

- b) computation of ϕ' ($= \log_{10}K + 2\log_{10}L_{\infty}$) from previous estimates of growth parameters in other populations of the same species (two cases), or related species (one case);
- c) estimation of K from the ϕ' and L_{∞} values; and
- d) construction of length-converted catch curves, from which total mortality (Z) and ancillary statistics are estimated.

This methodology, building on Pauly (1980, 1987), is fully documented in Venema et al. (1988), and was implemented using a beta version of the FiSAT software package (Pauly and Sparre 1991).

This led to the results summarized in Table 2 from which the following can be seen:

- estimated mean sizes at first capture are rather large, ranging from 32 cm in *C. sonnerati* to 42 cm in *E. chlorostigma*;
- the mean of the three estimates of fishing mortality in Table 1 ($F = 0.26 \text{ year}^{-1}$) is rather low compared with the mean of the estimates of natural mortality ($M = 0.35 \text{ year}^{-1}$)

These results suggest, albeit very tentatively, that the stocks from which the samples in Table 1 originated were lightly fished.

Table 2. Summary of statistics estimated from the length-frequency data in Table 1.

Statistic (Unit)	<i>Cephalopholis sonnerati</i>	<i>Epinephelus areolatus</i>	<i>Epinephelus chlorostigma</i>
TL_{∞} (cm)	50.2	49.4	69.1
ϕ'	2.315 ^a	2.644 ^b	2.191 ^b
K (year^{-1})	0.082	0.18	0.17
Z (year^{-1})	0.21	1.19	0.44
M (year^{-1}) ^c	0.25	0.43	0.38
F (year^{-1})	(-0.04) ^d	0.76	0.06

^a Mean ϕ' for related grouper species.

^b From growth parameters for the same species in Kuwait (Mathews and Samuel 1987).

^c Based on an annual mean habitat (bottom water) temperature of 20°C (from Bouhlel 1988).

^d Not a possible value, but indicating low F, and thus used to compute mean of three species.

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Comparative Growth Performance of Jack Mackerels of the Genus *Trachurus*, with Emphasis on *T. symmetricus murphyi* in Chile

LUIS S. CUBILLOS
HUGO F. ARANCIBIA

Abstract

This contribution presents von Bertalanffy growth parameter estimates for species/stocks of jack mackerels of the genus *Trachurus* from around the world, and compares these with growth parameters for *T. symmetricus murphyi* caught off central-southern Chile (33°S-

39°S). It is found that *Trachurus* stocks inhabiting upwelling areas such as the Humboldt and Benguela current systems grow better than their ecological equivalents in temperate waters, such as the North Sea. The von Bertalanffy growth parameters estimated for Chilean horse mackerel are: $FL_{\infty} = 65.2 \text{ cm}$ ($TL_{\infty} = 71.6 \text{ cm}$) and $K = 0.138 \text{ year}^{-1}$.

Introduction

Growth parameter estimates for different stocks of a given species can be usefully compared via the ϕ' growth performance index of Pauly and Munro (1984), based on Pauly (1979), and computed from the von Bertalanffy parameters L_{∞} and K (see also Venema et al. 1988). Thus, when growth data are not available for a specific stock, a mean value of ϕ' can be estimated from other stocks of the same species, and ϕ' used in conjunction with an estimate of L_{∞} to indirectly obtain an estimate of the K parameter.

Furthermore, "it is likely that the value of $[\phi']$ represents and quantifies the energetics of a given habitat or niche because $[\phi']$ is directly related to growth performance and hence metabolism and food consumption" (Munro and Pauly 1983).

Considering the worldwide distribution and considerable ecological and economic importance of the genus *Trachurus*, the objectives of this contribution are: (1) to present a summary of the von Bertalanffy and growth performance indices of different *Trachurus* stocks from around the world; and (2) to estimate the growth parameters for horse mackerel caught off central-southern Chile (33°S-39°S), for which previous estimates exist which are mutually incompatible (Kaiser 1973; Aguayo et al. 1981). [Also note that the taxonomic status of this species is far from clear (Parrish 1989)].

