Growth and Mortality of Indian Mackerel *Rastrelliger kanagurta* (Scombridae) in the Visayas Sea, Central Philippines*

MAY R. GUANCO
Department of Agriculture - Region 6
RIARC, Iloilo City
Philippines

Abstract

The growth of Indian mackerel *Rastrelliger kanagurta* in the Visayas Sea, central Philippines, is estimated, based on length-frequency data from 1983 to 1987 and the Compleat ELEFAN program. Results are TL_∞ = 38 cm and K = 0.8 year^{-1}. These estimates are tentative and other vital statistics could not be estimated due to the absence of small fish in the available catch samples.

Introduction

The Indian mackerel, *Rastrelliger kanagurta* (Family Scombridae, Fig. 1) is the dominant pelagic species caught by trawlers operating in central Philippines and landing at the Iloilo Fishing Port Complex (Fig. 2). This study is intended to provide biological inputs for managing this important resource.

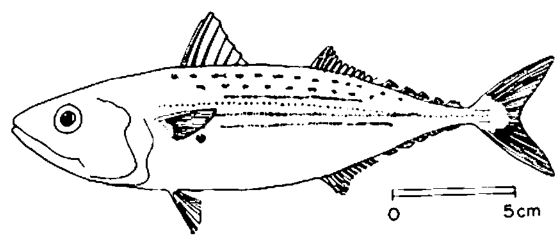

Fig. 1. The Indian mackerel *Rastrelliger kanagurta* (Family: Scombridae), or "bolao" in Visayan.

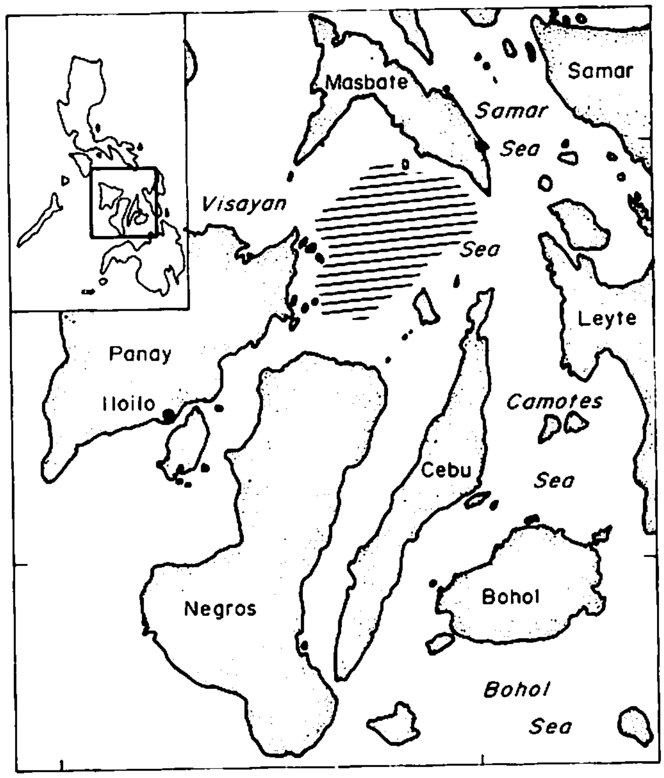

Fig. 2. Reported fishing ground, in the Visayan Sea, of the trawlers providing the catch samples used for this study.

Materials and Methods

This study is based on length-frequency (L/F) data collected from 1983 to 1987 in the frame of the Regional Stock Assessment Program implemented by the Philippine Council for Aquatic and Marine Research and Development (PCAMRD) and the Bureau of Fisheries and Aquatic Resources (BFAR).

Data were sampled from the landings of commercial trawlers at the Iloilo Fishing Port Complex every other two days with a total of 10 sampling days a month from 1983 to 1987. Other data such as length/weight measurements, catches, duration of fishing trip (from and to), location of fishing ground and gear specification were also recorded.

The original L/F data were pooled into a single "artificial year" and subsequently analyzed using the Compleat ELEFAN Software of Gayanilo et al. (1989).

Growth in fishes is commonly described by the von Bertalanffy growth function (VBGF) which takes, for length, the form:

$$L_t = L_\infty(1-e^{-K(t-t_o)})$$

*Written during a study stage at ICLARM (16-27 September 1991), funded by the US Agency for International Development through Philippine Council for Aquatic and Marine Research and Development (PCAMRD).

where L_t is length at age t, L_∞ is the asymptotic size, K is a growth constant and t_0 is the curve origin. The ELEFAN I was used to fit successive growth curves to the "restructured" sequential length-frequency data given iterations of L_∞ and K. The restructuring was performed using a modification of the running average method described by Pauly and David (1981).

Estimates of L_∞ independent of ELEFAN I were also obtained using a Wetherall plot, as incorporated in ELEFAN II (Pauly 1986; Wetherall 1986; Gayanilo et al. 1989).

