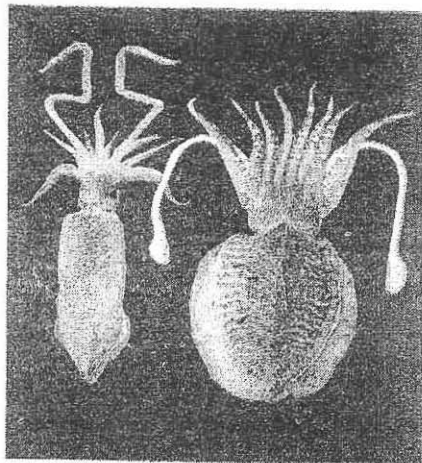




## TRENDS IN WORLD CEPHALOPOD FISHERIES AND INDIA'S STATUS



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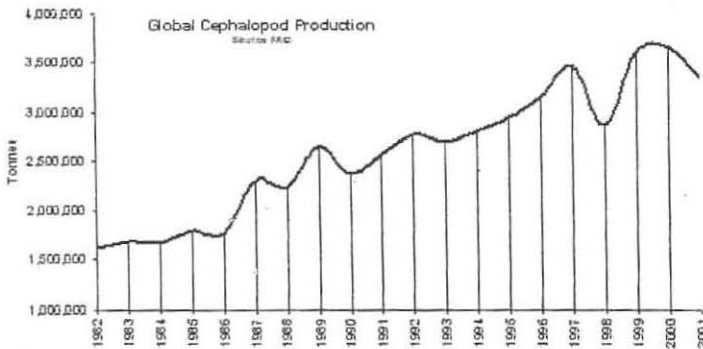
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## Introduction

Globally cephalopods are an important fishery resource and many species are taken in directed and bycatch fisheries around the world. Cephalopods make up only a small proportion (nearly 3%) of the world capture fisheries landings, but there have been substantial increases during the last three decades.

## Global production

According to the FAO, the total world landing of cephalopods was 1.6 million tonnes in 1982 and 3.4 million tonnes in the year 2001. The increase in landings is attributed to the reduction in competition and predation owing to diminished stocks of some finfish and marine mammals.



Due to the short life cycles and variable growth rates of most cephalopods, stocks are highly volatile and susceptible to both recruitment overfishing, but are capable of rapid recovery. Many species have multiple spawning periods so that multiple cohorts may be present in the population at any one time. Although many species are commercially fished, approximately 45 species are of major importance. Of the three groups of cephalopods, squids and cuttlefishes are more widely exploited throughout the world and octopuses the least exploited. The major species of squids exploited are

*Loligo forbesi*, *L. vulgaris*, *L. paelei*, *L. opalescens*, *L. gahi*, *L. duvauceli*, *Todaropsis eblanae*, *Todarodes sagittatus*. *T. filipovae*, *T. pacificus*, *Illex coindetti*, *I. illescebrosus*, *I. argentinus*, *Dosidicus gigas*, *Nototodarus gouldi*, *N. sloani*, *Ommastrephes bartrami*, *Symplectoteuthis oualaniensis*, *Onychoteuthis borealajaponicus*, *Doryteuthis bleekeri* and *Sepioteuthis lessoniana*. The major species of cuttlefishes exploited are *Sepia officinalis*, *S. pharaonis* and *Sepiella* sp. The principal species of octopus exploited are *Octopus vulgaris*, *O. maya* and *Eledone cirrhosa*. The major regions where cephalopod fisheries takes place are Northwest and Northeast Atlantic, the Saharan Bank off Northwest Africa, Gulf of California and Eastern Pacific seaboard.

Squids are mainly exploited by jigging and jigs account for nearly 40% of the world cephalopod catches. Trawling is the second most important fishing technique for cephalopods accounting for 25% of the world production. Of the other methods, gill netting accounts for nearly 10% of the catches notably in the North Pacific. Small amounts of catches are also obtained through seines in the Philippines, as also lift nets in California.

Many assessment methods have been applied to cephalopod stocks, including stock recruitment relationships, recruitment indices, swept-area biomass estimates, production models, length based cohort analysis, yield per recruit models and depletion estimates of stock size. Despite the widespread application of assessment methods, few stocks are rigorously managed, and the best example of a regulated fishery is the Falkland Islands squid (*I. argentinus*) fishery.

