ANCHOVY FISHERY OF SOUTHWEST COAST OF INDIA WITH NOTES ON CHARACTERISTICS OF THE RESOURCES

G. LUTHER

Vizhinjam Research Centre of Central Marine Fisheries Research Institute, Vizhinjam

ABSTRACT

A study of the monthly anchovy fishery data from the eleven fishery survey zones along the southwest coast of India lying between Cape Comorin and the northern border of Kerala coast has revealed that the southern region lying between Cape Comorin and Quilon is most productive for the anchovies, landing annually a little over 10,000 tonnes. This forms about 70% of the anchovy catch landed along the southwest coast. *Stolephorus devisi* and *S. bataviensis* are the commercially important anchovies along the southern region. There are two fishery seasons in the southern region, one during January-May and other during September-November; but only a single season extending from july to November is present in the northern region. The main fishery season throughout the southwest coast, however, is during September-November. The possibility of increasing the anchovy catch between Quilon and Ratnagiri has been pointed out. The present state of utilization of the catch and marketing are outlined, together with some suggestions for their improvement. Some details of the fisheries and biological characteristics of the anchovies of the Vizhinjam area are given. As the anchovy fishery is mainly supported by fishes of the '0' year class, anchovies are to be regarded as an annually renewable fishery resource. There is multiple spawning of individual fish and the spawning season of each species is also prolonged. The 'Nonnavu' fishery which takes a great toll of the young juvenile of *Stolephorus* spp., and its impact on the larger-sized anchovy fishery resources deserve detailed investigation.

INTRODUCTION

Anchovies of the genus *Stolephorus* support a lucrative fishery along three southern maritime states of India, namely, Andhra Pradesh, Tamil Nadu and Kerala, where nearly 95% of the average annual catch of about 27,000 tonnes of the country has been landed during the past decade. About 14500 tonnes of these fish are caught annually along the west coast of which a little over 70% is landed along the portion of the southwest coast extending from Cape Comorin to Chillekal (Quilon). The importance of the anchovies in the fisheries along southwest coast of India and the biology and fishery of the two commercially important species of *Stolephorus* were briefly reported by Luther (1972). The investigations by the Pelagic Fishery Project (UNDP), Cochin, as reported by

Menon and George (1975), have pointed out the existence of a large resource of *Stolephorus* in the sea not far from the shore, between Ratnagiri and Tuticorin. This paper presents an account of the status of the anchovy fishery along the southwest coast from Cape Comorin to Kunzathur (near the northern border of Kerala) with special reference to Vizhinjam area together with notes on the characteristics of the resources.

Material and methods

Catch statistics for the different survey zones along the southwest coast for three years (1969-71) presented in this paper were obtained from the Fishery Survey & Statistics Division of the Central Marine Fisheries Research Institute (CMFRI), and those for Vizhinjam area for 12 years (1965-76) were obtained from the fishery survey records at the Research Centre of the CMFRI, Vizhinjam, and from the author's observations. Information presented under the section, utilization of catch and marketing, was obtained from leading fish merchants of the area. Species composition are determined from samples obtained from different fishing centres.

For detailed studies on the anchovy resources of the Vizhinjam area the landing centres in the area were visited twice a week for collection of data on catch and effort, and of random samples of anchovies for estimation of species composition and for biological studies, Catch per unit of effort (cpue) in this account denotes the catch per unit of gear per fishing trip which is generally one per day. Usually 50-200 fish were measured in fresh condition for total length from each gear on each sampling day, for the two commercially important species, and the available number in the sample for the other species. The method of raising the sample values to the catch, as described by Sekharan (1962)has been followed for obtaining the monthly estimates of total catch of each species and for the numbers of fish in each length group for the commercially important species of anchovies. Examination of maturity stage of fish and analysis of stomach contents were made, however, on fish preserved in 2% formalin. Ova diameter along the long axis was measured at a magnification of 14.29 μ for each micrometer division. The fish were grouped into 5mm class intervals, as 40-44mm, 45-49mm, etc. and are referred to by their midvalue as 42mm and 47mm length group.

Exploitation of the anchovies along the southwest coast

The southwest coast extending from Cape Comorin to Kunzathur (near the northern border of Kerala) has been divided into eleven zones (Fig. 1) for the purpose of the estimation of the fish landings by sampling by the Fishery Survey & Statistics Division of the CMFRI. Two of the zones (TN-16 and TN-17) lie in the Tamil Nadu and the rest comprising zones K-1 to K9 cover the Kerala coast. The limits of these zones are as follows: TN-16: Cape Comorin

to Kottilpadi; TN-17: Kodimunai to Neerodi; K-1: Kollangode to Valia Veli; K-2: Kochuthura to Chillekal (Quilon); K-3: Pozhikara (Pozhimukkam) to Valiazhikal; K-4: Tharayilkadavu to Ottamassery; K-5: Vettakkal to Kathialam; K-6: Attupuram (Vekkodu) to Ponnanni; K-7: Koottayi to Idakkadavu; K-8: Quilandy to Kadengod; and K-9: Cheravattoor (Kanhimoola) to Kunzathur.

