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Population Dynamics of Trenched Sardine *Amblygaster sirm* (Clupeidae) in the Western Coastal Waters of Sri Lanka

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Abstract

Length-frequency data for trenched sardine *Amblygaster sirm* (Clupeidae) from western coastal waters of Sri Lanka, obtained over a period of three years, were analyzed using the Compleat ELEFAN software. The mean asymptotic length and growth coefficient (K) were estimated to be 25.23 cm and 1.25 year^{-1}, respectively. The instantaneous total mortality coefficient, natural mortality coefficient and fishing mortality coefficient were estimated to be 2.75 year^{-1}, 1.30 year^{-1} and 1.45 year^{-1}, respectively. The exploitation rate (E=F/Z) was over 0.5 indicating that the stock may be overexploited. Annual recruitment occurred as two unequal pulses separated by a 5-7 month interval. The mean size at entry into the fishery during the study period was 16.17 cm.

Introduction

The trenched sardine *Amblygaster sirm* is a pelagic clupeid species dominant in the fish catches of the western coast of Sri Lanka (Anon. 1984). Due to its importance in coastal fisheries, some work has recently been carried out on various aspects of its biology and fishery in Sri Lanka. A preliminary analysis of length frequency data was done in 1980-81 and 1983-84 to estimate the values of the growth paramters L_∞ and K of the von Bertalanffy growth equation (Siddeek et al. 1985; Karunasinghe, unpubl. data). Dayaratne (1984) estimated the same parameters using primary structures in the otoliths. Selectivity of *A. sirm* in the gill nets has also been studied recently (Dayaratne 1988; Karunasinghe and Wijeyaratne 1991).

Since *A. sirm* contributes about 25% of the small pelagic fish production of Sri Lanka (Anon. 1984), it is important to have good knowledge of the population dynamics of this species. This study investigated the growth, mortality and related statistics of *A. sirm* on the western coast of Sri Lanka.

Materials and Methods

Total lengths of *A. sirm* caught in gill nets ranging in mesh size from 2.3 to 3.8 cm were measured at fortnightly intervals over three years at the fish landing site at Negombo (Fig. 1) which is one of the major fish landing centers on the western coast of Sri Lanka. On each sampling day, about 150 specimens obtained from 10-15 boats were measured.

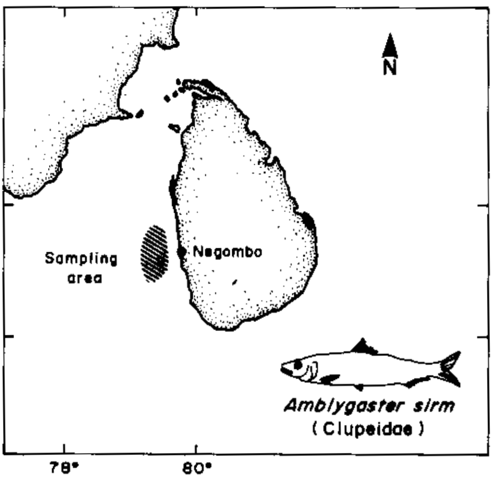

Fig. 1. Location of the sampling area.

The length-frequency distributions of *A. sirm* for each month were analyzed using the ELEFAN software package (Gayanilo et al. 1988), to estimate the parameters of the von Bertalanffy growth equation. The growth performance index ϕ, for the three consecutive years was estimated using the equation suggested by Pauly and Munro (1984):

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

Using the mean ϕ value and the mean L_∞, the mean K was estimated.

A length-converted catch curve was used to estimate the instantaneous total mortality coefficient from the pooled data of 1984-87 as described by Pauly (1984).

The natural mortality coefficient (M) was initially estimated using the multiple regression equation described by Pauly (1984).

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

where L_∞ = asymptotic length (cm); K = growth coefficient ($year^{-1}$); and T = temperature (°C).

The M value obtained here was multiplied by a factor of 0.6 as a corrective measure for clupeids (Pauly 1980).

Fishing mortality (F) was estimated by subtracting the value for natural mortality coefficient (M) from the total mortality coefficient (Z) as described by Ricker (1975); from this E=F/Z was also estimated.

The recruitment pattern was also derived for the 3-year period using the Compleat ELEFAN software (Gayanilo et al. 1988).

The approximate probabilities of capture of fish studied here were estimated by calculating the ratio between the points of the extrapolated descending arm and the corresponding values of the ascending arm of the length-converted catch curve as described in Gayanilo et al. 1988.

Results

The length-frequency distributions of *A. sirm* for the three years studied and the best growth curves estimated using the ELEFAN software are shown in Fig. 2. The values for asymptotic length (L_∞), von Bertalanffy growth coefficient (K) and growth performance index (ϕ) calculated for this stock are given in Table 1. The mean values estimated for L_∞ and ϕ were 25.23 cm and 2.9, respectively. The K value estimated using mean L_∞ and mean ϕ was 1.25 $year^{-1}$.

