva

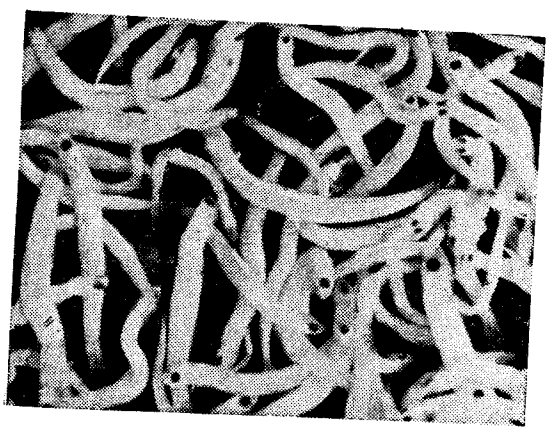

Fig. 4 (D) Post larvae

seines operated from boats of 36′, 43½′ etc. Though the mesh size of such nets have necessarily to be small, it is enough that smaller purse-seines are used, due to the close aggregation of the fish shoal as a result of light attraction. In the months of July to September when the major part of the whitebait stock migrates to the Gulf of Manaar and pile up there, they can be easily exploited with mid-water trawls. But during this period, due to the monsoon weather conditions, large vessels are required to exploit this fish in the Gulf of Manaar. Experimental fishing conducted by a 90′ vessel *(Blue fin)* with midwater trawl in September 1974 yielded 9.7 tonnes of white bait per hour in one operation. *R. V. Rastrelliger* (152′) in October 1974 caught from Gulf of Manaar as much as 40 tonnes per hour with a mid-water trawl. As such, the exploitation of *Anchovielle* does not pose much of a technological problem. The problem which at the moment appears to be of a great magnitude is that of handling, processing and distribution of the catches.

The conventional utilisation of whitebait in India has been as either fresh or as sun dried. If a pair of 32′ vessels operating a high opening mid-water trawl for 6 hours a day can fetch a catch of 4.8 to 5 tonnes of fish and if 20 such units operate from a centre, the problem will be one of handling approximately 100 tonnes per day. If a vessel of the type of *R. V. Sardinella* (54′) operating a mid-water trawl lands a catch of 15 tonnes per day, it could easily become a serious problem in handling by a single entrepreneur owning 3 or 4 such boats. The

any rate before the Integrated Fisheries Project could expand its work in the production of fish powder, certain detailed investigations were necessary on customer acceptance and nutritional effects. So a combined work was undertaken with the Medical College, Trivandrum on a large scale feeding programme with fish powder in order to find out the acceptability of the product and its nutritional effects on the consumers. The work has been carried out over the past one year. The product used was conventional fish meal prepared under hygenic conditions and imported from Norway. It was neither deodourised nor completely defatted. The results of the work are summarised as follows (Soman *et al* 1974 MSS.)

"The studies revealed excellent acceptability of the product, by healthy people belonging to different social strata and also by malnourished persons. The product was found to retain its qualities for more than 15 months.

Nutritional studies were carried out on children suffering from various grades of malnutrition. The fish meal was administered along with cooked cassava, as a lunch to the children at selected Balwadis. The meal provided 400 calories and 11 gm. protein (coming chiefly from 15 gm. fish powder) and was given 5 days a week. The condition of the children were monitored continuously and an evaluation conducted at the end of 6 months. Significant weight gains were observed in the children given the supplement when compared with matched control children. Other anthropometric indices like height, mid-arm circumference and skin fold thickness, also showed marked improvement in the test group over the control. Studies carried out in hospitalised children recovering from Kwashiorkor revealed that the regeneration of albumin obtained with the fish meal was as good as that with vegetable mixes ".

Simultaneous with these experiments, the project started packing 150 gms. of *Anchoviella* powder (sufficient for 10 feeds) in polythene packing and distributing them to a panel of 50 persons. They were requested to use the powder in different forms as given below .

a) Mixing in vegetable curry especially using potatoes or tapioca as the main vegetable component.
b) In fish soup
c) In fish cutlets
d) Fried with a mixture of onion and ginger
e) As fish kheema.