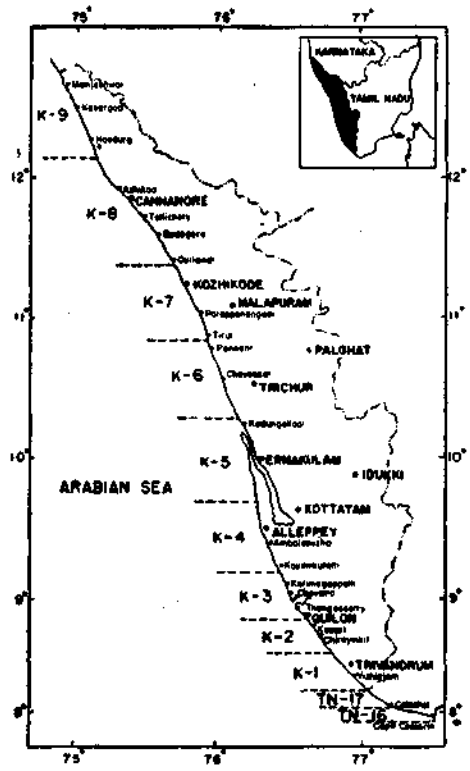

FIG. 1. Map showing the coast line of southwest coast of India divided into 11 zones. Zones TN-16 and TN-17 lie in Tamil Nadu and K-1 to K-9 cover the Kerala coast. The inset shows the Kerala state (shaded) in relation to the two neighbouring states.

Shore seine is the main gear operated along the coast and it lands the bulk of the anchovy catches. Boat seine is the next important gear. It is in fact the main gear for this fishery at places where the shore is rocky as at Cape Comorin, Muttom, Vizhinjam, Poonthura, Anjanko, etc., in the southern region. In the peak fishery season, however, gill net locally known as 'Netholi vala' is operated at many fishing centres. The shore seine covers a maximum distance of about 1 km from the shore during its operation. The boat seine is operated between 1 km and 6 km distance from the shore, at depths of 14-40m depending on the availability of fish. The gill net (Netholi vala), 1000m x 7m in size, with 15mm long mesh, is operated up to a distance of 5 km from the shore

and to a maximum depth of 30 metres depending upon the availability of fish, the foot rope of the net sometimes touching the bottom of the fishing ground.

Regional variation in the anchovy catch (Fig. 2)

Anchovy catch along the eleven survey zones (TN-16 to K-9) of the southwest coast during 1969-71 varied between 12,000 tonnes and 18,000 tonnes with the average at 14,500 tonnes (Table 1). Of this, the four southern zones (TN-16, TN-17, K-1 and K-2) together accounted for 71.59%, the next three zones (K-3 to K-5) for 23.06% and the remaining four zones (K-6 to K-9) for 5.35%. Thus the region between Cape Comorin and Quilon (zones TN-16 to K-2) is most productive for anchovies and the region between Attupuram (Vekkodu) and Kunzathur comprising the northern most four zones (K-6 to K-9) is the least productive from the capture point of view at present.

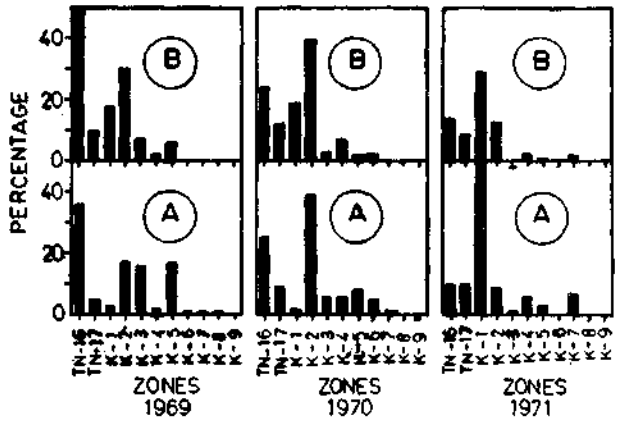

FIG. 2. Variations in anchovy catch among the eleven zones (TN-16 to K-9) in three years (1969-71): (A) Variations in anchovy catch in different zones. (B) Percentage composition of anchovy in the total fish catch in different zones.

Anchovies also make a very significant contribution to the fisheries of the four southern zones compared with the middle three zones (K-3 to K-5) and the northern four zones. In these three regions anchovies accounted for 24.19%, 2.83% and 0.33% of the respective annual total fish catch.

Fishery season of the anchovies

Fig. 3 presents the monthly variations in the anchovy catch in each of the eleven zones in the three years. In the southern region comprising the zones from TN-16 to K-2, two peak seasons are seen for the fishery. The major peak in the four southern zones occurs generally during September-November period whereas the period of the minor peak seems to occur first in the southern most zone (TN-16) and then shift to the northern zones in the later months. Yet, the period of the minor peak may be considered to occur during January-April/ May in the southern region.

TABLE 1. *Anchovy* (Stolephorus) *landings (in tonnes) in the eleven zone* (TN-16 *to* K-9) *along the southwest coast of India during the three years* 1969-1971.

