## Editorial

This issue of *Fishbyte*-in-*Naga* is rather short, but this is not a portent of things to come: the next issues will be fat again! Thin as it is, this issue includes the usual mix of site- and species-specific papers (on anchovy in Ghana, and croaker in Kuwait) and methods-oriented papers. The star this time is - I believe - Djebali et al.'s paper on the estimation of M in Mediterranean fishes, a constructive answer to the global pretenses of my empirical model for estimating M. *D. Pauly*

# Size at First Maturity of the Anchovy (*Engraulis encrasicolus*) in Ghanaian Waters and Suggestions for Appropriate Mesh Size in Its Fishery

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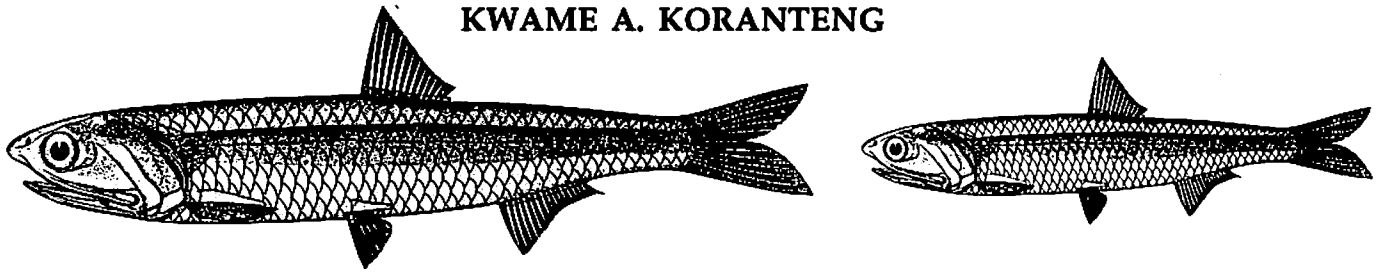


### Abstract

The mean length at first maturity of anchovy, *Engraulis encrasicolus* in Ghanaian waters has been estimated using length-frequency and gonad data sampled between June 1983 and September 1986 off Accra and Tema, Ghana.

The length at first maturity of these fish is around 5.7 cm (fork length). The minimum mesh size for rational exploitation of the resource in Ghanaian waters is put at about 20 mm (0.8 inch).


### Introduction

In the Gulf of Guinea, the so-called European anchovy, *Engraulis encrasicolus* (Linnaeus, 1758) is one of the most important marine fish species. In Ghana, anchovy contributed around 25% of total marine fish landings in the last five years. This amounts to an annual landing average of about 76,000 t. The record catch of nearly 88,000 t was in 1987.

In Ghana, anchovies are caught mainly by small-scale fishers using a very small-meshed purse seine gear called "poli" operated from dugout canoes. Tuna baitboats based in Tema and/or others operating in Ghanaian waters also exploit the anchovy as bait in their tuna fishing operations.

In recent years, these fishers have put considerable pressure to obtain a revision of the law that prohibits the use of any gear with meshes less than one inch (25 mm) for fishing in marine waters in Ghana (Ghana Fisheries Law 1991). The fishers claim that the use of such mesh size instead of the 3/8 inch (about 10 mm) stretched mesh that is normally used in "poli" net (Doyi 1984) will drastically reduce yields. It is further claimed that meshes of size between 10 and 25 mm gill the fish, which is disastrous for a purse seine fishery, as considerable time has to be spent to remove the fish from the net.

This work forms part of an investigation aimed at establishing a legal mesh size for the anchovy fishery in Ghana.

### Materials and Methods

Between June 1983 and September 1986, some 4,727 specimens of anchovy caught off Accra-Tema and adjacent areas in Ghanaian waters were measured; on each sampling occasion, a subsample was taken for dissection to determine the sex and the stage of maturity of the gonads. Here, all fish with small, transparent ovaries were classified as immature; and all those with ovaries containing visible eggs were considered to be mature. In the male testes, the presence of milky fluid was taken as indication of sexual maturity.