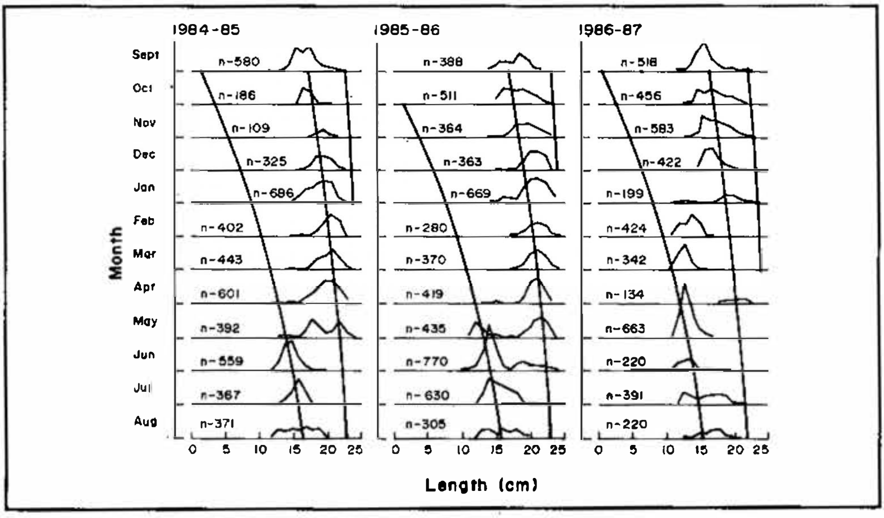

Fig. 2. Length-frequency distribution of *A. sirm* during the study period with estimated growth curves. Lines are drawn through the major recruitment pulse only. Effects of gear selectivity are shown in smallest size groups.

Table 1. The asymptotic length (L_∞), growth coefficient (K) and growth performance index (ϕ) for *A. sirm* during the study period.

Period	L_∞(cm)	K(year^{-1})	ϕ
1984-85	25.00	1.10	2.84
1985-86	24.90	1.20	2.87
1986-87	25.80	1.48	2.99.

The abundance of fish of ages corresponding to each 1-cm length class is shown in Fig. 3. The value for Z calculated from the data presented in this figure was 2.75 year^{-1}.

The values of M and F were 1.30 year^{-1} and 1.45 year^{-1}, respectively. The exploitation rate was estimated to be 0.527.

The recruitment pattern of *A. sirm* for 1984-87 is shown in Fig. 4. This shows one strong pulse, although the length-frequency distributions on Fig. 2 indicate the presence of two recruitments each year, of which one is very dominant.

The sizes of recruitment at 25, 50 and 75% probabilities of capture were 14.54, 16.17 and 17.81 cm, respectively.

Discussion

The growth parameters of *A. sirm* appeared to vary slightly from year to year during the period of investigation. Similar observations have been recorded by several workers for many species inhabiting tropical waters (Sucondharman et al. 1970; Hongskul 1972; Somjaiwong and Chullasorn 1974; Ingles and Pauly 1984; Corpuz et al. 1985; Siddeek et al. 1985). Earlier studies have shown that the asymptotic lengths for *A. sirm* in the western coastal waters of Sri Lanka during 1980-81 and 1983-84 were 24.75 and 24.80 cm, respectively (Siddeek et al. 1985). The asymptotic length and the von Bertalanffy growth coefficient estimated for *Rastrelliger brachysoma* from the Gulf of Thailand have varied

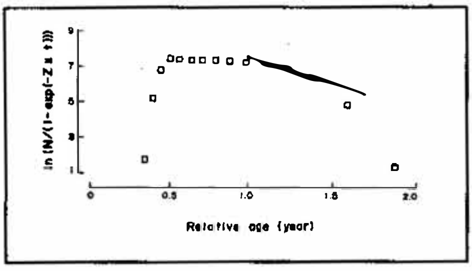

Fig. 3. Abundance of fish of different relative ages with estimated catch curve.

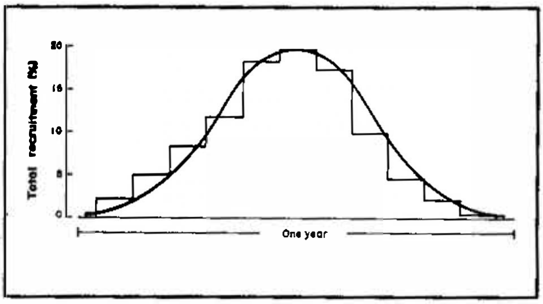

Fig. 4. Recruitment pattern of *A. sirm*, combined for 1984-87.

from 18.2 to 23.0 cm and from 1.56 to 4.2, respectively (Sucondharman et al. 1970; Hongskul 1972; Kurogane 1974; Somjaiwong and Chullasorn 1974). Similarly in Samara Sea, Thailand, L_∞ and K of *R. brachysoma* have varied from 24.5 to 25.5 cm and from 1.28 to 1.60, respectively (Ingles and Pauly 1984; Corpuz et al. 1985).

Values closer to the present estimates of L_∞ and K have been recorded for *A. sirm* in the Java Sea (Dwiponggo et al. 1986). According to the present average estimate of L_∞ and K, a length of 24.0 cm is achieved when the fish is about 29 months old. However, according to Chacko and Gnanamekalai (1963), *A. sirm* inhabiting the Gulf of Mannar achieve a length of 24.0 cm when they are 18 months old. Although the total length of the largest specimen recorded in the present study was 24.0 cm, individuals as large as 30.0 cm were observed in the Gulf of Mannar (Chacko and Gnanamekalai 1963). This could have been due to a misidentification of *A. clupeoides* which grows to a larger size than *A. sirm*.

The instantaneous natural mortality coefficient was lower than the estimate made by Siddeek et al. 1985. The exploitation rate estimated was over 0.5 indicating that the stocks may be overexploited.

The length-frequency distributions indicated the presence of two unequal recruitments separated by an interval of 5-7 months. Thus, the recruitment pattern on Fig. 4, which indicates the presence of one single recruitment may be due to the weak pulse getting obliterated in the pooled data for 1984-87.

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