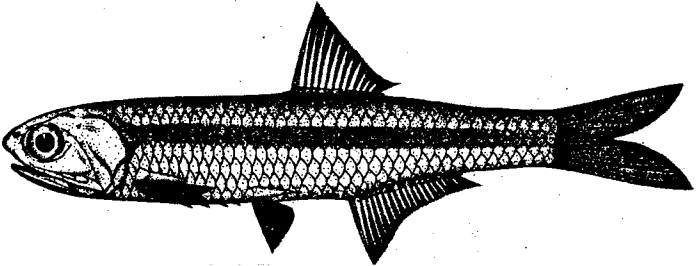




# TRENDS IN WORLD ANCHOVY FISHERIES AND INDIA'S STATUS



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## Introduction

Anchovies belonging to the (family Engraulidae) are the small pelagic fishes and constitute one of the most important pelagic resources in the world. This forms about 12.8 % of the world fish production during the years 1996-2000. This group includes some of the world famous fisheries like the peruvian anchovita, Californian, Chilean and Japanese anchovies. Peruvian anchovita, *Engraulis ringens* is one of the most dynamic fisheries of the world and a classical case of how the fishery independent factors influence the resource. The economy of the country legends on the success of the anchovita fishery and failure of it puts the nation in red. Other important anchovies of the world are Japanese anchovy 1.28 million tonnes.

In India anchovies form the artisanal fisheries and a major source of income for the traditional fishers. During the last decade the resources have become vulnerable to the trawlers also. The impact of changing fishing pattern is the cause of concern in some states. However, they are annual renewable resources hence their periodical removal is desirable to make full use of the fishery.

## World Anchovy production

World anchovy catch varied between 5.9 (1998) and 14.5 million tonnes (2000) during the last five year with an average of about 11 million tonnes forming about 12.8 % of the world fish production. Of the total production of anchovies 74.5 % came from Southern Pacific waters, 13.1 % from northwest Pacific, 3.6 % Mediterranean and black sea, 2.2 % eastern Indian Ocean, 1.9 % Western central Pacific and 0.8 % Western Indian Ocean.

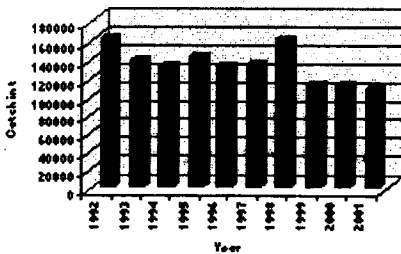
Among the anchovies, Peruvian anchovita, *Engraulis ringens* ranked first with an average annual production of 7.656 million tonnes forming 72.4 % anchovy production followed by the Japanese anchovy *E. japonicus* with annual catch of 1.385 million tonnes forming 13.1 %. The other important species contributing to the fisheries are *E. encrasicolus*, 0.549 million tonnes (5.2 %),

*C. mysticetus*, 0.136 million tonnes (1.3 %), *E. capensis*, 0.133 million tonnes (1.3 %), *Stolephorus* spp., 0.276 million tonnes (2.6 %) and other Engraulids 0.413 million tonnes (3.9 %).

### Indian Anchovy production

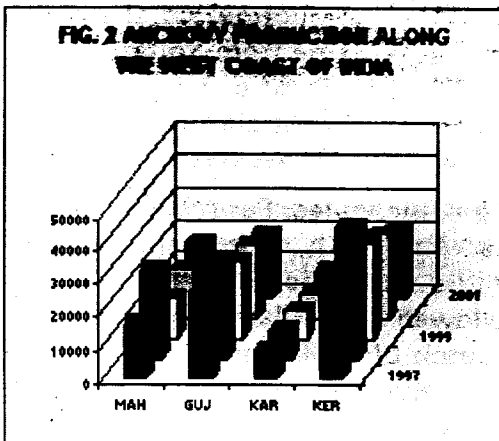
In India, the anchovy resource contributed 111,140 (1999) to 161,161 t (1992) with an average catch of about 133,000 t during 1991-2000 (Fig. 1.). The species, which constitute the important fisheries, are *Coilia dussumieri*, *Stolephores* spp. *Thryssa* spp., *Thryssinna* spp. and *Setipinna* spp.