Materials and Methods

Length-at-age data, or L_{∞} and K estimates for *Trachurus* stocks from around the world were obtained from the literature, then grouped by species and regions. When growth parameters had not been estimated, this was done by fitting the available length-at-age data pairs with the von Bertalanffy growth function using the nonlinear routine incorporated in the FISHPARM package (Saila et al. 1988).

Subsequently, the growth performance of the different stocks was compared using the ϕ' index of Pauly and Munro (1984), i.e.,

$$\phi' = \text{Log}_{10}K + 2\text{Log}_{10}L_{\infty} \quad \dots(1)$$

To estimate the growth parameter of horse mackerel caught off central-southern Chile, annual length-frequency data (fork length, FL), raised to the total annual catches from the fishery, for the period 1982 to 1991, were used to obtain an average length-frequency sample roughly representative of the steady-state population. Subsequently, an estimate of the asymptotic length was

obtained by using the Wetherall (1986) method as modified by Pauly (1986) and incorporated in the Compleat ELEFAN software package of Gayanilo et al. (1988). The estimate of FL_{∞} obtained in this fashion was converted to TL_{∞} using the relationship:

$$TL_{(\text{cm})} = 0.5 + 1.091 FL_{(\text{cm})} \quad (n = 125; r^2 = 0.95) \quad \dots(2)$$

Then, TL_{∞} was used in conjunction with the average value of ϕ' for *T. symmetricus murphyi* to estimate K .

Results and Discussion

The growth parameters and the ϕ' values computed for various stocks of *Trachurus* are listed in Table 1.

An ANOVA test of the ϕ' values of *T. trachurus*, *T. trachurus capensis* and *T. symmetricus murphyi* shows that there are significant differences in the mean ϕ' of those species ($P < 0.01$). This suggests that *T. symmetricus murphyi* grows better, as a whole, than the other *Trachurus* stocks. *T. capensis* also has high values of ϕ' , suggesting that horse mackerel stocks inhabiting upwelling areas, where they may have an enormous predatory impact (Muck and Sanchez (1987), grow better than their ecological equivalents in other areas. This would validate Munro and Pauly's interpretation of ϕ' .

The average catch composition of *T. symmetricus murphyi* from central-southern Chile is shown on Fig. 1, left panel. From this, the modified Wetherall plot (Fig. 1, right panel) yielded an estimate of FL_{∞} 65.2 cm (TL_{∞} 71.6 cm), compatible with the maximum size of 60 cm FL observed, off New Zealand, by Russian researchers (A. Grechina, pers. comm.).

The asymptotic length and the mean value of $\phi' = 2.85$ for this species led to an estimate of $K = 0.138 \text{ year}^{-1}$.

We believe that our estimates of L_{∞} and K adequately describe the growth of the fraction of the population of *T. symmetricus murphyi* caught along the central-southern area of Chile.

