# BIOLOGY AND STATUS OF TUNA IN YEMEN

Saeed Shaher Saeed

*Ministry of Fish Wealth*
*Marine Science Research Centre*
*Labour Island - Khormaksar*
*Aden, Yemen*

## INTRODUCTION

Various studies of pelagic fish populations in the Gulf of Aden and estimates of their stock size have been made (FAO, 1973; Kesteven *et al,* 1981). The Marine Science Research Centre (MSRC) initiated fishery research activities in 1983, and has carried out various surveys on the research vessel *Ibn Magid*.

The total pelagic fish stocks, calculated using an integrated echo sounder, were estimated to be 376,000 to 495,000 t (FAO, Kesteven *et al*, 1981). The tuna and seerfish stocks in the Gulf of Aden are estimated to amount to 50,000 t (Shaher S., 1984). Tuna are not exploited by commercial fisheries in Yemen; fishing activities are confined to the in traditional artisanal fishery.

Production of skipjack and frigate tuna is very low; kawakawa and yellowfin tuna are the principal species in the catch. The main species of tuna and seerfish, and their annual catches in 1988 (in the cooperative sector only) were:

| | |
|---|---|
| Yellowfin tuna (*Thunnus albacares*) | 1,251.6 t |
| Kawakawa (*Euthynnus affinis*) | 1,043.0 t |
| Spanish mackerel (*Scomberomorus commerson*) | 277.8 t |
| Longtail tuna (*Thunnus tonggol*) | 150.0 t |
| Striped bonito (*Sarda orientalis*) | 48.0 t |
| Frigate tuna (*Auxis thazard*) | 50.0 t |
| Skipjack tuna (*Katsuwonus pelamis*) | 17.1 t |

The production (in the cooperative sector only) of the traditional artisanal fishery exceeds 30,000 t. The actual total catches of tuna and seerfish are greater than this if the catch from the private sector is added to these totals.

The distribution of tuna and seerfish species along the coast of Yemen is not homogenous, and is affected by environmental and hydrographic conditions such as food availability, temperature, dissolved oxygen, salinity and upwelling. The distribution pattern shows that the small size categories are distributed in coastal areas, while the larger size categories are distributed in the offshore area and are not exploited commercially.

The production of tuna and seerfish in Yemen is oriented toward local consumption and export after canning, at either the Shoqra or Mukalla canning factories.

The number of boats and the manpower involved in the traditional artisanal fishery are unknown, but they are increasing, so we can conclude that the trends in effort and tuna and seerfish exploitation are also increasing.

## MATERIALS AND METHODS

Catch data for tuna and seerfish were collected by the statistics branch of the MSRC. Biological samples and data for tuna and seerfish were collected randomly from traditional artisanal fish-landing sites, mainly from Mukalla, al-Sherher, Aden, Imran and Soctra, and also at sea during surveys and from a commercial tuna-fishing boat.

The type of data and biological samples collected were:

- individual fork length, to the nearest centimeter
- weight, in grams
- sexual maturity stage
- stomach contents
- caudal vertebrae