FIG. 1 ALL INDIA ANCHOVY PRODUCTION



On the west coast of India, Kerala is the leading state, where the catch varied from 25,643t (2000) to 40,013 t (1998) with average catch of about 30,000 t, followed by Gujarat with the catch ranging between

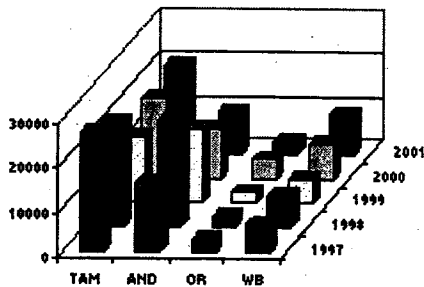
FIG. 2 ANCHOVY PRODUCTION ALONG THE WEST COAST OF INDIA



18,837 t (2001) and 29,148 t (1998) with an average catch of 24,000 t. Maharashtra ranked third with the landings of 12,138 t (1999) to 26,428 t (1998) with an average of 17,338 t. In Karnataka, the catch is more or less stable and it varied between 7,698 t (2000) and 8,764 t (1997) t with an average catch of 8,340 t (Fig. 2.)

On the east coast, Tamil Nadu is the leading state where the catch ranged between 14,642 t (1999) and 26,267 t (1997) with an average of 20,596 t followed by Andhra Pradesh, where the catch varying between 6,089 t (1998) and 8,273 t (1999). The production of Anchovy is good in West Bengal also where the catches ranged between 5,217 t (1999) and 7,802 t (2000). The anchovy production is least in Orissa the catch varied from 2,266 t (1999) to 4,230 t (2000) with an average of about 3000 t (Fig. 3.).

**FIG. 3 ANCHOVY PRODUCTION ALONG THE EAST COAST OF INDIA**



### Species-wise catch

In Gujarat *C. dussumieri* and *Thryssa* spp. constitute the fishery forming on an average 67.1 % and 32.9 % respectively. In Maharashtra *C. dussumieri* contributes on an average of 79.1 %, *Thryssa* spp. 19.6 % and *Stolephorus* spp. 1.2 %. Whereas, in Karnataka, *Stolephorus* spp. formed (64 %) and *Thryssa* spp. contributed 36 % of the fishery. The fishery in Kerala too is supported mainly by *Stolephorus* spp. (83 %) and *Thryssa* spp. (17 %).

On the southeast coast *Stolephorus* spp. (60 %), *Thryssa* spp. (35 %) and *C. dussumieri* (4 %) constituted the fishery in Tamil Nadu, whereas in Andhra Pradesh *Stolephorus* spp. (56 %), *Thryssa* spp. (41 %) and *C. dussumieri* (3 %) form the fishery. On the northeast coast *Stolephorus* spp., *Setipinna* spp., *Thryssa* spp and *Coilia* spp. contributed 35, 34, 21 and 10 % respectively in Orissa. In West Bengal *Coilia* spp. (51 %), *Setipinna* spp. (29 %), *Thryssa* spp. (18 %) and *Stolephorus* spp. (2 %) contribute the anchovy fishery. It is pertinent to mention here that more number of species of *Coilia* spp. constituted the fishery in West Bengal and the notable among them are *C. ramacarti*, *C. neglecta* and *C. reynaldi*.

Mixed species of white bait larvae are the most numerous among the clupeoids along the south west coast of India and occur in all the months, with peak abundance during March-July and November. Relatively dense concentrations of the larvae are seen in the area south of Kasargode to Gulf of Mannar with maximum over the outer shelf in the area from 7.30°N to 11.30°N. According to some reports *E. hetroloba* and *S. zollingeri* occur in large numbers. Larvae of anchovies formed about 12-13 % of the total fish larvae in the International Indian Ocean Expedition samples.