In 1983 Juanico opined that "squids are not fish and few principles of fish biology applies to these molluscs. However, Pauly in 1985 stated that little is to be gained by highlighting these differences; rather, it is better to infer that models developed for fish populations will work for squids also. While some cephalopod stocks may be more resistant to overfishing than long-lived finfish, they remain susceptible to uncontrolled fishing and some stocks have already declined. For cephalopods in mixed fisheries, Caddy has argued that management for cephalopods may be unnecessary because cephalopod stocks are likely to be more resilient to overfishing than finfish stocks.

In a global context, cephalopod fisheries represent a relatively new activity. During the 70s, exceptionally large cephalopod aggregations were observed, at the same time as fish stocks were decreasing in various areas. It is generally accepted today, that the abundance of cephalopods, although subject to high variability, may have resulted directly, or indirectly, from high fishing pressure on the traditional finfish species. The indirect changes may have resulted from "top down" effects as the removal of top predators in the trophic chain. Also, "bottom up" effects associated with trawling and to the disturbance and damage of the sea bottom environment are underlined. Very high discarding is another consequence of heavy trawling and it has been suggested that this may contribute to an increasing abundance of benthic cephalopods.

Due to the increased catches, global cephalopod trade has been rising and supplies on the world market are very strong. The increased supply of squid was initially absorbed without problems, with a strong buying interest reported in Spain and Japan.

Squid imports into Japan reached a high of 62 500 tonnes in 1999, almost 30 percent more than in 1998. In 1999, Japanese cuttlefish imports dropped by 3.1 percent to 43 400 tonnes, with Thailand supplying nearly half of this total. Octopus catches in the Eastern Central Atlantic were good in 1999, leading to higher exports to Japan and lower prices on the world market. In many of the countries that are not traditional cephalopod eaters, squid consumption is increasing. The best example is the United States, where "calamari" is now well established in fast-food chains. In countries with low seafood consumption, such as Argentina, squid has found a market niche in the fried fast-food sector.

### **Indian Cephalopod Fisheries**

Cephalopods are a marine fishery resource of increasing importance and many species are exploited as bycatch by trawlers along the Indian coast. Although they form only 4-5% of the total marine fish landings, cephalopod stocks are under heavy fishing pressure because of their high value as an exportable commodity. So much so, of late, they are even targeted by the trawl fleet in certain seasons of the year along parts of the westcoast of India. The CMFRI has initiated studies on cephalopod stock from Indian waters during the seventies. The initial results of this programme on the taxonomy, biology, fishery and stock assessment of cephalopod stocks pertaining to the seventies were published as a bulletin. Subsequently a major exercise on the stock assessment of Indian cephalopod stocks with data of 1979-89 was made by CMFRI. These studies indicated that squids were exploited at optimum level on both coasts and cuttlefishes were optimally exploited along east coast and underexploited along west coast.

### **Exploited Cephalopods**

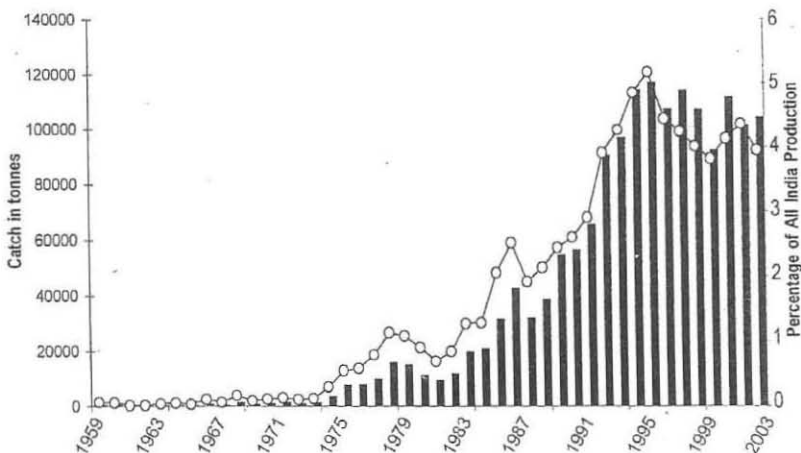
Cephalopods exploited from Indian seas can be broadly divided into three, viz., squids (order Teuthoidea), cuttlefishes (order Sepiioidea) and octopuses (order Octopodidae). The dominant species occurring in commercial catches are *Loligo duvauceli*, *Sepia pharaonis*, *S. aculeata* and *Octopus membranaceus*.