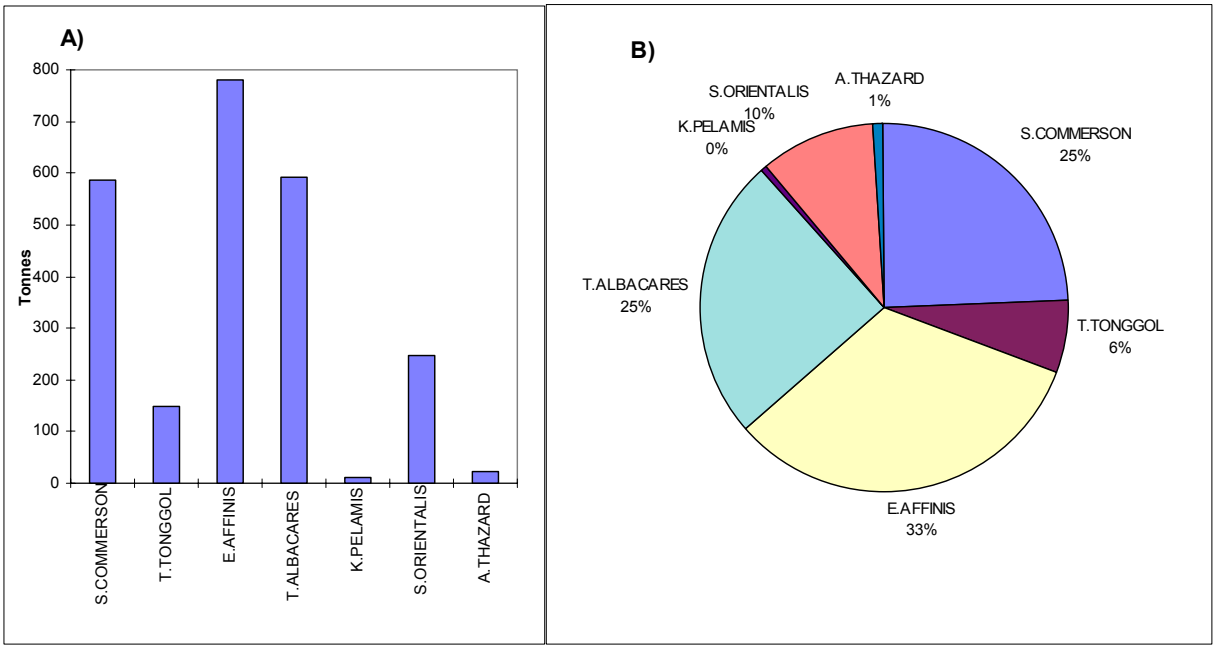
The catch was sorted into separate species groups, and the tuna and seerfish species were taxonomically classified with the help of FAO identification sheets for the Indian Ocean. Each species was grouped into 4 or 5 cm length groups for length-frequency analysis.

The following von Bertalanffy equation for estimating growth parameters was applied for tuna and seerfish:

$$L_t = L_\infty (1 - \exp(-K(t - t_0))$$

Growth parameters were estimated from length frequency at age of the modes from the length-frequency plot (Patterson method) and by counting the rings on caudal vertebrae. The length-weight relationship

***Figure 1**. Total catch of tuna species in 1989, in t (panel A) and as a percentage (panel B).*



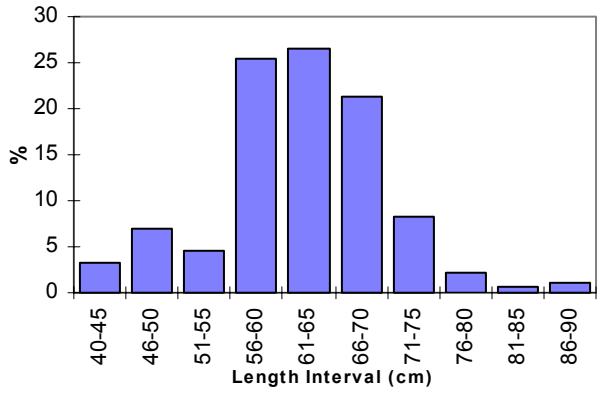

$W = aL^b$ was applied.

Lengths and weights were converted to logarithms, and the values of a and b were estimated from the slope of the straight line obtained from the plot of log($L$) and log($W$). Stomach contents and the sexual maturity stage of 240 specimens were examined.

## FISHING GEARS AND METHODS

The fishing craft operating along the coast of Yemen in the traditional fishery are mainly of two types, the larger *sambook* and the smaller *hoori*.

***Figure 2**. Length-frequency distribution of kawakawa caught offshore.*




### *Sambook*

*Sambooks* are 12 to 14 m long, 2 to 3 m wide, and are constructed from wood, or more recently fiberglass; most are mechanized, with either inboard or outboard gasoline engine of 15 to 45 hp. They operate 15 to 25 miles from shore, with crews of 4 to 6 persons. They use troll lines, handlines, small-purse seines, longlines, and surface gillnets. The catch is preserved either with ice or is salted and dried.

### *Hoori*

*Hooris* are from 3 to 11 m long and 1.5 to 2 m wide, constructed from either wood or fiberglass, and most are mechanised with outboard gasoline engines of 8 to 15 hp, with crews of about 2 to 5 persons. They use the same gears and methods as the *sambooks*.

The gears and methods commonly used by small-scale fisheries in both cooperative and private sectors are as follows:

- Longlines: for tuna, shark, and billfish
- Trolling: for pelagic fish species
- Gillnets and draftnets: for both pelagic and demersal species
- Small purse seines: for sardine, Indian mackerel, tuna and seerfish

## CATCHES

The total annual catch by the cooperative sectors along the south coast of Yemen exceeds 30,000 t, made up of a variety of species (Table 1 and Figure 1) of three categories:

- Large and small pelagic fishes
- Semi-pelagic fishes
- Demersal fishes

The table does not include the catches of the private sector, which amount to 20% of the cooperative production. At present the private sector is becoming more active and widespread, general, while the cooperative sector is declining.