For each sex, the percentage of mature fish at every half cm fork length was calculated. A plot of fork length versus percentage mature was then produced for each sex. From the underlying sigmoid curve, and following Gunderson (1977) and Ni and Sandeman (1984), a logistic equation of the form

$$P = 1/\{1 + e^{-(a+bL)}\} \quad ...1)$$

was fitted, where P is the estimated proportion of mature fish at fork length L, and a and b are constants. The logit of equation (1) is given by

$$\text{logit } P = \text{Ln } [P/(1-P)] = a+bL \quad ...2)$$

The model was fitted using the GLIM statistical package (Baker and Nelder 1978). For P = 0.5, which defines the mean size at first maturity ($L_m$), we have Ln [P/(1-P)] = 0 and $L_m = a/b$.

To obtain a mesh size that will, in general, retain 50% of the fish of size $L_m$, i.e., for $L_c = L_m$, the relationship used was:

$$Lc = \text{selection factor} \times \text{mesh size} \quad ...3)$$

(Gulland 1983). This was used in conjuction with Pauly's (1984) nomogram, expressing the graphical relationship between the selection factor and depth ratio (= maximum girth/total length) or girth factor (= standard length/ depth) of fish.

## Results

Table 1 gives the frequency distribution of the fish considered in the analysis; as might be seen, the females tend to become larger than the males, and the female:male sex ratio increases with size.

**Table 1. Summary of data used for estimation of mean size at first maturity in *Engraulis encrasicholus* off Ghana.**

| Midlength* (FL,cm) | Females | | Males | | F/M |
|---|---|---|---|---|---|
| | No. | % mature | No. | % mature | |
| 3.75 | 40 | 0 | 77 | 0 | 0.52 |
| 4.75 | 174 | 36.8 | 225 | 28.4 | 0.77 |
| 5.75 | 254 | 52.8 | 402 | 74.1 | 0.63 |
| 6.75 | 596 | 72.7 | 762 | 66.1 | 0.78 |
| 7.75 | 523 | 64.2 | 695 | 55.3 | 0.75 |
| 8.75 | 357 | 79.8 | 390 | 74.1 | 0.92 |
| 9.75 | 129 | 98.4 | 78 | 89.7 | 1.65 |
| 10.75 | 20 | 100 | 5 | 100 | 4.00 |

*The frequencies were initially to the nearest 1/2 cm (fork length); they were adjusted to match the maturity data, measured as presented here, i.e., with 3.5, 4.0, 4.5 etc., as lower class limits.

From the fitted equations, $L_m$ was estimated to be 5.7 and 5.6 cm for female and male fish, respectively.

The depth ratio of anchovy was estimated as 6.64, and their girth factor 0.38. Using these estimates, the selection factor was calculated to be 3.48. From equation (4), and using $L_m$ for female fish, the mesh size to ensure, generally, that only mature fish are retained in the net, was calculated to be 1.64 cm (or 0.65 inch).

## Discussion

Macroscopic examination of the gonads of a small fish such as anchovy, especially of the very young ones, is fairly difficult. Looking at the per cent maturity values in Table 1, one clearly sees some inconsistencies, i.e., the unlikely decrease for fish between lengths of 5.75 and 7.75 cm. This defect in the data reduced the goodness of fit of the logistic model, and hence increased the variance of the estimate of $L_m$.

The $L_m$ estimate for the male fish was slightly less than that for the females. Since the "poli" or any other fishing net would not distinguish between the two sexes, and also because female spawning is the critical factor, the higher estimate of $L_m$, i.e., that for female fish, was considered more important for management purposes.

To ensure that the fish attain sexual maturity before being subjected to heavy exploitation, their length at first capture ($L_c$), which is determined by the mesh size of the net, should be larger than $L_m$. The mesh size necessary to ensure this must be bigger than 1.64 cm; a value of 2.0 cm (0.8 inch) may be thus, most appropriate, considering the uncertainty in the estimation of $L_m$.

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