Zone	1969	1970	1971	*Average*
TN-16	6430.05	2982.34	1389.14	3600.51
TN-17	901.34	1019.02	1363.61	1094.66
K-1	619.96	193.15	7114.53	2642.55
K-2	3098.04	4645.14	1274.46	3005.88
K-3	2812.68	674.75	195.81	1227.75
K-4	356.76	751.36	831.51	646.54
K-5	3099.61	917.28	354.06	1456.98
K-6	145.53	620.33	——	255.29
K-7	137.82	135.42	999.28	424.17
K-8	214.33	3.72	2.46	73.50
K-9	0.85	6.60	54.15	20.53
	17,816.97	11,949.11	13,579.01	14,448.36

In the two northern regions (zones K-3 to K-5 and K-6 to K-9) only one main season, during the course of July to November is present although the January-April season occurs in its place in some zones and in some years. Thus September-November season yielding about 60-70% of the annual catch is the main fishery season for the anchovy along the southwest coast of India.

Examination of the season of abundance in the different zones and years, however, suggests that the anchovy fishery shifts from south to north with progress in time. This aspect, however, requires detailed investigation.

Species composition

Only two species, namely, *Stolephorus devisi* (Whitely)* and *S. bataviensis* Hardenberg contribute to the main bulk of the anchovy catch in the southern zones with *S. buccaneeri* Strasburg occasionally a considerable contribution to this fishery. A similar situation seems to prevail in the northern zones according to Menon and George (1975) excepting that *S. heterolobus* (Ruppell) takes the place of *S. devisi***

* *Stolephorus devisi* (Whitley) is same as *Stolephorus* sp. A. of Ronquillo (1967) and Whitehead (1968) as also pointed out by Whitehead (1973). This has been confirmed in the FAO Species Indentification Sheets for Fishery Purposes: Eastern Indian Ocean (Fishery Area 57) and Western Central Pacific (Fishery Area 71), Vol. 2, ENGR. Stol. 1.

** *Stolephorus heterolobus* (Ruppell) and *Stolephorus devisi* (Whitley) resemble each other very closely. The latter can be distinguished from the former by the large sized teeth that occur at regular intervals intesperced with small ones on the maxillaries. In *S. heterolobus* (Ruppell) the teeth on the maxillaries are of uniform size, except for the extreme distal portion.

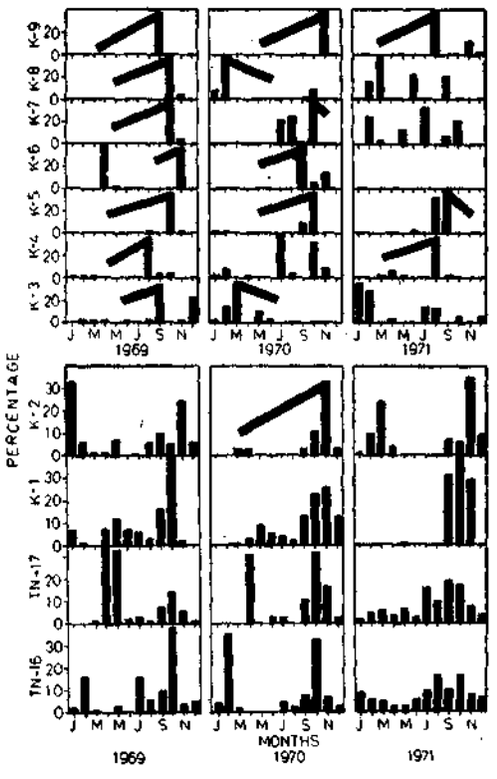

FIG. 3. Monthly variations in the anchovy catch in the different zones along the southwest coast for three years (1969-71)

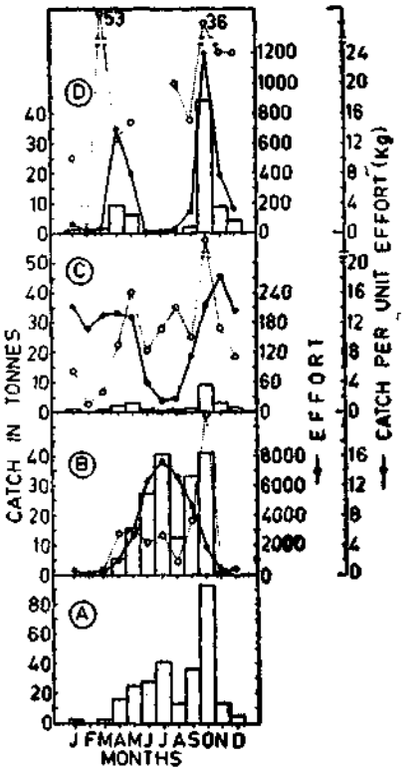

FIG. 4. Monthly trend of the anchovy fishery at Vizhinjam (A) Trend of the total anchvy catch. (B) Trend of the catch, catch rate and number of units operated in respect of boat seine; (C) and (D) same as in B for shore seine and gill net (*Netholi vala*) respectively.

ANCHOVY FISHERY OF THE VIZHINJAM AREA WITH NOTES ON THE CHARACTERSTICS OF THE RESOURCES

The fishery

The general account on the fishery is based on data for the period 1965-1976. The species composition and biological observations are from the data collected during 1970-76. As the Vizhinjam bay, unlike the neighbouring fishing centres, affords facilities for landing fishing craft during all months of the year, fishing is done around Vizhinjam almost throughout the year. On account of this the seasonal trend of the fishery of the Vizhinjam area is somewhat different from that of other centres in Zone K-1, which includes Vizhinjam also.

