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ESTIMATES OF INDIVIDUAL FECUNDITY IN THE SQUID *LOLIGO VULGARIS* (CEPHALOPODA: LOLIGINIDAE)

by

M.L. Coelho, S.S. Lopes and J.P. Andrade
UCTRA, Universidade do Algarve, Campus de Gambelas
8000 Faro, Portugal

ABSTRACT

This paper presents estimates of potential fecundity of the long-finned squid, *L. vulgaris*, which were assessed using both volumetric and stereological methods. The results show that the stereological method drives to higher values for potential fecundity, when compared to those calculated from the volumetric method, in this study, and in previous works. Furthermore, the results in this study, combined to the micro and macroscopic features of the ovary, strongly support that potential fecundity in this species should be determined in maturing females in macroscopic stages III and IV. This is in opposition with the common procedure for fecundity estimates in Loliginids which uses mature females, in stage V.

Introduction

Previous results on the oocyte dynamics (unpublished data) showed that *L. vulgaris* is probably a monocyclic species which may spawn over an extended period of time in south temperate areas (Coelho *et al.*, 1994). The fecundity of *L. vulgaris* has been studied by Mangold-Wirz (1963) based on spawned egg masses and by Coelho *et al.* (1994) using volumetric methods. The stereological methods have been used in fecundity estimates of fish species (Emerson *et al.*, 1990; Diack & Priede, 1994; GreerWalker *et al.*, 1994) because it was found to be a more accurate method as it is based on histological information.

In this paper, both volumetric and stereological methods have been used to estimate potential fecundity of *L. vulgaris*. The results obtained are described and they are related to data on length and weight as well as to the macroscopic maturity stages of the ovary.

Materials and methods

A total of 18 female squid, 9 in the maturity stage III and 9 in the maturity stage IV, was measured (dorsal mantle length, DML) and weighted to the nearest 1mm and 0.1g, respectively. The oogenesis was classified into 6 histological stages (unpublished data), and the macroscopic development of the gonads into V stages according to Ngoile (1987).

Three sub-samples of each ovary were used to estimate the total number of oocytes by a volumetric method (Fecundity VOL). Histological sections of each ovary were used for the stereological analysis (see details in Emerson *et al.*1990).

The fecundity estimates were related with the DML, the body weight and the ovary weight. The regression lines were fitted by the least squares method (Sokal & Rholf, 1981).

Results

The fecundity estimates obtained by the volumetric method and by the different estimates of the stereological method are presented in Figure 1. The females in the maturity stage III presented a smaller DML than those of the maturity stage IV. The mean fecundity estimates in the former ranged from 951 to 9231 oocytes, and from

2705 to 20520, in the later. In both maturity stages III and IV, the estimates from volumetric method and from stereological method, based on counting histologic stages 4, 5 and 6, were similar and significantly correlated ($p<0.01$). The estimates from stereological method based on counting oocytes in all histological stages and in histological stages 1, 2 and 3 were also concordant and significantly correlated ($p<0.001$).

The potential fecundity is significantly correlated with the DML ($p<0.001$), both for the volumetric method and the stereological method using histological stages 4, 5 and 6 (Figure 2). These fecundity estimates are also significantly correlated with the body weight ($p<0.001$) (Figure 3) and the ovary weight ($p<0.001$) (Figure 4).

Discussion

The values of the potential fecundity calculated with the volumetric method and the stereological method based on histological stages 4, 5 and 6 were always lower than those obtained with the stereological method using histological stages 1, 2 and 3 or using oocytes in all histological stages (1-6). This difference is higher when maturity stage IV ovaries are used in this analysis. Furthermore, the results obtained with the stereological method for the total number of oocytes are equivalent to those considering only the stage 1, 2 and 3 of the oogenesis. Thus, the fecundity estimates based on these initial stages of oogenesis might be a good indicator of the total production of oocytes, but confirmation is required.

Unpublished data on the oogenesis of the squid indicates that the recruitment into vitellogenesis might virtually cease during stage IV of maturation. Moreover, all the resting oocytes develop into vitellogenesis during subsequent stages. Considering this dynamics, the fecundity estimates based on counting oocytes in the stage 1, 2 and 3 of oogenesis should be corrected with additional counting of the oocytes in this first stages of oogenesis, eventually occurring in stage IV of maturation.

More information about the number of batches spawned is essential to understand the dynamics of spawning. Future studies will have to address this problem, since the delineation of the spawning frequency is essential to accurate fecundity estimates.