### Crafts and gears

The anchovies are landed as by catch by traditional gear *dol* net (mesh size 5-25 mm) in Maharashtra and Gujarat which target Bombay duck. The craft employed is mainly plank built Satpati-type boat fitted with engine varying from 5 to 65 in H. P. In Orissa and West Bengal also these species are caught in bagnets.

In Andhra, Tamil Nadu and Kerala, the most common artisanal gears in vogue are the boat seines (cod end mesh size, 10mm) and shore seine (cod end mesh, 10-20 mm). South of Quilon, gill net known as *Netholi vala* ("Anchovy net") with the mesh size of 15mm is employed for targeting white baits. All these gears are operated from catamarans and small country

crafts, many of them fitted with outboard engines in Kerala. Purse seines (mesh size, 4-18 mm) are employed in Maharashtra, Goa, Karnataka and Kerala coast. Ring seines (mini purse seine with the mesh size of 8 mm) operated from plank built boats fitted with out board motors are employed along the coasts of Kerala and Karnataka. The depth of operation of these gears generally ranges from 10-50 m.

### **Gear-wise catch in India**

In Maharashtra trawl accounted for 70 % of the catch of *C. dussumieri* and the remaining by traditional *dol* net. At Mangalore in Karnataka *S. devisi* is the dominant species in all gears; in purse seine, it formed 69 % followed by *S. bataviensis* (11 %). In trawl also *E. devisi* dominated the catch and formed about 85 % of the catch at Mangalore and Malpe area, while *E. bataviensis* formed the rest of the catch. At Cochin *S. devisi* dominated the catch in trawl (74 %), ring seine (95 %) and purse seine (88 %). At Kakinada, *S. bataviensis* (33 %), *S. commersonii* (21 %), *S. devisi* (19%) and *S. indicus* (7 %) constituted the anchovy fishery in trawl.

### **Migration**

The whitebaits undertake seasonal migration along the southwest coast and the Gulf of Mannar in 4 distinct phases: (i) In October, when the northeast monsoon sets in, the shoals are discontinuously distributed in a narrow elongated band along the southwest coast from Mangalore to Cape Comorin. (ii) During November to February, the shoals form a continuous wide belt with a disruption between 11°N and 12°N. (iii) During March-April, the shoals break up and begin their southward migration, which continues till July. (iv) In August the southward migration culminates, with the bulk of stock

migrating towards north in the east coast and piling up between Cape Comorin and the central Gulf of Mannar in the east coast. The migration of the whitebaits follows the surface currents of the northeast and the southwest monsoons. During the southwest monsoon, the currents flow southwards along the west coast; and north and northeastwards in the Gulf of Mannar; during the northeast monsoon, the current flows in the reverse direction.

### **Resource characteristics of some of the important species of the World**

#### ***Peruvian Anchovy, Engraulis ringens***

The general distribution is between 6°S- 43°S along the Western coast of South America from Aguuja Point, Peru to Chile in the south. The distribution being dependent on the coastal extent of Peru Current. The preferable temperature range is 13-23°C and occurs mainly within 80 Km of coast, forming huge school chiefly in surface waters. The total biomass and maximum production during its maximum outburst may reach 20 million tonnes and 13 million tonnes. The population of Peruvian anchovita undergoes catastrophic decline because of strong El Nino events. After strong El Nino event 1997-98 led to decline in the catch to a mere 1.7 million tonnes in 1998 but in 2000 anchovita catch reached 11.3 million tonnes indicating the capability of anchovita population for a quick recovery.

It is a filter feeder entirely dependent on the rich plankton, phyto- and zooplankton, and diatoms constituting as much as 98 % of the diet.

The anchovita spawn during the entire year in Peru's current, however, the main spawning activity takes place around September. A secondary spawning peak, smaller



and less distinct than the main peak, occurs in April-May. The anchovitas are recruited to the fishery at about 5 months of age. Thus, progeny of first spawning peak enter the fishery in January-February and those of second in July-August. A large percentage of anchoveta mature at the age of one year and fecundity is high; a two year female may spawn over 20, 000 eggs.

