The Biometrics of Marine Fishes from the Gulf of Aden

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Abstract

The growth parameters (L_∞, K, t_0), total mortality and length-weight relationships of 23 species of fishes studied during a UNESCO-sponsored study of the fish populations of the Gulf of Aden, in the mid-1980s, are listed in tabular form, with a brief presentation of the methods used for their estimation.

Introduction

A study was made of marine teleost fish stocks and their biometrics in 1983-1987, based on data collected aboard R/V Ibin Magid, a 300-t Japan-built stern trawler and R/V Dr. Fridtjof Nansen, under the sponsorship of the Ministry of Fishwealth, Aden, PDR of Yemen, the Islamic Development Bank of Saudi Arabia and UNESCO, Paris. Due to reported overexploitation of the only natural resources of PDR Yemen by trawlers from the USSR, the principal aim of this study was to estimate sustainable yields and an appropriate management scheme.

This contribution summarizes the key results of this effort, whose final report (to the UNESCO Marine Science Division) has remained unpublished.

Methods

Trawl hauls of 1-3 hour duration were performed at depths of 10 and 130 m throughout the year in the area shown in Fig. 1. Specimens of all species

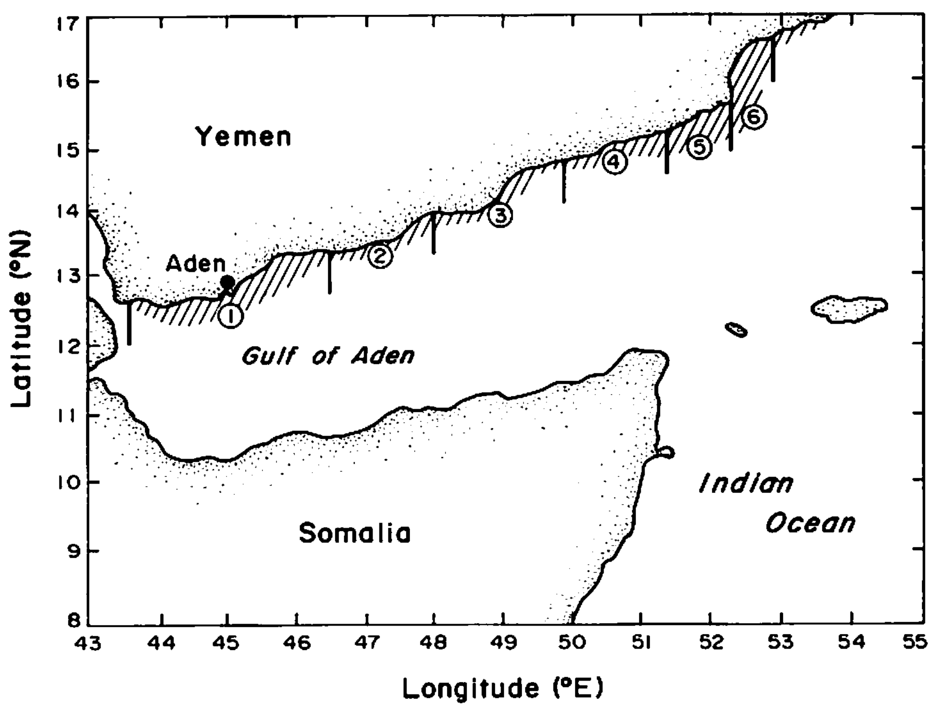

Fig. 1. Location of survey area (numbers refer to strata) in the Gulf of Aden, off the Yemeni coast. Shaded area indicates shelf (< 200 m depth).

studied were measured to the nearest cm (fork length), then weighted to the nearest g. Aging was performed by counting vertebral rings, presumed to be annual. This was far quicker than otolith reading and only needed a magnifying glass lens. Von Bertalanffy growth curves were fitted to the resulting length-at-age data. Total mortality rate (Z) was calculated from random trawl samples aged at sea; this was then compared to M estimated by using the formula of Pauly (1980) and/or by assuming M ≈ 2K (Beverton and Holt 1957). This allowed calculation of probable fishing mortality F from Z - M = F. Samples were also taken from the local oil sardine fishery (Edwards and Shaher 1985).

Results and Discussion

A summary of the biometric data collected for commercial species is given in Table 1 (see Sanders 1981 for results pertaining to the cuttlefish *Sepia pharaonis*).

Estimates of the standing stocks of demersal and pelagic fish and of potential yields (after Gulland 1968) were given by Kesteven et al. (1981), Strφmme (1984) and Edwards et al. (1985, 1987). The pelagic teleosts showed clear annual modes in length frequencies associated with spawning during upwelling (Edwards et al. 1985). Strφmme (1984) and Edwards et al. (1987) showed how, in August, monsoonal upwelling water of low oxygen but high nutrient content, pushed demersal fish inshore while the pelagic fish migrated offshore to avoid this water.

Concerning the growth parameters summarized in Table 1, Edwards et al. (1987) made the following conclusions:

1) The values of the curvature parameter K of the von Bertalanffy growth function (VBGF) for demersal fish were in the range 0.09-0.31, and in the range 0.39-0.67 year^{-1} for small pelagic fish.

2) Demersal fish recruited to the trawl fishery at three years of age on average, while for cuttlefish

Table 1. Key information on teleost fish caught in the Gulf of Aden.