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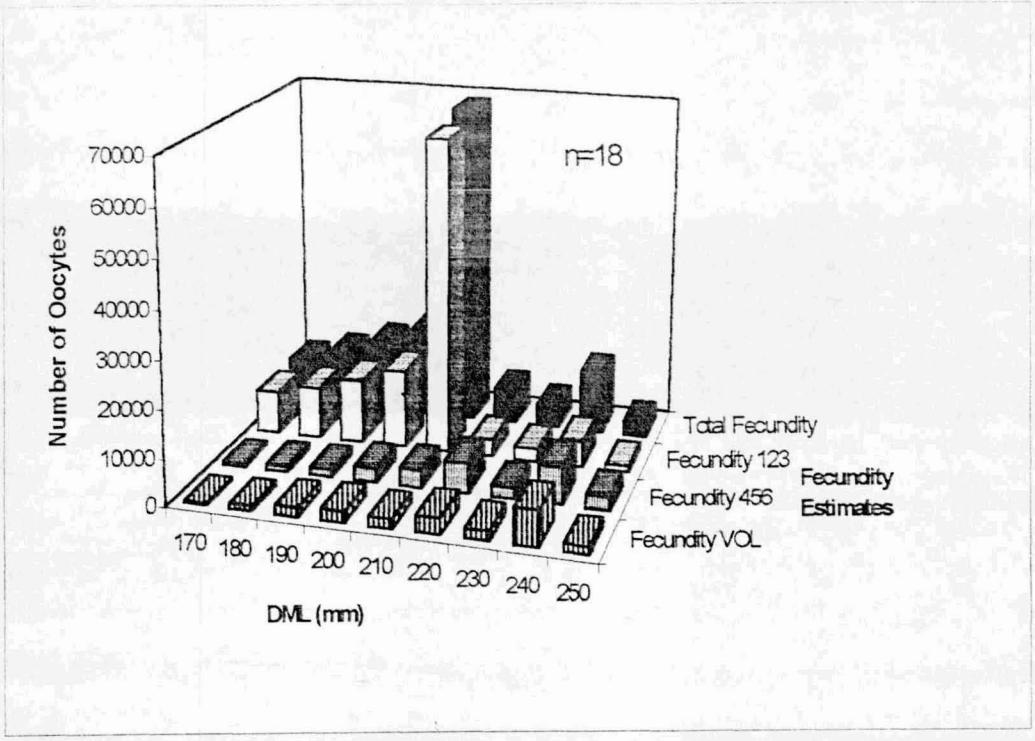

Figure 1. Fecundity estimates by DML classes. Fecundity was determined by the volumetric method (Fecundity VOL) and by different estimates of the stereological method: estimates from total oocytes (Total fecundity), estimates from oocytes in histologic stages 1, 2 and 3 (Fecundity 123) and estimates from oocytes in histological stages 4, 5 and 6(Fecundity 456).

a)

b)

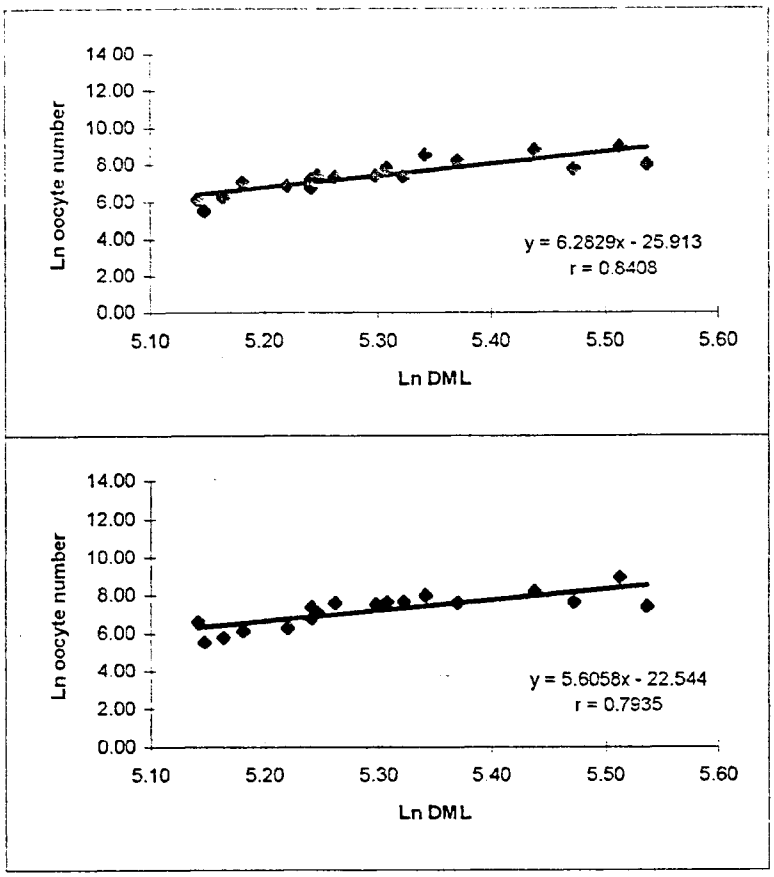

Figure 2. Linear regressions between the number of oocytes and the DML, from two different methods a) volumetric method and b) stereological method based on oocytes from histological stages 4, 5 and 6.