The annual anchovy landings in the Vizhinjam area during 1965-1976 varied between 84.2 tonnes and 632.6 tonnes with the average at 275.6 tonnes, and formed 3.5-12.6% of the total fish catch with the average at 7.3%. Anchovies occur in the catches at Vizhinjam almost throughout the year, although in very small quantities during December-March. There are two prominent seasons for the fishery: a long one extending from April to July and a short one during September-October accounting for 40% and 47% respectively of the annual catch (Fig. 4 A). Boat seines land the bulk (64%) of the annual catch, followed by gillnet (28%) and shore seine (8%), at an average catch rate (cupe) of 5.53 kg, 24.36 kg and 11.86 kg respectively. The seasonal trends in the catch, effort and catch rate for the above three gears over the 12 years period are presented in Fig. 4 B-D.

Boat seines land good catches during May-July and September-October. The catch rates vary betwen 4.4 kg and 6.0 kg during the former season and between 7.3 kg and 21.7 kg during the latter season with their average at 5.1 kg and 11.5 kg respectively. Despite high effort by the boat seine, anchovy catch is generally low during August indicating seasonal movement of this fish away from the inshore waters of the Vizhinjam area. The shore seine land good catches during April-May, and during October-November at a catch rate ranging between 9.0 kg and 16.3 kg, during the former and between 9.8 kg and 40.3 kg during the latter season, with the average at 12.6 kg and 24.1 kg respectively. Both the total anchovy catch and the cach rate are generally low during December-March period in shore seine, despite higher effort, indicating that the fish moves away from the inshore waters seasonally. Gill net landings also show two seasons for the fishery; a major one during October-November, the range in the catch rate and the average being 23.6 kg-36.0 kg and 33.0 kg respectively, and a minor season during April-May, with the catch rate varying between 12.6 kg and 14.8 kg, and the average at 13.5 kg.

Thus, April-July and September-October periods emerge as the two important seasons, the latter being the main season, for the anchovy fishery in the Vizhinjam area.

Species composition

Seven species of anchovies of the genus *Stolephorus* Lacepede occur in the fishery. The overall relative composition by weight of the different species in the non-selective gear is as follows: *S. devisi* (Whitley) 40.7%, *S. bataviensis* Hardenberg 42.4%, *S. indicus* (van Hasselt) 8.2%, *S. buccaneeri* Strasburg 5.2%, *S. andhraensis* Babu Rao 2.6%, *S. commersonii* Lacepede 0.7% and *S. macrops* Hardenberg 0.1%. Thus *S. devisi* and *S. bataviensis* are the two commercially important anchovies in the area. The relative composition of the different species of anchovies in the three common gears is given in Table 2.

TABLE 2. *Perecntage composition of the different species of* Stolephorus *in the different gear.*

	Boat seine	*Shore seine*	*Gill net (Netholivala)*	*Non-selective (Boat and Shore seine*	*All gear combined*
S. devisi	41.0	36.0	85.2	40.7	53.4
S. bataviensis	43.7	23.5	13.9	42.4	34.3
S. indicus	6.6	32.5	0.3	8.2	5.9
S. buccaneeri	5.1	7.3	——	5.2	3.9
S. andhraensis	2.7	0.2	0.1	2.6	1.9
S. commersonii	0.7	0.2	——	0.7	0.5
S. macrops	0.1	0.2	——	0.1	0.1

Characteristics of the anchovy resources

The average monthly catch of the different species of *Stolephorus* is given in Table 3; their overall legth frequency distributions are given in Fig. 5; and the ova diameter frequency diestribution of mature ovaries of the common species of *Stolephorus* are given in Fig. 6. The continuous distribution of immature, maturing and mature groups of ova, and the occurrence of the two types of partially spent-recovering ovaries in respect of five species studied generally indicate that species of *Stolephorus* are multiple spawners, an individual fish spawning about three successive batches of egg in a spawning season. Sexes are generally equally distributed. The anchovies are plankton feeders, subsisting mainly on zooplankton as also reported by Venkataraman (1960), Rabindranath (1966), Luther (1972) and Menon and George (1975). The fishery for anchovies is based mainly on '0' year class fish.

Observations on the fishery season, size composition, spawning season and size at first maturity of the different species of *Stolephorus* are given below:

1. *S. devisi*

S. devisi is the most common anchovy of the area, occurring in the fishery throughout the year although in very small quantity during January-March. The annual landings of this species ranged between 96.3 tonnes and 308.7 tonnes with an average at 164.4 tonnes. Its principal fishery season is September- October and the next important season is June-July. These two seasons account for about 45% and 23% respectively of the annual catch of the species. When compared with *S. bataviensis* this species is equally abundant in boat seine but more abundant in shore seine and most abundant in gill net. However, about 51.5% of its annual total catch is landed by boat seine, 45.5% by gill net, and only 3% by shore seine.