Species	L_∞ (FL, cm)	L_{max} (FL, cm)	K (year^{-1})	t_0 (year)	Z (year^{-1})	M (year^{-1})	$W=a \cdot L^b$ a	b
Demersal species								
Acanthopagrus bifasciatus	49.8	41.5	0.25	-0.035	0.35	0.71	0.039	2.91
Argyrops spinifer	57.8	35.2	0.21	+0.026	0.39	0.54	0.111	2.54
Cheimerius variegatus	59.7	47.2	0.18	+0.022	-	0.41	0.044	2.80
Drepane punctata	46.5	37.6	0.19	+0.025	0.38	0.54	0.040	2.91
Epinephelus tauvina	150.0	106.8	0.09	+0.007	0.31	0.24	0.031	2.84
Lethrinus nebulosus	87.0	69.6	0.09	+0.540	0.44	0.44	0.035	2.81
Nemipterus japonicus	29.1	27.4	0.31	+0.048	0.67	0.85	0.025	2.87
Epinephelus diacanthus	57.0	52.7	0.21	+0.026	-	0.52	0.018	2.94
Pagellus affinis	60.5	37.0	0.14	+0.017	0.76	0.40	-	-
Plectorhynchus pictus	83.0	77.9	0.17	+0.025	0.37	0.43	0.144	2.42
Pomadasys maculatus	70.5	59.3	0.16	+0.019	0.35	0.43	0.067	2.62
Psettodes erumei	62.2	49.6	0.38	+0.462	-	0.76	0.011	3.10
Rachycentron canadum	160.0	113.9	0.09	+0.006	0.22	0.24	0.001	3.50
Saurida undosquamis	56.2	49.1	0.21	+0.026	0.44	0.55	0.010	3.03
Semi-pelagic species								
Alectis indicus	105.0	103.4	0.17	+0.018	0.35	0.40	0.081	2.57
Caranx ignobilis	152.0	67.1	0.08	+0.177	-	0.21	0.067	2.67
Gnathanodon speciosus	103.6	81.7	0.14	+0.015	-	0.34	0.071	2.68
Sphyraena jello	148.4	128.3	0.10	+0.009	-	0.25	0.028	2.60
Pelagic species								
Scomber japonicus	53.0	36.5	0.28	+0.040	-	0.66	-	-
Rastrelliger kanagurta	32.3	29.6	0.67	+0.695	-	1.48	0.017	3.01
Sardinella longiceps	24.0	24.8	0.55	+0.091	-	1.23	0.009	3.02
Scomberomorus commerson	230.3	116.1	0.12	+0.010	0.44	0.38	0.011	2.85
Trachurus indicus	34.0	30.7	0.39	+0.060	-	0.94	0.004	3.38

this was 1.5 years (Sanders 1981), and less than one year for penaeid shrimps;

3) Total mortality coefficients (Z) were in the 0.22-0.67 range (i.e., 20 to 49% year^{-1}) for demersal fish, and 0.91-1.10 (60 to 67% year^{-1}) for small pelagic fish. For large pelagic fish, the mean Z value was 0.44 (38% year^{-1}). The two groups of pelagic fishes were mainly caught by the (small) coastal artisanal fishery. A general figure for fishing mortality (F) for demersal fish was 0.13 year^{-1} (12% year^{-1}), if M ≈ 2K.

4) The total small pelagic fish stock was around 300 t·10^3; the stock of large pelagic fish, including bonito, tuna and Spanish mackerel was 16 t·10^3. Sustainable annual yield for pelagic fish as a whole was estimated at 87 t·10^3.

5) Total demersal fish stocks have been reduced by USSR trawlers from 290 t·10^3 in 1969-1970 to 116 t·10^3 in 1985. This leads to a sustainable yield of 11.6 t·10^3 year^{-1} without accounting for recruitment, possibly of around 10% year^{-1}). Cuttlefish were reduced to 10 t·10^3 t by 1986 (see Sanders 1981).

6) The maximum biomass of demersal fish varied by depth and season and ranged from 6 t·km^{-2} at 30 m depth in October to 10 t·km^{-2} in depths of less than 20 m during upwelling in August (Strφmme 1984).

7) Large changes in stock composition by taxa, caused by trawling, occurred in the period 1967-1980, with an increase in the proportion of "trash" fish possibly caused by the return of live rejected fish to the sea (Sanders 1981).

The errors in estimating standing stocks of tropical demersal fish from trawl catches are probably obvious enough, although these were not considered by Shindo (1972) in the South China Sea. These were realized by Edwards (1983) and Edwards et al. (1985) following Pauly (1979). Different species have differing abilities to avoid an approaching trawl. Groupers (Serranidae), lizard fish (Synodontidae), Malabar soles (Cynoglossidae) and hakes (Psettodidae) tend to "stay put"; sea breams (Sparidae) are active swimmers which take evasive action. This also applies to the Carangidae (jacks, scads, trevallies, pompanos) and to the Sphyraenidae (barracudas) which are semipelagic and schooling, so that parts of schools or entire schools occur at depths above the trawl headline. Carcharhinid sharks also easily avoid trawls (Edwards 1983). For these reasons trawl catches do not give an accurate estimate of stock composition by taxa.

Acknowledgements

The authors are grateful to Dr. Daniel Pauly, ICLARM, for encouraging preparation of this article. Thanks are due to Capt. Mustafa A. Nasser and the crew of R/V Ibin Magid and to Dr. Tor Strφmme, Capt. Rolfe Drange and the crew of R/V Dr. Fridtjof Nansen, FAO/NORAD. Members of the Ministry of Fishwealth, Aden, who took part were S. Shaher, A. Bakhader, A. Ghaddaf, S. Aklan, A. Hakim, H. Mohamed, B. Nagi, A. Hammadi, A. Dahabeli. The final report was typed by Ms. H. Mohamed.

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