## Methods of Exploitation

In India, cephalopods are principally caught by bottom trawlers operating upto 100m depth zones. While most of the catch is as bycatch from the shrimp and fish trawls employed by the trawlers, of late, there is a targeted fishery for cuttlefishes during the post monsoon period (Sep-Dec) using high opening bottom trawls along the SW and NW coast. Prior to the seventies traditional gears like shore seines, boat seines, hooks and lines and spears were the principal gear employed to capture cephalopods. These traditional gears continue to be used especially for cuttlefishes at Vizhinjam. Experimental squid jigging has been tried with Japanese expertise along the west coast by GOI vessels with considerable success. However, commercial squid jigging is not practised in India.

## Cephalopod Production

Cephalopod production, which remained at very low-level upto the early seventies, has shown a remarkable increase crossing the 100,000 tonne mark in 1994. From 1973 onwards the commencement of export of frozen cephalopod products to several countries saw



the transition of the resource from a discard to a quality resource fetching high foreign exchange. Thereafter its production showed a steep increase. The west coast maritime states, Gujarat (GUJ), Maharashtra (MAH), Goa (GOA), Karnataka (KAR) and Kerala (KER) contribute to the bulk (86%) of the production. The production from the east coast amounts to only 14% of 84551 t, of which, Tamil Nadu (TN) contributes the maximum followed by Andhra Pradesh (AP). The states of West Bengal (WB), Orissa (OR) and Pondicherry (PON) contribute only a small percentage. Overall, KER ranks first contributing a third of the all India production followed by MAH, GUJ and KAR.

At the national level, Jan-Mar and Oct-Dec were the most productive periods. Along the upper east and west coasts, the above months were the most productive, while in KAR, KER, TN and AP, Jul-Sep was also equally productive.

### **Specieswise Production**

The neretic squid *L. duvauceli* contributed more than a third of the cephalopod production during 1990-94 followed by the pharaoh cuttlefish *S. pharaonis* and the needle cuttlefish *S. aculeata*. These three species together contribute 84% to the total cephalopod production from India. Along the west coast, *L. duvauceli* contributes more than 50% to the landings, followed by *S. pharaonis* and *S. aculeata* (47%). Among squids, *Doryteuthis* sp. and among cuttlefishes, *S. elliptica* form significant part of the catch from Kerala and Gujarat respectively. A number of octopus species, chiefly, *O. membranaceous* forms 1% of the catch mainly from Kerala.

The dominant species in landings from the east coast is *S. pharaonis*, followed by *L. duvauceli* and *S. aculeata*. The diversity of squid and cuttlefish species exploited in commercial quantities is more along east coast as compared to west coast. *Doryteuthis* sp. and *S. lessoniana* are also caught in considerable quantities from TN and AP. Octopus species, which were formerly discarded, has gained importance in recent years. The major production is from Kerala. Their proportion in the landings from both the coasts are increasing considering the export value of the same.

### **Biology of Exploited Species**

All investigations on cephalopod biology centre around the commercially exploited species such as the Palk Bay squid, *Sepioteuthis lessoniana*, *L. duvauceli*, *Sepia pharaonis*, *S. aculeata*, *Sepiella inermis* and *Octopus dollfusi*. The aspects of biology of cephalopods detailed here pertain mainly to *L. duvauceli*, *S. pharaonis* and *S. aculeata*.

### **Food and Feeding**

Adult cephalopods are voracious and active carnivores feeding mainly on fishes and crustaceans. Fish always occurs in the diet of *L. duvauceli* of all sizes. The preference to crustacean meal declines with increase in size and there is evidence of cannibalism above 80 mm DML. Cephalopods are preyed upon by a variety of marine fishes (including tunas and billfishes) and cetaceans. Many workers have noticed the predominance of empty stomachs in samples and slackness in feeding during spawning period. This may be due to the partial ingestion, fragmentation and rapid digestion of prey.