Total mortality rate (Z) was determined from length-converted catch curve (Pauly 1984); natural mortality rate (M) was estimated from the empirical equation of Pauly (1984), i.e.:

$$\log_{10}M = 0.0066 - 0.279\log_{10}L_\infty + 0.6543\log_{10}K + 0.4634\log_{10}T$$

where L_∞ and K are parameters of the VBGF and T is mean environmental temperature, here taken as 28.3°C (Dalzell and Ganaden 1987).

Comparison of the growth performance of various stocks of *R. kanagurta* were performed based on the ϕ' index of Pauly and Munro (1984), viz.:

$$\phi' = \log_{10}K + 2\log_{10}L_\infty$$

where L_∞ is conventionally expressed in cm (total length) and K put on an annual basis.

Munro (1983), working on coral reef fishes, demonstrated the uniformity of ϕ' within taxonomical groupings. Indeed, it emerged that ϕ' was normally distributed in each species represented by a number of stocks. This allows for the estimation of K from L_∞ in a given stock (i), using

$$\log_{10}K_i = \bar{\phi}' - 2\log_{10}L_\infty$$

where $\bar{\phi}'$ is the mean of a set of values of ϕ' obtained from a number of stocks of the same species. [This method was used here due to the absence of small fish in the L/F data, and the difficulty this caused in reliably estimating K].

Results and Discussion

The Wetherall plot (not shown) was difficult to interpret, as only a few large length classes (above 30 cm) appeared to be completely recruited to the

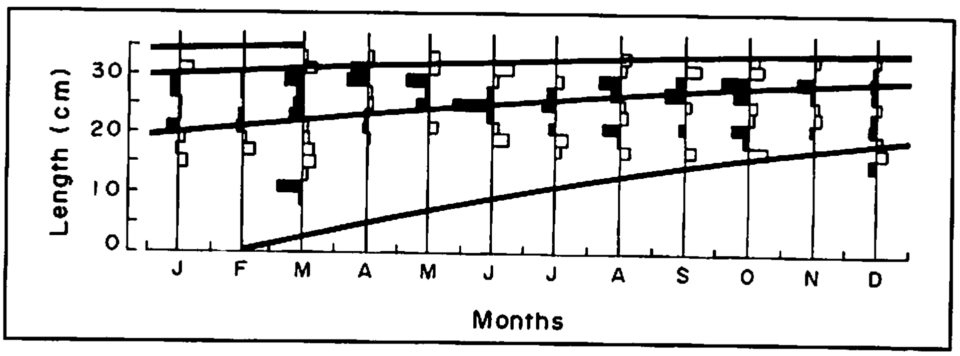

Fig. 3. Estimated growth curve for *R. kanagurta* in the Visayan Sea (L_∞ = 38 cm, K = 0.8 $year^{-1}$), and the restructured length-frequency data (1983-1987, pooled) from which this was derived. Note the scarcity of fish > 15 cm.

Table 1. Growth parameters of *R. kanagurta* in the Philippines, as reported or estimated (based on BFAR files) by Tandog-Edralin et al. (1987), and as estimated here.

Area	Year	Sources	TL_∞(cm)	K($year^{-1}$)	ϕ'[a]
Palawan	1965	Ingles and Pauly (1984)	28.0	1.55	3.08[b]
Ragay Gulf	1981	Corpuz et al. (1985)	27.5	1.30	2.99
Illana Bay	1984	BFAR Files	39.0	0.72	3.04
Illana Bay	1983	BFAR Files	39.0	0.72	3.04
Samar Sea	1981	Corpuz et al. (1985)	28.5	1.31	3.03
Guimaras Strait	1985	BFAR Files	27.5	1.65	3.10
Samar Sea	1984	BFAR Files	26.5	1.60	3.05
Visayan Sea	1984	BFAR Files	37.0	0.70	2.98
Visayan Sea	1983	BFAR Files	29.5	1.50	3.12
Visayan Sea	83-87	This study	38.0	0.80	3.06

[a] $\phi' = \log_{10}K + 2\log_{10}L_\infty$ (Pauly and Munro 1984).
[b] and not 3.58, a typographical error in Tandog-Edralin et al. (1987).