**.Table 1** Catches (t) in Yemen by species, 1986-1989.

| *Species* | *1986* | *1987* | *1988* | *1989* |
|---|---|---|---|---|
| *Thunnus albacares* | 634.5 | 399.9 | 1,251.6 | 660.8 |
| *Thunnus tonggol* | 72.1 | 77.1 | 137.8 | 149.4 |
| *Euthynnus affinis* | 697.0 | 750.5 | 1,043.1 | 979.8 |
| *Auxis thazard* | 32.7 | 77.5 | 59.2 | 20.8 |
| *Katswonus pelamis* | 23.2 | 28.1 | 17.1 | 26.9 |
| *Sarda orientalis* | 0.0 | 7.7 | 48.2 | 246.8 |
| *Scomber. commerson* | 653.0 | 409.9 | 277.8 | 446.1 |
| *Rastrelliger kanagurta* | 702.2 | 410.2 | 152.3 | 297.9 |
| Anchovy | 498.5 | 10,135.5 | 8,341.1 | 5479.9 |
| *Sardinella logiceps* | 1,699.8 | 2,039.1 | 2,621.1 | 0.0 |
| *Selar crumenophthal.* | 27.8 | 34.2 | 17.9 | 56.1 |
| *Scomber japonicus* | 22.7 | 0.0 | 10.0 | 5.7 |
| *Rachycentron canadus* | 55.1 | 33.4 | 20.1 | 13.0 |
| *Istiophorus platypterus* | 24.8 | 39.9 | 189.7 | 190.8 |
| *Scomberoides tol* | 0.0 | 0.0 | 1.3 | 0.5 |
| *Carangoid. gymnostata* | 3.4 | 7.1 | 0.0 | 1.0 |
| *Caranx ignoblis* | 55.6 | 46.9 | 51.0 | 22.9 |
| *Caranx sexfaciatus* | 0.0 | 3.7 | 8.2 | 4.4 |
| *Trachinotus bluchii* | 56.7 | 88.8 | 104.1 | 20.8 |
| *Megalaspis cordila* | 2.5 | 1.1 | 6.9 | 9.5 |
| *Caranx sem* | 0.0 | 0.0 | 138.6 | 149.7 |
| *Gnathandon speciasus* | 23.7 | 26.3 | 114.2 | 44.0 |
| *Trachurus bailloni* | 0.0 | 0.0 | 2.3 | 1.0 |
| *Carango. fulvogutatus* | 46.5 | 109.5 | 0.0 | 0.0 |
| *Carangoides. Spp.* | 200.5 | 250.5 | 438.0 | 473.1 |
| *Scomberiodes lysan* | 11.7 | 0.8 | 1.1 | 1.9 |
| *Lutjanus coeruleanli* | 5.8 | 5.7 | 16.4 | 2.6 |
| Serranidae | 5.5 | 14.8 | 103.6 | 106.2 |
| *Epinphelus tauvina* | 0.0 | 0.0 | 0.1 | 0.0 |
| *Nemipterus japonicus* | 0.3 | 4.8 | 9.5 | 95.4 |
| *Lethrinus nebulosus* | 15.0 | 17.7 | 56.0 | 36.7 |
| *Lethrinus spp* | 16.0 | 10.9 | 10.7 | 32.8 |
| *Pomadasys maculatus* | 3.7 | 1.5 | 0.3 | 0.0 |
| *Sphraena jello* | 87.0 | 42.3 | 144.1 | 59.7 |
| *Sphyraena obustata* | 0.0 | 0.0 | 0.2 | 0.2 |
| *Argyrops spinifer* | 0.0 | 0.0 | 0.8 | 0.1 |
| *Psettodes erumei* | 4.3 | 2.1 | 1.7 | 0.5 |
| Shark | 3,085.7 | 4,529.9 | 4,371.0 | 3,254.8 |
| *Grinimugil orientalis* | 22.7 | 14.4 | 19.0 | 15.1 |
| *Elagatis bipinnulatus* | 0.0 | 24.4 | 1.5 | 12.6 |
| *Scomberoides comers.* | 86.8 | 112.7 | 54.9 | 22.0 |
| *Alectis indicus* | 0.1 | 0.0 | 1.6 | 0.1 |
| *Carangoid.chirysophr* | 5.6 | 11.0 | 52.4 | 30.0 |
| Others | 10,316.3 | 7,129.7 | 7,803.1 | 17,215.8 |