These pelagic eggs have almost negligible store of nutrient material, consequently, newly hatched larvae required a high density of food in their immediate environment if they are to survive. The pelagic eggs and larvae are subjected to severe predation from variety of plankton feeders ranging from carnivorous zooplankters to their own parents. The spawning aggregation intermix large number of filter feeding adults. The eggs and larvae consumed by the spawners are sufficiently large and cannibalism during the period of larval drift serve as basic mechanism of controlling population density and stabilizing the number of recruits.

The natural mortality is very high; an estimated 9 million tonnes of anchovitas are consumed by marine predators, which include, bonito, mackerel, hake and squid.

Peruvian anchovieta supports large population of guano birds and pelicans, which by feeding nearly 10 times the quantity of fish and produce nearly 1 million tonne of guano.

### ***Japanese anchovy, Engraulis japonicus***

The Japanese anchovy, *Engraulis japonicus* has a wide range of distribution from 50°N to 7°S ranging from Western Pacific, southern Sakhalin Island, Sea of Japan and pacific coast of Japan, and south to almost Canton/Taiwan. It is also reported from the coast of South Africa

to Namibia. But mainly distributed in the northwest Pacific extending from the southern Okhotsk seas in the north to the north of South China sea in the south. The species prefers 7 to 14°C temperature and undertakes migration during summer months.

It feeds on copepods, Feeds on phytoplankton, viz. diatoms and dinoflagellates; zooplankton: copepods, ostracods, cladocerans, amphipods and euphausiids. The crustacean plankton accounted for about 60 % of the total diet. The anchovy hardly feed during spawning season and during over wintering.

Spawning varies from region to region, from highly seasonal to throughout the year. The main spawning takes place from April to June along the coast of the Liaoning; Shandong and Jiangsu Provinces. After spawning, the anchovy leave the coast to the middle of the Yellow Sea and the Bohai Sea for feeding, when the schools become relatively sparse. The average size of spawners ranges from 103 to 117 mm (FL) comprising of one and two year old fish. The fecundity ranges from 2,500 to 11, 000 eggs.

The average annual biomass of the anchovy was estimated to be about 3 million t (range: 2.5 to 4.3 million t) in the Yellow Sea and the East China Sea, based on the winter acoustic surveys by R/V *Beidou* during 1984-1993. The annual yield increased from 40,000 t (1989) to an average catch of 13, 84, 564 t (1996-2000) due to the increased exploitation by the Chinese fishers. The species grows at a faster rate (K 0.8-1.05) and maximum length is 16.3 cm

### ***Golden anchovy, Coilia dussumeiri Valenciennes***

It is a pelagic and largely marine, but enters estuaries and rivers also. The normal distribution is 23° N-8° S. It forms a commercial fishery on the northwest (Maharashtra

and Gujarat) and northeast (West Bengal and Orissa) coast of India. Elsewhere it is reported from Bangladesh, Burma, Thailand and Indonesia.

It feeds on copepods, ostracods, amphipods, fish and prawn larvae but prefers to feed on ostracods and *Acetes* spp.

Spawning season is from January to May. The individual spawns only once in a year. The size at first maturity is 16.2 cm. Unlike other anchovies, the eggs are spherical.

It grows to 22cm and has short life span of less than two years. Earlier, it was exploited mainly as by catch in *dol* net. Of late, 70 % of the landing is by trawl gear. Maximum sustainable yield estimated for Maharashtra is about 16,000 t. The current exploitation is below Emax.

This species is consumed fresh and sun dried. Dry fish is bartered for rice in equal weight in Gujarat.

***Devis' anchovy, Encrasicholina devisi***

The species is widely distributed in Indo-Pacific tropical waters 30°N-24°S. Most abundant species among engraulids in India, and constitutes a fishery in Andhra Pradesh, Tamil Nadu, Karnataka and Kerala and form recognizable fisheries in Indonesia, Malaysia and Srilanka. It is distributed in northern Australia also eastward to Fiji and Tonga. It is a schooling species, mostly confine to shallower depth range and known to enter estuaries. The size ranges between 40 and 100 mm with major mode at 80mm.