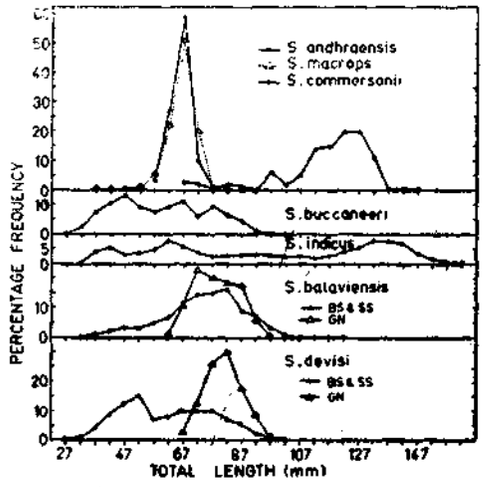

FIG. 5. Length-frequency distribution of the different species of *Stolephorus* at Vizhinjam.

The total length range of *S. devisi* in the fishery varies from 25 mm to 100 mm. Recruitment takes place during November-June/July at 32 mm-47 mm modal length. During this period larger fish ranging between 52mm and 72mm modal length also occur in the fishery. Thereafter, however, only large sized fish ranging in modal lengths from 62 mm to 87 mm are dominant. Over the whole period, fish ranging in length between 42 mm and 82 mm are dominant in the catches. In the gill net, however, modal lengths 77 mm and 82 mm are most dominant.

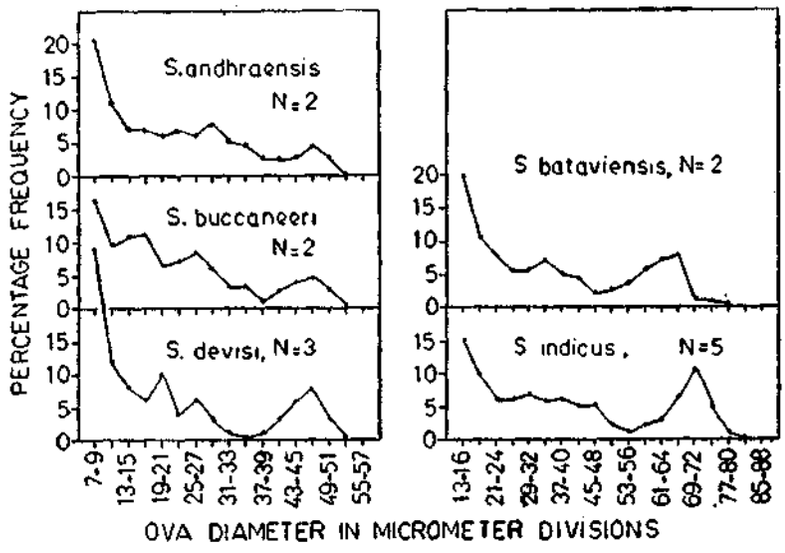

FIG. 6. Ova diameter frequency distributions of five species of *Stolephorus*, to show the multiple spawning habit of anchovies.

TABLE 3. *Monthly variations in the landing's (in kg) of* Stolephorus *Spp. at Vizhinjam during* 1970-'76.

	Jan.	*Feb.*	*Mar.*	*Apr.*	*May.*	*June*	*Jul.*	*Aug.*	*Sep.*	*Oct.*	*Nov.*	*Dec.*
S. devisi	222	129	326	12,215	8,632	17,348	20,227	11,206	18,241	56,113	9,985	9,776
S. bataviensis	4	8	123	5,841	10,347	16,518	12,591	1,856	20,605	34,039	3,534	23
S. indicus	57	106	252	1,827	6,138	2,126	743	687	2,740	644	2,311	726
S. buccaneeri	3	——	1	27	1,859	1,077	3,591	3,749	55	336	164	1,188
S. andhraensis	——	——	——	79	60	556	401	45	4,499	41	46	——
S. commersonii	3	——	1	1	——	12	610	857	——	15	9	2
S. macrops	——	——	——	——	6	10	1	175	41	——	——	27

The spawning seaon is a prolonged one. The spawning activity is generally low during July-September, fairly high from October/November to June of the following year. It is intense during December-March. The smallest fish and 50% of fish in the population are sexually mature at lengths of 42 mm and 57 mm respectively in respect of male and at 52 mm and 61 mm respectively in female. Majority of fish caught during the principal fishery season (September-October) have only maturing gonads.

2. *S. bataviensis.*

The annual catch of *S. bataviensis* ranged between 45.8 tonnes with an average at 105.5 tonnes. About 85.4% of its annual total catch is landed by boat seine, 3.1% by shore seine and 11.5% by gill net. The general trend of the landings is almost similar to that of *S. devisi*, but it is relatively more scarce during December-March and August. The principal fishery season (September-October) and the next important season (May-July) respectively account for about 52% and 37% of the annual landings of the species. *S. bataviensis* is less abundant in shore seine when compared with *S. devisi* and *S. indicus*, the two other important components in the anchovy landings by shore seine. It would therefore appear that *S. bataviensis* is relatively an offshore inhabitant.

The total length range of *S. bataviensis* in the fishery varies from 30 mm to 124 mm. Small sized fish between modal lengths 37 mm and 57 mm enter the fishery during February-June/July, when fish between 62 mm and 82 mm modal lengths also occur in the fishery. Thereafter, however, only larger fish ranging in modal lengths from 72 mm to 97 mm are dominant. On the whole, representation of fish below 57 mm modal length is poor, and of fish between 62 mm and 82 mm modal lengths is high. In the gill net, fish between 72 mm and 87 mm modal lengths is dominant.