## TUNA CATCH BY SPECIES

### Kawakawa

Kawakawa is found along the coast of Yemen, where it is known as *shirwa*. It is caught during the whole year, mainly to the west of Aden and in the Mukalla area. It is one of the more profitable and productive fish in the traditional artisanal fishery. The total annual catch by the cooperative sector in 1988 exceeded 1,000 t (Table 1), and represented 37.2% of the total catch of species in this group. The mean length of the catch was about 62 cm, and the maximum length observed was 90 cm (Figure 2).

It is clear from the statistics for the various years that the catch is highest in the period from March to June, which is the best fishing season.

### Yellowfin tuna

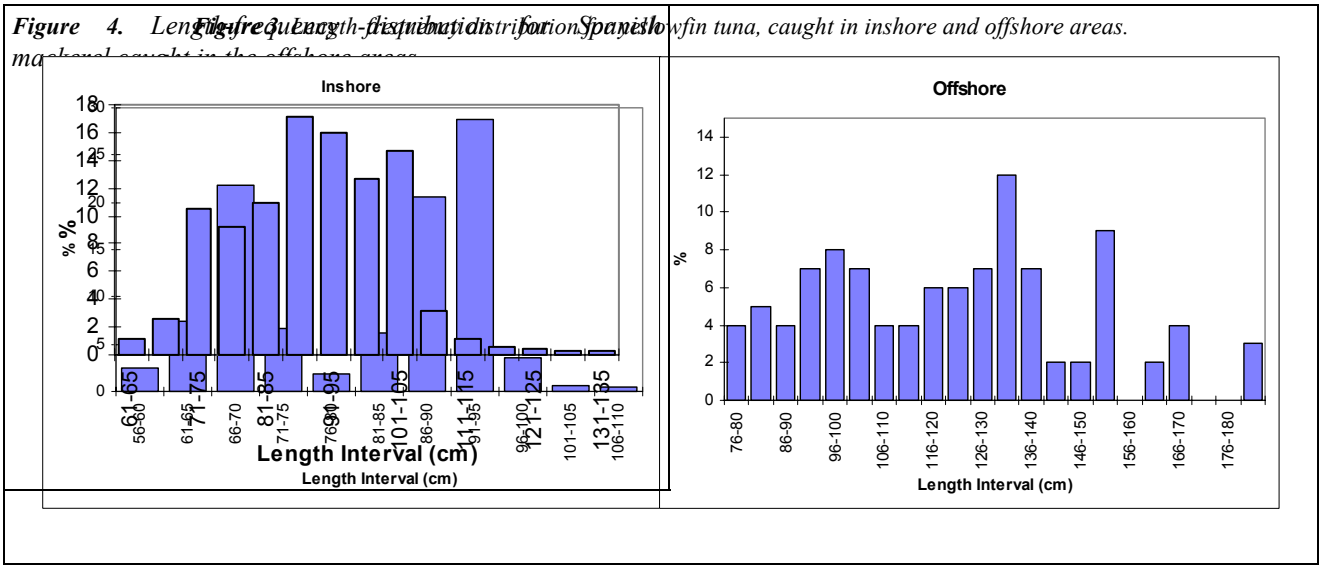
This species, which is widely distributed throughout the Indian Ocean, is found along the south coast of Yemen, especially the east part of the Gulf of Aden. Like skipjack tuna, it is an oceanic and migratory species, and appears seasonally, coming to the Gulf of Aden to feed before its breeding season starts. The fishing season for yellowfin is from October to December around Soctra and in the other coastal fishing grounds, with a peak in October. It is normally found at depths near the thermocline, and in the traditional artisanal fishery it is caught mainly with troll lines, small-purse seines, and longlines.

Yellowfin is a valuable and profitable fish in the local markets, where it is known as *Thamad.* The annual catch by cooperative sector exceeds 700 t, representing about 36.1% of the catch (Table 1).

In the commercial fishery the mean daily longline catch of yellowfin in April around Soctra at a depth of 200-300 m was 518 kg, or 18 fish of large size. The most common size in the catch was between 95 and 130 cm. The catch rate can be expected to increase if a more suitable period and area were selected.