a)

b)

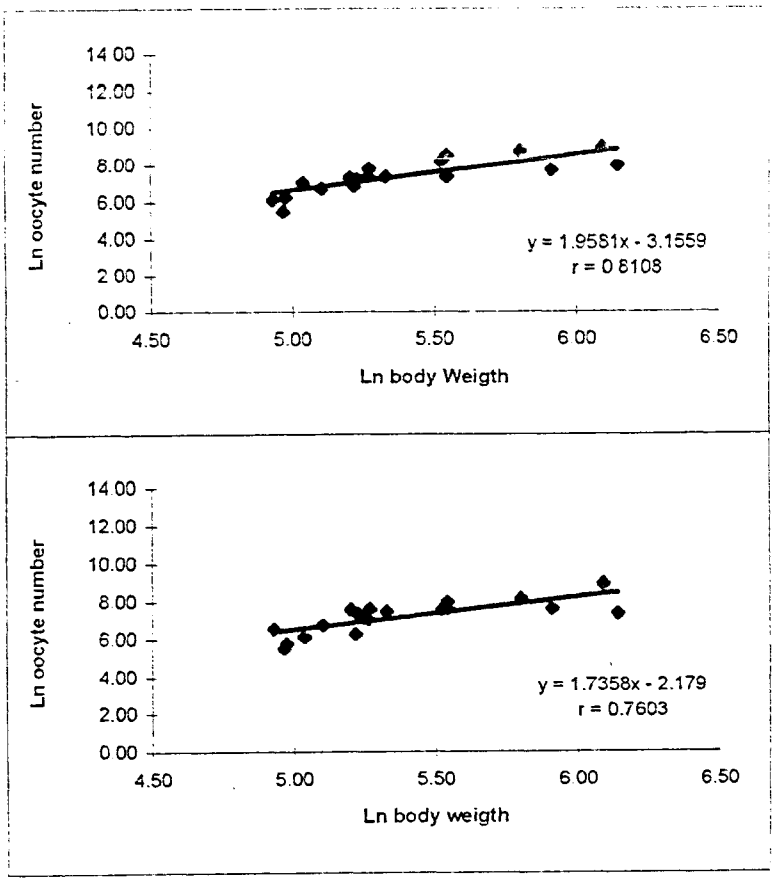

Figure 3. Linear regressions between the number of oocytes and the body weight from two different methods a) volumetric method and b) stereological method based on oocytes from histological stages 4, 5 and 6.

a)

b)

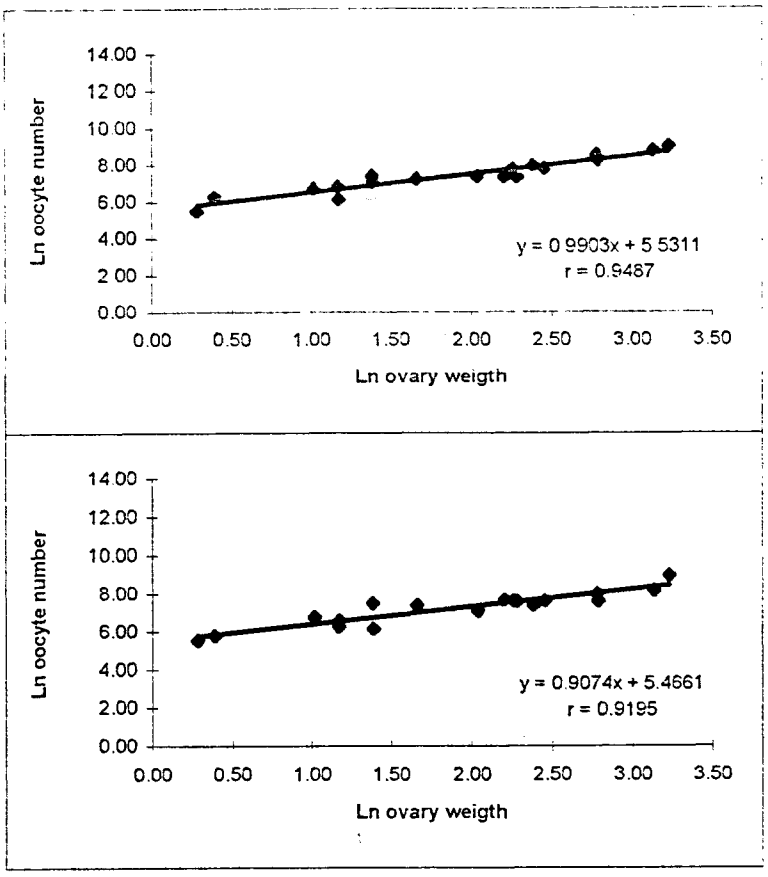

Figure 4. Linear regressions between number of oocytes and the ovary weight from two different methods a) volumetric method and b) stereological method based on oocytes from histological stages 4, 5 and 6.