Immature and early maturing fish predominate in the fishery of *S. bataviensis.* Mature, partially spent-recovering, and spent fish are met with in stray numbers during April-December. As mentioned earlier, this species is scarce during December-March. The smallest mature female and male were met with at 67 mm and 77 mm modal length respectively. *S. bataviensis* may be an offshore or deep sea spawner.

3. *S. indicus.*

The annual landings of *S. indicus* ranged between 5.8 tonnes and 34.2 tonnes with the average at 18.4 tonnes. This species occurs almost throughout the year although in small quantity during January-March. The principal fishery season (April-June) and the next important season (September-November) account for about 55% and 31% respectively of its annual landings. This trend is just the reverse of that for *S. devisi* and *S. bataviensis*. Though *S. indicus*

accounts for only about 6% of the anchovy catch, it is the second important anchovy in the shore seine. However, about 74.4% of its annual catch is landed by boat seine, 24.4% by shore seine and 1.2% by gill net.

The total length range in the fishery varies from 25 mm to 164 mm. Small fish between 42 mm and 62 mm modal lengths enter the fishery during February-May/June during which period larger fish between 87 mm and 147 mm modal lengths also occur in the fishery. Fish around 137 mm modal length is dominant in the catches. Thus *S. indicus* is the largest species among the anchovies of the genus *Stolephorus* occurring in the area.

Mature, partially spent-recovering and spent fish occur during September-April/ May. Majority of fish caught during its principal fishery season have only maturing gonads. The smallest fish and 50% of them in the population are sexually mature at length of 107 mm and 123 mm in respect of both the sexes.

4 *S. buccaneeri.*

Annually, about 12 tonnes of *S. buccaneeri* is landed on an average with a wide annual variation of 2.6-26.1 tonnes. This fish forms a seasonal fishery, 85% of its annual catch being landed during May-August period and another 10% during December, But stray specimens are netted in other months also. About 86% of the annual catch is landed by boat seine and 9% by shore seine and 5% by gill net.

Fish ranging in length between 25 mm and 100 mm occur in the fishery, length groups between 37 mm and 82 mm being generally dominant. In gill net 70-79 mm long fish is common. Recruitment takes place during November-June/ July between 92 mm-47 mm modal lengths.

Mature, partially spent-recovering, and spent fish are available almost throughout the year. Minimum size at first maturity is at 42 mm modal length for both the sexes, and 50% of fish are sexually mature at 45.5 mm length in male and 48.5 mm length in female. Thus *S. buccaneeri* becomes sexually nature at a smaller size than all the other species of *Stolephorus* examined in the present study.

5. *S. andhraensis.*

S. andhraensis usually occurs sporadically in small quantities during April-December. But occasionally it occurs in large quantities also. The annual landings varied between 0.1 tonnes and 20.8 tonnes tonnes with an average at 5.7 tonnes. A large proportion of the annual catch is landed during June, July or September. This is a small-sized fish varying in total length between 55 mm and 89 mm in the fishery, and fish around 67 mm modal length is dominant. Minimum size at sexual maturity is around 56 mm total length and 50% of males and of females are sexually mature at about 62 mm length. Mature, partially spent-recovering and spent fish are observed during April-November.

6. *S. commersonii*

S. commersonii also occurs sporadically in the fishery. Bulk of the annual catch is landed during July-August period. The annual landings of the fish ranged between 0.027 tonnes and 3.9 tonnes with the average at 1.5 tonnes. In size, this is the second largest species among the species of *Stolephorus* in the area, its total length in the fishery ranging between 67 mm and 147 mm, and the dominant sizes ranging between 112 mm and 127 mm. Minimum size at first maturity is around 110 mm. Only immature and maturing fish are common in the catches.

7. *S. macrops*

S. macrops is also a small-sized fish like *S. andhraensis*. They resemble each other superficially. This fish also occurs sporadically in the fishery, bulk of its annual catch being landed during August and September. The annual catch varies between 53 kg and 876 kg with the average at 260 kg. Length range in the fishery varied between 37 mm and 77 mm, fish around 67 mm modal length being predominant in the catches. Minimum size at first maturity is around 67 mm. Only immature and maturing fish are common in the catches.

Thus a pattern in the seasonal abundance of the species of anchovies is discernible. *S. devisi* and *S. bataviensis* which are the main support of the anchovy fishery of the area show a greater similarity to each other in the seasonal trend of their fishery, which comprises of two peak priods of abundance: a major period in October, and a minor one in June-July with an interveneing period of poor catches in August. Whereas a period of poor catch in August is also noticeable for *S. indicus* and *S. andhraensis* the peak periods of their catch generally precede with that of *S. devisi* and *S. bataviensis*. Thus a transition period of poor catches is seen in August for four of the seven species of anchovies occurring in the area. On the other hand, the month of August seems to represent a period of abundance for *S. buccaneeri, S. commersonii* and *S. macrops*. These seasonal changes in the abundance of the anchovy fauna in the area may be mainly the result of the changes in the physico-chemical environment of the fish. There is thus a possibility that the species of anchovies could serve as biological indicators of the movement of the water masses in the sea along the southwest coast of India.