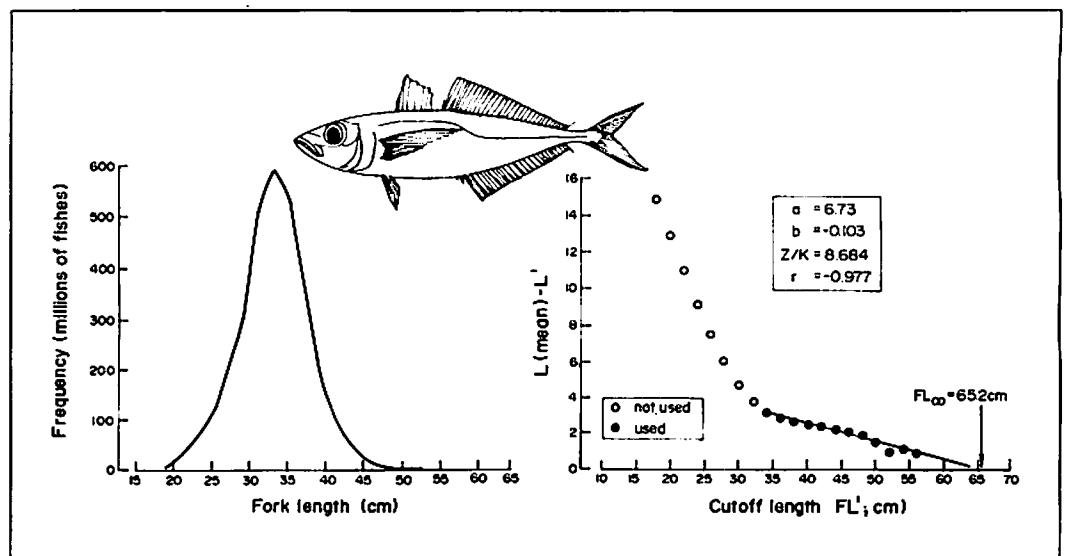


Fig. 1. (A) Average catch at length composition (1982-1991) of Chilean horse mackerel in the central-southern region, with Talcahuano (37°S) as their main port of landings. (B) Modified Wetherall plot for estimating asymptotic length from the data shown in (A).

Table 1. Growth parameters and growth performance index (ϕ') for the horse mackerel stocks (genus *Trachurus*), as reported from various authors.

Species and region	TL _∞ (cm)	K (year ⁻¹)	ϕ'	Source
<i>T. trachurus</i> , North Atlantic:				
ICES Subarea VIII-f	46.07	0.170	2.557	Trouvery (1977)
ICES Subarea VIIIb	47.86	0.156	2.553	Trouvery (1977)
ICES Subarea VIIIa	49.09	0.144	2.540	Trouvery (1977)
Celtic Sea/G. of Gascogne	45.28	0.201	2.615	Trouvery (1977)
English Channel	40.20	0.137	2.345	Nazarov (1978)
Celtic Sea/Bay of Biscay	44.94	0.123	2.395	Nazarov (1978)
North Sea	33.85	0.289	2.520	Nazarov (1978)
ICES Subarea IX/N	40.45	0.248	2.608	Lourdes et al. (1978)
ICES Subarea IX/S	58.11	0.122	2.615	Lourdes et al. (1978)
Galician shelf	41.57	0.195	2.528	Fariña (1983)
W. Great Britain/Ireland	41.59	0.223	2.586	Kerstan (1985)
Western Iberian waters	40.36	0.290	2.674	Borges (1991)
Western Iberian waters	42.93	0.240	2.646	Borges (1991)
Western Iberian waters	50.00	0.140	2.544	Borges (1991)
<i>T. trachurus capensis</i> , South-East Atlantic:				
ICSEAF Division 1.6	54.30	0.127	2.573	Geldenhuis (1973)
ICSEAF Division 1.0	47.00	0.250	2.742	Kompowski and Słószarczyk (1975)
ICSEAF Division 1.3/1.4	56.40	0.110	2.544	Terré (1976)
ICSEAF Division 1.3/1.4	55.00	0.110	2.522	Wengrzyn (1976)
ICSEAF Division 1.3/1.4	62.60	0.109	2.631	Babayán and Bulgakova (1983)
ICSEAF Division 2.1	43.50	0.426	2.906	Uozumi and Kawahara (1983)
ICSEAF Division 1.3	52.40	0.130	2.553	Sosa (1981)
ICSEAF Division 2.1/2.2	50.30	0.427	3.034	Hecht (1990)
ICSEAF Div. 1.6/2.1/2.2	48.80	0.556	3.122	Nalsh et al. (1991)
<i>T. japonicus</i> , North-West Pacific:				
Japan	51.20	0.280	2.866	Pauly (1980)
<i>T. indicus</i> , Indian Ocean:				
Gulf of Aden	34.00*	0.390	2.654	Edwards and Shafer (1991)
<i>T. declivis</i> , South-West Pacific:				
South-East Australia	46.40	0.200	2.634	Stevens and Hausfeld (1982)
Great Australian Bight	41.70	0.190	2.519	Stevens et al. (1984)
<i>T. symmetricus symmetricus</i> , North-East Pacific:				
Southern California Bight	60.29	0.094	2.534	Wine and Knaggs (1975)
<i>T. symmetricus murphyi</i> , South-East Pacific:				
Coastal waters off Chile	92.70*	0.140	3.080	Kaiser (1973)
Off Valparaíso (Chile)	116.49*	0.110	3.174	Pavez and Saa (1978)
Oceanic waters off Peru	79.07*	0.090	2.750	Abramov and Kotlyar (1980)
Off Talcahuano (Chile)	49.06*	0.180	2.637	Aguayo et al. (1981)
Oceanic waters off Chile	81.58*	0.090	2.777	Nekrasov (1982)
Oceanic waters off Chile	99.14*	0.120	3.072	Shevshuk and Chur (1984)
Central southern Chile	71.65*	0.070	2.556	Castillo and Arrizaga (1987)
Oceanic waters off Chile	105.14*	0.060	2.822	Nekrasov (1987)
Oceanic waters off Chile	85.39*	0.080	2.766	Nosov et al. (1989)
Oceanic waters off Chile	81.47*	0.111	2.867	Kochkin (in press)