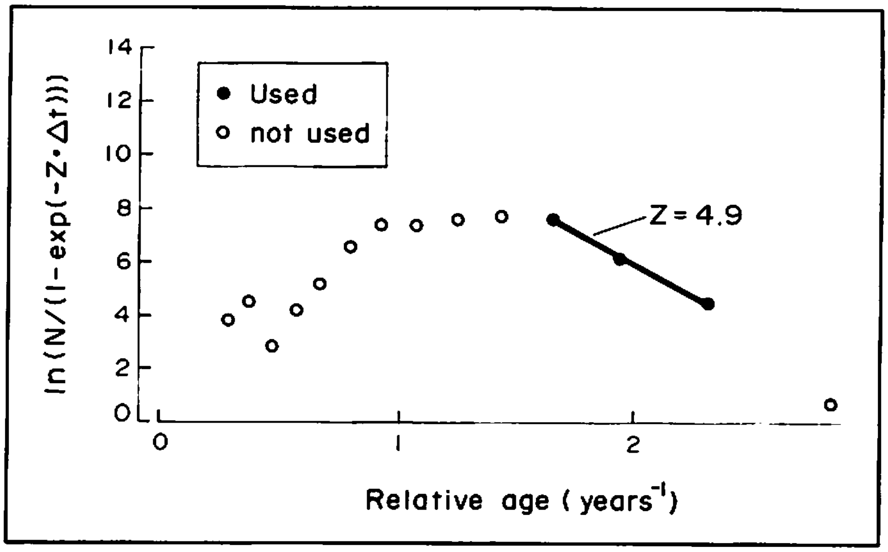

Fig. 4. Length-converted catch curve for trawl-caught *R. kanagurta* in the Visayan Sea. Note incomplete recruitment/selection up to relative ages of 1.5 year, with first usable point at 28 cm.

fishery and/or selected by the gear. One interpretation of the plot provided an estimate of 38.5 cm, and this, and our value of L_{max} = 36 cm, led us to set L_∞ = 38 cm.

This value of L_∞, used with the abovementioned pooled L/F dataset led to an estimate of K = 0.8 $year^{-1}$. Fig. 3 shows the corresponding growth curve, superimposed on the (restructured) L/F data for an artificial year.

As might be seen from Table 1, L_∞ = 38 cm and K = 0.8 $year^{-1}$ lead to a value of ϕ' very close to the mean (=3.05) of the ϕ' values reported for *R. kanagurta* in the Philippines, although our L_∞ is higher than all previous estimates.

Fig. 4 shows the length-converted catch curve derived from the L/F data and growth parameter estimates at hand. This confirms the observation above that only large *R. kanagurta* are fully recruited to and/or selected by the fishery, and that, hence, little confidence can be given to the estimates of mortality (tentatively: Z = 4.92, M = 1.44, F = 3.48 $year^{-1}$ and E = F/Z =0.72).

Detailed inferences on the recruitment pattern of *R. kanagurta* in the Visayan Sea are not possible - again due to the absence of small fishes in the L/F samples. However, Fig. 4 suggests the existence of a second cohort, in addition to the one to which the growth curve was fitted, as also reported from a large number of Philippine fishes (Ingles and Pauly 1984).

This study, similar to that conducted by Jabat and Dalzell (1988), emphasizes the need, when studying growth, to obtain length-frequency samples that include small fish, and hence also underscores for fishery-independent sampling of stock assessment data.

Acknowledgements

Special thanks go to Mr. R. Ladrido, A. Legaspi and G. Dello for collecting data samples, and to Dr. D. Pauly, Mr. Francisco Torres, Jr. and Mr. Felimon Gayanilo, Jr. for their support during my stay at ICLARM.

References

Corpuz, A., J. Saeger and V. Sambilay, Jr. 1985. Population parameters of commercially important fishes of the Philippines. Univ. Philipp. in the Visayas, Coll. of Fisheries, Tech. Rep. Dept. Mar. Fish. 6: 1-100.

Gayanilo, F.C., Jr., M. Soriano and D. Pauly. 1989. A draft guide to the Compleat ELEFAN. ICLARM Software 2, 70 p.

Ingles, J. and D. Pauly. 1984. An atlas of the growth, mortality and recruitment of Philippine fishes. ICLARM Tech. Rep. 13, 127 p.

Jabat, M. and P. Dalzell. 1988. Preliminary stock assessment of the Davao ring net fishery of bullet tuna, central Visayas, Philippines. BFAR Tech. Pap. Vol. XI. No. 1.

Munro, J.L. 1983. Epikogue: progress in coral reef fisheries research, 1973-1982, p. 249-276. *In* J.L. Munro (ed.) Caribbean coral reef fishery resources. ICLARM Stud. Rev. 7, 276 p.

Pauly, D. 1984. Fish population dynamics in tropical waters: a manual for use with programmable calculators. ICLARM Stud. Rev. 8, 325 p.

Pauly, D. and N. David. 1982. A BASIC program for the objective extraction of growth parameters from length-frequency data. Meeresforsch./Rep. Mar. Res. 28(4): 205-211.

Pauly, D. and J.L. Munro. 1984. Once more on growth comparisons in fish and aquatic invertebrates. Fishbyte 2(1): 21.

Tandog-Edralin, D.D., E.Z. Cortez-Zaragoza, P. Dalzell and D. Pauly. 1987. Some aspects of the biology and population dynamics of skipjack (*Katsuwonus pelamis*) in Philippine waters, p. 100-111. *In* Reports of the Second Meeting of the Tuna Research Groups in the Southeast Asian Region, Manila, Philippines, 25-28 August 1987. Indo-Pacific Tuna Development and Management Programme, IPTP/87/GEN/12 Colombo. 154 p.

Wetherall, J. 1986. A new method for estimating growth and mortality parameters from length-frequency data. Fishbyte 4(10): 12-14.