Early juveniles ranging between 25 mm and 40 mm length are available in the inshore catches sporadically during November-July in respect of *S. devisi S. buccaneeri,* and during February-July in respect *S. bataviensis S. indicus* and *S. andhraensis*. While mature, partially spent-recovering and spent fish are dominant in the inshore etches in respect of *S. devisi, S. indicus S. buccaneeri* and *S. andhraensis,* only immature and early maturing fish predominate the fishery of *S. bataviensis* indicating the last mentioned species to be relatively an offshore or deep sea spawner. Information on this aspect for *S. commersonii* and *S.*

macrops is too meagre to draw any definite conclusion. These observations generally indicate that each species of *Stolephorus* has a prolonged spawning season.

UTILIZATION OF CATCH AND MARKETING

The catch of each fishing unit is generally sold in auction. The whole of anchovy catch during the slack period (January-March), about 40% of the catch during the next quarter, about 70% during the third quarter and about 30% in the fourth quarter are disposed of for consumption in fresh state and the rest is dried for trade. A small fraction of the fresh fish is also used as bait in the hooks and line fishing.

To make dry fish, fresh fish is thinly spread over sand on the beach without application of salt for about two days during dry weather, whereas during cloudy and rainy weather fresh fish is kept in brine water overnight and then dried on mats. Anchovy dried by the former method is reported to keep well for about 12 months and has more demand over the anchovy dried by the latter method which keeps only about 4 months. Further, anchovy dried on large grained sand has a better market as it looks brighter than that dried over sand with an admixture of fine, black or grey sand.

It is generally believed that dried *S. devisi* and *S. buccaneeri* taste better than the other species of anchovies, and fish dried with the head intact is reported to taste better than that without it as in the case of majority of fish landed by gill net. Anchovy caught in shore seine and boat seine lose their body scales by the time they are put to dry and as such are preferred by the consumer over the dry anchovy made from gill net which retain the body scales and lose the head.

About 3000 tonnes of dry anchovy has been estimated to be produced annually on an average from the southwest coast of India, of which 90% comes from the southern region extending from Cape Comorin to Quilon. Important centres in this region are: Cape Comorin-Rajakimangalam, Kadiyapattanam-Colachel, Yannayam-Kollangode, Pozhiyur-Pulluvila, and Poonthura-Perumathura.

Price of fresh anchovy per quintal is reported to have ranged between Rs. 80|- and Rs. 225|- during 1970-72, between Rs. 120|- and Rs. 300| per quintal during 1973-75, and between Rs. 200|- and Rs. 450|- during 1975-76. Dry anchovy made during April-June, being well dried and of good quality that would keep well for a longer period, as well as being the early arrival for the year, fetches a higher price than that made during the next two quarters of the year. Thus the price of dry anchovy per quintal at the production centre is reported to have ranged between Rs. 175|- and Rs. 225|- during 1970-72, between Rs. 225|- and Rs. 300|- during 1973-74 and between Rs. 350|- and Rs. 500|- during 1975-76.

Majority of the sundried variety was exported to Ceylon via Tuticorin prior to 1973. Thereafter, there has been considerable decline in the export of this fish to Ceylon. Chief wholesale markets in India for the dry anchovy are located at Koilpatty, Rajapalayam, Thiruchirapally and Madras, in Tamil Nadu. Bangalore, Cuddapah, Bellari, Adoni and Bombay are the other important wholesale markets for this fish.

General remarks

Menon and George (1975) have reported that the standing stock of anchovies (*Stolephorus* spp.) off southwest and southeast coasts, between Tuticorin and Ratnagiri (between latitude 6°N and 17°N), varies between 230,000 tonnes and 520,000 tonnes. The average annual standing stock may then be calculated as 375,000 tonnes. The present analysis of the anchovy catch in the different zones along the southwest coast, however, indicates that the inshore fishing region north of Quilon is hardly significant for the fishery. This is clearly seen from the trend of the anchovy landings in zones from K-6 to K-9 which together account for only 5.35% of the anchovy catch along the southwest coast. But a recent report on the Pelagic Fishery Project (Anon 1976) indicates that north of Quilon anchovies are located as far as 30 km off the shore whereas in the south they are frequently found near the coast. It would therefore appear that the anchovy catch along the southwest coast could be increased by extending the area of exploitation beyond the present inshore fishing region.

Although *S. devisi* and *S. bataviensis* form the two equally important elements in the anchovy catch in the southern region, only one of the two species has been found to dominate individual samples pointing to the possibility that the two species shoal independently. The considerable size of air bladder in both the species also suggests that the fish are capable of making extensive vertical migrations. Differential depth distributions of the two species may bring about the variations in the relative composition of the two species in the individual samples. It would be worthwhile, therefore to investigate whether the two species differ in their shoaling depths.

Majority of fish caught in gill net lose their head while they are disentangled from the net, resulting in loss of weight of about a sixth of the total catch. Owing to the selectivity of the net, majority of the catch in the gill net belong to *S. devisi* thus leaving out *S. bataviensis* which is equally abundant in the same area. Therefore operation of purse-seines could minimize the loss in weight of catch, besides harvesting both the commercially important species of anchovy in the same proportion of their availability in the sea.