### **Age and Growth**

The relationship between length and weight of Indian cephalopods has been reported to be allometric with the 'b' value of the regression near to 2 than 3. This relationship is also significantly different for males and females.



Growth in cephalopods has been perceived to be linear, exponential, asymptotic and/or oscillating and the use of VBGF model with seasonal oscillation was advocated as a means of standardising growth estimates of different cephalopods allowing comparative studies to be made. Studies on the growth of Indian cephalopods have been made by using the asymptotic (VBGF) model and the seasonally oscillating version of VBGF. Clear sexwise difference in growth rate has been reported from Indian waters. In the case of *L. duvauceli* and *S. pharaonis* females grow faster than males, while in the case of *S. aculeata* males grow faster than females.

### ***Maturity Stage and Spawning***

Similar to other tropical marine resources, cephalopods along the Indian coast are reported to spawn almost throughout the year. The squid *L. duvauceli* spawns throughout the year along both the coasts, but along the west coast, peak spawning has been observed during post monsoon i.e., Sep-Nov. This species forms large schools (consisting of fully mature animals, 80% males) during this season, and becomes vulnerable to the purse seine fleet operating along Karnataka coast. Based on this observation, it is opined that the squids congregate for spawning (copulation) in nearshore areas after which the females migrate to the shallow subtidal regions with hard substratum for laying the fertilized eggs. From the sex ratio (M 80: F 20) of such squid schools it would be easy to conclude that female die after spawning (semelparity is common among cephalopods). However, based on the relatively low GSI levels and the occurrence of mature females over a wide range of size classes, it is concluded that this species is a multiple spawner and not a semelparous species. Similar studies on other commercial cephalopods are lacking.

## ***Fecundity***

Estimates on the fecundity of Indian cephalopods are few. In the spineless cuttlefish *S. inermis* the total number of ripe eggs in individuals between 69-71 mm DML was from 470 to 850 (average 14.9 eggs/g body weight). In the squid *L. duvauceli*, on an average, an individual produced 5300 eggs and there was good correlation between length, ovary weight and fecundity. In general, fecundity is low in cephalopods because of the absence of a larval stage and the hatchlings are virtually miniature adults.

## **Stock Assessment and Management**

Ever since the CMFRI initiated a major research project on the biology and stock assessment of cephalopod resources of India, a number of research papers have been published on the subject. Mostly length based models have applied to study cephalopod stocks. The relationship between spawning stock and recruitment of squids has also been made to assess the productivity of the population in terms of recruitment. Ricker's stock recruitment curve could adequately explain the variation in recruitment with respect to spawning stock biomass (SSB).

Studies on the exploitation rates during 1997-2002 indicate that some of the stocks are under heavy exploitation pressure. In general cuttlefish and octopus stocks are lightly exploited along both coasts. *L. duvauceli* stocks at Visakhapatnam, Kakinada, Mumbai, Mangalore and Calicut are under heavy exploitation pressure. Similarly, *S. aculeata* stocks in Rameshwaram and *S. pharaonis* stocks in Vizhinjam are also being exploited above the optimum level. *S. pharaonis* stocks in Cochin and *S. aculeata* stocks in Visakhapatnam are under exploited.

Cephalopods are not a targeted fishery along the Indian coast (excepting seasonally along the SW coast) and therefore, it is difficult to set management targets and many of the models applied would have little relevance. Yet, it is suggested that the most effective means of managing cephalopod fisheries is by regulating fishing effort, which will reduce the risk of recruitment overfishing. The present ban on trawl fishing during the monsoon as practised by different maritime states along the west coast is a means of regulation of fishing effort and should be continued.

### **Utilization and Marketing**

There is very little internal market demand for cephalopods and consequently almost all the catch is exported. While the quantity peaked in 1995, when cephalopods formed about the 45% of the total quantity exported, the annual average is about 25%. However, the value of cephalopods in total marine exports has remained at 15% from 1992 onwards without much variation. In 1996 the value of cephalopod exports amounted to more than Rs 8500 million. Categorywise, squid products are the maximum in all years followed by cuttlefish products. The products include dried, frozen whole, filleted, tentacles, rings, roe, wings, IQF and bones and ink. Octopus products exported are meagre, but from 1994 onwards there is rising trend. The main markets for export of Indian cephalopods are Europe, Japan and China.