High concentrations have been found in 9-14° sN which vary from month to month. After May, the continuous distribution breaks up and a southward displacement of concentration takes place and in August the bulk of the whitebait stock is found to be concentrated in the region

south and south east of Kanyakumari (7-8 °N). During southwest monsoon season there is a strong southerly transport of coastal water masses along with southwest coast coinciding with upwelling of nutrient laden waters on the shelf. From October onward there is a similar strong northerly current on the shelf. The northward transport and distribution of whitebait stocks in the shallow shelf waters from October onward and southward displacement and distribution from March/April onward are evidently governed by these two current systems.

The food of *E. devisi* comprised of copepods and other zooplankton.

*E. devisi* breeds throughout the year with peak during October-November and shed three batches of eggs in quick succession and second set of multiple spawning cinnebcas after a period of three and four months. The size at first maturity for *E. devisi* is 64.5 mm. The fishery is constituted by 92.5 % of adult fish. The fecundity varied between 670 and 6,785 eggs. The eggs are oval, without a knob at one end.

The species grows at a faster rate and attains the first year growth of about 110 mm.

It is an important link in the food chain. It is consumed both fresh as well as sundried. Value added products, like anchovy powder, sauce, etc. are prepared. It is also used as bait for hook and line fishery.

### **Stolephorus waitei**

It is widespread in the northern part of Indian Ocean. form and recognizable fisheries in Indonesia, Malayasia, and Srilanka. It is distributed in northern Australia also eastward to Fiji and Tonga. It constitutes a minor fishery in Andhra Pradesh, Tamil Nadu, Karnataka and Kerala.

The species shares the same niches as that of *S. devisi* but with low stock density.

It is a planktonic feeder, feeds on zooplankton viz. copepods, cladocerans, *Lucifer*, fish post larvae, larval crustaceans and bivalve and phytoplankton like *Coscinodiscus* sp.

Peak spawning season is November-March. It spawns in about 3 successive batches of eggs. Fecundity ranges from 670 (68 mm) to 3,166 eggs (90 mm) from the west coast and 303 to 4812 eggs during the course of one multiple spawning from the east coast.

It is also consumed both fresh and dry forms.

### Stock assessment

Age and growth studies indicated that *C. dussumieri* grows to a maximum length of  $217 \pm 9.2$  mm and the growth coefficient is  $1.19 \pm 0.144$  (annual). The species has a short life span of 2 years only. It attains 151.6 mm and 196.9 mm at the end of first and second year of its life. However the effective life span is  $< 2$  years.

The natural mortality coefficient estimated by Pauly's method is 2.12. The average total mortality coefficient (Z) is 4.976 with exploitation ratio (F/Z) of 0.574 indicating that the resource is under exploited. However the same may be viewed with caution, in view of reported throwing of juveniles along with trash fish by the trawlers particularly during September to January when the prawn landing is good.

The maximum sustainable yield (MSY) for Maharashtra has been estimated at about 15, 000 t.

The growth parameters viz., L<sub>∞</sub> and K for *E. devis* has been estimated as 11.6 cm and 2.8 respectively from the west coast while it is 10.5 cm and 2.6 from the east coast. 6Z and F have been estimated at 9.2 and F 4.7

with F/Z 0.51 on both the coasts of India. Yield per recruit (Y<sub>W/R</sub>) analysis produced E<sub>max</sub> at 1 indicating that the fishery can sustain high fishing pressure and the present yield is much below the optimum.

The growth parameters and mortality estimates of the other anchovy resources from both west and east coast evidence that most of the other resources are lightly fished except for *S. commesonii*, which is fished relatively high (F/Z 0.72) though; E<sub>max</sub> is about 1 in this species also.

The overall MSY of all the commercially important species of genus *Coilia*, *Encrasicholina* and *stolephorus* constituting fisheries in India, barring Orissa and West Bengal is estimated at 2, 30, 000 t whereas the present yield is about 1, 22, 000. There is scope to expand the fishing effort for targeting anchovies.