Anchovies can be lured by artificial light kept over the surface in the inshore waters on dark nights. This habit of anchovies gathering around light, is taken advantage of in some areas, especially in the Palk Bay and the Gulf of

Mannar (Hornell 1939, 1950; Sekharan, 1955; and James 1967a). This torch-fishing' or 'light-fishing,' together with operation of non-selective gear such as purse seine, could be tried in other parts along the southern States during the peak season to increase the anchovy catch in India.

The increase in the anchovy catch would bring in its train, problem for their effective utilization, as the fish is prone to quick spoilage and is liable to get crushed while handling. As dry fish, anchovy has a great demand all over the south east Asian countries. But the season of abundant catch along the south-west coast coincide with the two monsoon eason. Therefore organization of a few centres with facilities for drying the catch artifically seeme to be a step forward in the direction of their proper and effective utilization. Menon and George (1975) have suggested preparation of fish meal from the anchovy for human consumption. In addition to this, the economics of transportation of the anchovy catch in an organized manner to nearby places in the Tamil Nadu where the effect of monsoons is less, may also be considered for drying the catch.

Movement of anchovy shoals into the inshore regions usually coincides with the fisheries for larger sized carinvorous and piscivorous fishes such as carangids, ribbon-fishes, tunas, seer-fishes, barracudas, sciaenids, sharks, wolf-herrings, etc., for which anchovies are an important food item, as reported by Job (1940) Devanesen and Chidambaram (1953) Prabhu (1955), James (1967b), Rabindranath (1966) and others. Abundant occurrence of very young juveniles of *S. devisi, S. indicus* and *S. buccaneeri* in the inshore *'Nonnavu'* catches from November to May every year along the southern region suggest that the spawning grounds of the three species is not far away from the inshore waters. As the anchovies are short-lived fish with the fishery being supported mainly by '0' year class, their fishable stocks are to be renewed every year. There is, therefore, great need to prevent the traditional distruction of the young juvenile anchovy in the name of the 'Nonnavu' fishery, in order to conserve and increase the production of anchovy along the southwest coast.

Acknowledgements

The author wishes to thank Dr. E. G. Silas, Director, Central Marine Fisheries Research Institute, for the kind encouragement, and late Dr. K. V. Sekharan, Dr. M. D. K. Kuthlaingam and Dr. S. V. Bapat for critically reviewing the manuscript. He acknowledges the help received from Shri D. C. V. Easterson and Shri R. Bhaskaran Achari.

References

Anon. 1976. Pelagic Fisheries Project. *Sea food export Journal* 8(2): XV-XX.

Devanesan, D. W. and K. Cidambaram. 1953. *The common food fishes of the Madras State* Department of Industries and Commerce, Madras, pp. 79.

Hornell, J. 1938. The fishing methods of the Madras Presidency. Part II. The Malabar coast, *Madras Fish. Bull.* 27: 17.

HORNELL. 1950. *Fishing in many waters.* Cambridge University Press, Cambridge, 149.

JAMES, P.S.B.R. 1967a. A note on the torch (Soonthu) fishing for white-bait off Rameswaram in Palk Bay. *J. Bombay nat. Hist. Soc.*, 64(1): 123-125.

JAMES, P.S.B.R. 1967b. *The ribbon-fishes of the family Trichiuridae* of India. Memoir I. Marine Biological Association of India. pp. 226.

JOB T. J. 1940. Nutrition of Madras Perches. *Rec. Indian Mus.* 42: 286-364.

LUTHER, G. 1972. White-bait fishery resources of the southwest coast of India. *Symp. pelag. fish. resour., CMFRI.*, Cochin. Abstract No. 17.

MENON, M. D. AND K. C. GEORGE. 1975. White-bait resources of the southwest coast of India, *Sea food export Journal* 7(1): 1-14.

PRABHU, M. S. 1955. Some aspects of the biology of the ribbon fish, *Trichiurus haumela* (Forskal). *Indian J. Fish.* 2: 132-163.

RABINDRANATH, P. 1966. *Biology and Seasonal Distribution of the Pelagic Food Fishes of Trivandrum Coast.* Kerala Univ. Publ., pp. 1-14.

RONQUILLO, I. A. 1967. (MS.) A review of the genus *Stolephorus*, with a key to species. *Report by FAO Andre Mayer Research Fellow.*

SEKHARAN, K. V. 1955 Observation on the Choodai fishery of Mandapam area. *Report by FAO Andre Mayer Research Fellow*, 2(1): 113-131.

SEKHARAN, K. V. 1962. On the oil sardine fishery of the Calicut area during the years 1955-'56 to 1958-59.,*Report by FAO Andre Mayer Research Fellow*. 9A(2): 679-700

VENKATARAMAN, G. 1960. Studies on the food and feeding relationships of the inshore fishes of Calicut in the Malabar coast. *Indian J. Fish.*, 7(2): 275-306.

WHITEHEAD, P. J. P. 1968. Indian Ocean anchovies collected by the *Anton Bruun* and *Te Vega*, VTFC-FD. *J. mar. biol. Ass. India.*, 9(1): 13-37.

WHITEHEAD, P. J. P. 1972. A synopsis of the clupeiod fishes of India. *J. mar. biol. Ass. India.*, 14(1): 160-256.