*Total length transformed by using equation (2).

Table 2. Mean growth performance index (ϕ') of various species of *Trachurus*.

	ϕ'	s.d.	c.v.	n
<i>T. trachurus</i>	2.552	0.090	3.527	14
<i>T. trachurus capensis</i>	2.736	0.229	8.378	9
<i>T. japonicus</i>	2.866	-	-	1
<i>T. indicus</i>	2.654	-	-	1
<i>T. declivis</i>	2.577	0.081	3.156	2
<i>T. symmetricus symmetricus</i>	2.534	-	-	1
<i>T. symmetricus murphyi</i>	2.850	0.201	7.041	10

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L.S. CUBILLOS and H.F. ARANCIBIA are from the Instituto de Investigación Pesquera, Octava Región, Casilla 350, Talcahuano, Chile.

NEWS ITEMS

Spring Lobster Workshop

A WORKSHOP on the fisheries management of, and artificial shelters for spiny lobsters, will be held in Havana, Cuba, on 17-21 October 1994. Spiny lobster is the most valuable commercial fishery in Cuban and adjacent waters. Scientists engaged in the exploitation of this important resource are invited. For further information, please contact Lic. Marisela Hernández Ceballos, Secretary, Organizing Committee, Centro de Investigaciones Pesqueras, 5ta. Ave. y 248, Barlovento, Santa Fé, La Habana,

Cuba; Tel. (537) 227089/233614; Fax: (537) 311108/331534.

On Board

FROM 1989 TO 1993, the Organization of Eastern Caribbean States (OECS) Fisheries Unit published a newsletter called *On Board* dealing with the fisheries industry of the member countries (the British Virgin Islands, St. Kitts and Nevis, Dominica, Antigua and Barbuda, St. Lucia, Montserrat, St. Vincent and the Grenadines, and Grenade), and related development issues.

Edited by Mike Findlay, this 8-page

Newsletter brought a lively mix of news items on industry developments, descriptions of local fisheries, report on training courses for the members of fishers cooperative and fisheries officers, etc.

On Board also reported on efforts to standardize the acquisition and archival of fisheries data, initiated by Peter Murray, the Data Management Officer of the OECS Fisheries Unit, an important area of work for that unit.

Unfortunately, due to lack of funds, *On Board* was discontinued *pro term*; some back issues can be obtained by writing to either of the above mentioned