Figure 3 shows the frequency distribution of yellowfin in the offshore and coastal areas. The size of the specimens in the former is greater: the maximum and the minimum size in the coastal area were 110 and 55cm, respectively, and in the

***Figure 4.*** *Length-frequency distribution for Spanish mackerel caught in the offshore areas.*




offshore area 185 and 75cm. The highest weight recorded was 100 kg, for a 160-cm fish. This pattern of distribution agrees with the literature, which says that as fish grow they moves to offshore areas.

**Spanish mackerel**

The narrow-barred Spanish mackerel is one of the most valuable fish in the local fish market, where it is known as *derrak* . It inhabits the coastal waters of Yemen, and particularly the Imran, Aden, Maqatin, Al-Sheher, Mukalla and Nishton areas. It breeds to the west of Aden, and juveniles migrate and spread to the east part of the Gulf of Aden with the help of strong currents generated by the northeast monsoon. It is caught during the whole year, and the main fishing gears and methods used are small purse seines,. troll lines, and gillnets.

The total catch by the cooperative sector is only about 500 t per annum, representing 19.2% of the total.

*S. commerson* is one of the fastest-growing fish. The maximum length is estimated to be 230 cm, and the mean length in the catch was 90 cm.

The size-frequency distribution by different gears shows that the smallest size group in the catch was 40 cm.

Juveniles and fishes smaller then 60 cm are distributed in the coastal area with the other pelagic fishes while the larger sizes are distributed in the offshore area.

**RESULTS**

1. From the catch composition of tuna and seerfish it is clear that the catch size of these species is fluctuating from year to year, and also varying within the same year with seasonal variations of the year. This is mainly because of the influence of the following factors:

- Meteorological conditions: During the wind season, particularly the southwest monsoon, known locally as *azyab*, when the sea is very rough, most of the fishermen in the artisanal fishery stop fishing.
- Hydrographic conditions: Especially the upwelling period, when the fish are redistributed. In these periods the fish are escaping from low oxygenated (6mg/L-1Mg/L) and cold (29,25,--17°C) water coming from the deep sea of the Indian Ocean. the pelagic fishes migrate to the offshore area while the demersal fish move to the shelf; when normal conditions return the fishes are redistributed again.
- Emigration and immigration of those migratory species which appear and disappear seasonally.

2. The distribution of tuna and seerfish in Yemen is characterized by the following:

- distribution of small size categories in the coastal area, while the large size categories are distributed in the offshore are.
- the distribution of large pelagic fish is related to the distribution of the small pelagic fish (prey-predator relationship).

In May 1994 the author observed near the Al Sheher fish landing area schools of striped bonito (*Sarda orientalis*) and kawakawa preying on sardine (*Sardinella logiceps*). Nearshore tuna and seerfish are high predators; they follow the schools of small pelagic fish, mainly oil sardine, chub mackerel, Indian mackerel, and other small pelagic fishes.

3. Production of skipjack tuna and frigate tuna are very low where kawakawa and yellowfin tuna occupy the highest peak of tuna production.

4. Examination of gonad maturation stage of 240 specimens of yellowfin tuna showed

- All sizes larger than 110 cm are sexually mature.
- In April they are in post-maturation stage, and are expected to breed in May-June.

5. Stomach content examination showed that yellowfin tuna mainly feed on small skipjack tuna, loligo, crabs, sardines, chub mackerel, sepia and unidentified juveniles of fishes.

6. The results obtained from the biometric study of tuna and seerfish were the following:-

| ***Species*** | $L_\infty$ | ***K*** | $t_o$ | ***a*** | ***b*** |
|---|---|---|---|---|---|
| Yellowfin tuna | 172 | 0.27 | 0.80 | 3.099*10 | 2.87 |
| Kawakawa | 92.1 | 0.23 | 0.31 | 0.030 | 2.83 |
| *S. commerson* | 230 | 0.12 | 0.01 | 0.011 | 2.85 |

## CONCLUSIONS

The stock of pelagic fish in Yemen is characterized by fluctuation of the biomass, which is highest in autumn and lower in winter/spring.

Catch composition varies with variation of the season.

Kawakawa and *S. commerson* are two of the predominant inhabitants on the coast of Yemen and are fished all year, while yellowfin and skipjack tuna are oceanic migrants and are fished seasonally.

The eastern part of the Gulf of Aden from Shuqra to the border of Oman and the area from Ras-Fartak to Socotra Island are the best fishing grounds for tuna-like fishes.

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