It was unanimously reported that the product was excellent for use as (a) (d) & (e). 66% of the members reported that in the fish soup, the powder gave a strong flavour of dried fish. 72% reported that though the fish powder formed a desirable base for the cutlet, it was a bit costly. Some work on the price resistance was also done. Though this aspect has not been intensively done, preliminary indications are that a price of Re. 1/- per 150 gms. was acceptable to about 90% of the members, since at this price the fish protein requirements for 10 persons per day, could be provided with Re. 1/-. In terms of price per kgm. it would come to Rs. 6.70. At this price if the industry was to go into large scale handling, processing and packing of *Anchoviella* as fish powder, the producer (fishing vessel) can be given a price of 75 paise per kgm. of fresh fish. Two 32′ boats fishing for

ancillary establishments required to handle such large quantities of fresh fish or iced fish assume huge proportions when several units of boats enter the field for fuller exploitation. Without sufficient stabilisation of our fish handling sector, such heavy landings will necessarily lower the price of fish in the market to an extent which will make it uneconomic for the fishing vessels to exploit them. It will also lead to conversion of a very large quantity of much needed protein food into fish manure due to inadequacies in handiing the fish as fresh or iced. If a major quantity of the fish was to be processed as frozen fish, the distribution mechanism of frozen fish in our country has to be enlarged and strengthened very much necessitiating large investments. As stated earlier the highest availability of *Anchoviella* (0.6 million tonnes in October '74 in Gulf of Manaar) occurs during the monsoon months when sun drying is a difficult proposition. It will call for the establishment of very large artificial driers or a large number of small artificial driers of the type developed by the Central Institute of Fisheries Technology, if a major portion of the landings at this time was to be processed as dried fish. The experimental canning of *Anchoviella* in tomato sauce carried out by the Central Institute of Fisheries Technology under the auspices of the Marine Products Exports Development Authority in 1972 had shown good promise. But if the fish canned in tomato sauce is to make any recognisable inroads in the internal and external markets, there is an urgent necessity to improve the quality of Indian tomato sauce (or Indian tomatoes), reduce the cost of cans and introduce aiuminium quarter dinghy cans besides undertading a large scale national and international market promotion campaign.

The handling of the fish on board fishing vessels also pose several problems. It has been found that ice used in preserving the *Anchoviella* on board the vessels usually crushes the fish to bits and pieces. Dumping large quantities of *Anchoviella* mixed with ice into the fish hold also reduces the fish to a fairly pulpy condition. For using the fish as fresh or frozen, they have to be stored in fish boxes of convenient sizes (20 or 30 kgm. capacity) and mixed with salt and finely powdered ice. Boxing limits the quantity of fish that can be taken on board the vessel because of the limiations of the fish hold size. In Malayasia, a traditional method has been prevalent to meet this problem with regard to whitebaits. The method used is to boil the fish in 10% brine for 3–5 minutes on board the vessel and then box them with powdered ice. Fairly large quantities can be stocked in the fish hold in good condition. This process has still not been tried by us. On landing, the boiled fish can be dried either in the sun or in artificial driers. The product is reported to have a high quality and longer shelf life.

The various problems in the handling and processing detailed above point out that if a good portion of the available stock of *Anchoviella* is to be exploited and utilised economically the most suitable processing procedure will probably be one of reduction into fish meal or fish powder. The Integrated Fishery Project has been carrying out a series of experimental work in the reduction of *Anchoviella* into fish powder for human consumption. In a country like ours with so much of calorie hunger and demand for fish for human consumption, the question of utilising fish as fish meal for animal feed should normally receive only the last attention. At

Anchoviella can at this rate fetch an income of Rs. 3750/- per day which will make it very economic and give the requisite incentive for fuller exploitation of the available stock.

Above all, the utilisation of the fish as fish powder will eliminate all problems in transport and storage at end markets, as no ancillary facilities other than what is available at present are required. This form of utilisation will also enable us to take highly essential fish protein for human consumption to every nook and corner of this large country. It is also possible to develop a very large export market in South East Asia and African countries for this product.

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