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Anatomical differentiation of the ovary in *pseudolithus typus* from the Ivorian marine coast

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Abstract

Overexploitation of fish resources causes the scarcity or even extinction of certain species. Fish farming appears to be the solution. The objective of our work was to understand the morphological differentiation of the ovary in *Pseudolithus typus* in order to control its reproduction. The sex and stage of sexual maturity of the fish were determined after dissection. The present work showed that the ovary of *Pseudolithus typus* is formed of 2 lobes and presented 6 stages of sexual maturity.

Keywords: Overexploitation; Fish Farming; Ovary; *Pseudolithus Typus*; Reproduction; Fish; Stage; Maturity; Sexual

1. Introduction

Like the inhabitants of many countries on the West African coast, fish is the main source of animal protein for the Ivorian consumer. In Ivory Coast, fish represents between 15 and 16 kg per year of consumption per inhabitant [1]. National fish production is 50,000 tones on average while needs are estimated at more than 360,000 tones met through imports worth 289 million euros [2]. In order to cover these increasingly growing fish needs of a rapidly growing population while reducing imports leading to a significant outflow of foreign currency, the Ivorian public authorities have undertaken several actions to strengthen the institutional framework of the aquaculture sector through the definition of a strategy for the development of fisheries and aquaculture [3] and [1]. Thus, many studies have been conducted on the reproduction of indigenous fish with aquaculture potential. However, it seems to us judicious to know more about the development of the ovary in *Pseudolithus typus*.

2. Material and methods

The study involved 517 females of *Pseudolithus typus* sampled at the fishing port of Abidjan from January 2017 to December 2017. After dissection of the fish, their sex and stage of sexual maturity were determined according to the method of [4]. All ovaries were collected for morphological study. The ovaries corresponding to the different stages of sexual maturity were described taking into account the following criteria: - Size - Shape - Weight - Coloration - Superficial vascularization.

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3. Results

In the female of *Pseudotolithus typus* the ovary is formed of two lobes connected at the oviduct. The scale of sexual maturity presents six stages of development (Figure 1):

3.1. Stage 1

The ovary (Figures 1 A and 1 A1) is formed of two unequal filiform lobes. The right lobe is 1.6 cm long while the left lobe is 1.9 cm long. Both lobes have the same diameter of 0.1 cm. The pinkish ovary weighs 1.6 g. The blood vessels are not visible.

3.2. Stage 2

The ovary has two cylindrical lobes (Figures 1 B and 1 B1) of unequal size. The right lobe is 1.9 cm long and the left lobe is 2.1 cm long. Both lobes have the same diameter of 0.2 cm. The yellowish ovary weighs 2.5 g. The blood vessels have a diameter of 0.07 mm.

3.3. Stage 3

The ovary is relatively developed (Figures 1 C and 1 C1). The two lobes are cylindrical and unequal. The right lobe measures 4.4 cm and the left lobe measures 4.8 cm. The two lobes do not have the same diameters, the right ovary has a diameter of 0.5 cm while the left lobe has a diameter of 0.3 cm. The ovary is yellowish-pink in color and weighs 3.7 g. The oocytes are visible through the transparent ovarian membrane (Figure 1 C1). The blood vessels have a diameter of 0.09 mm with a fairly branched vascularization (Figure 1C1).

3.4. Stage 4

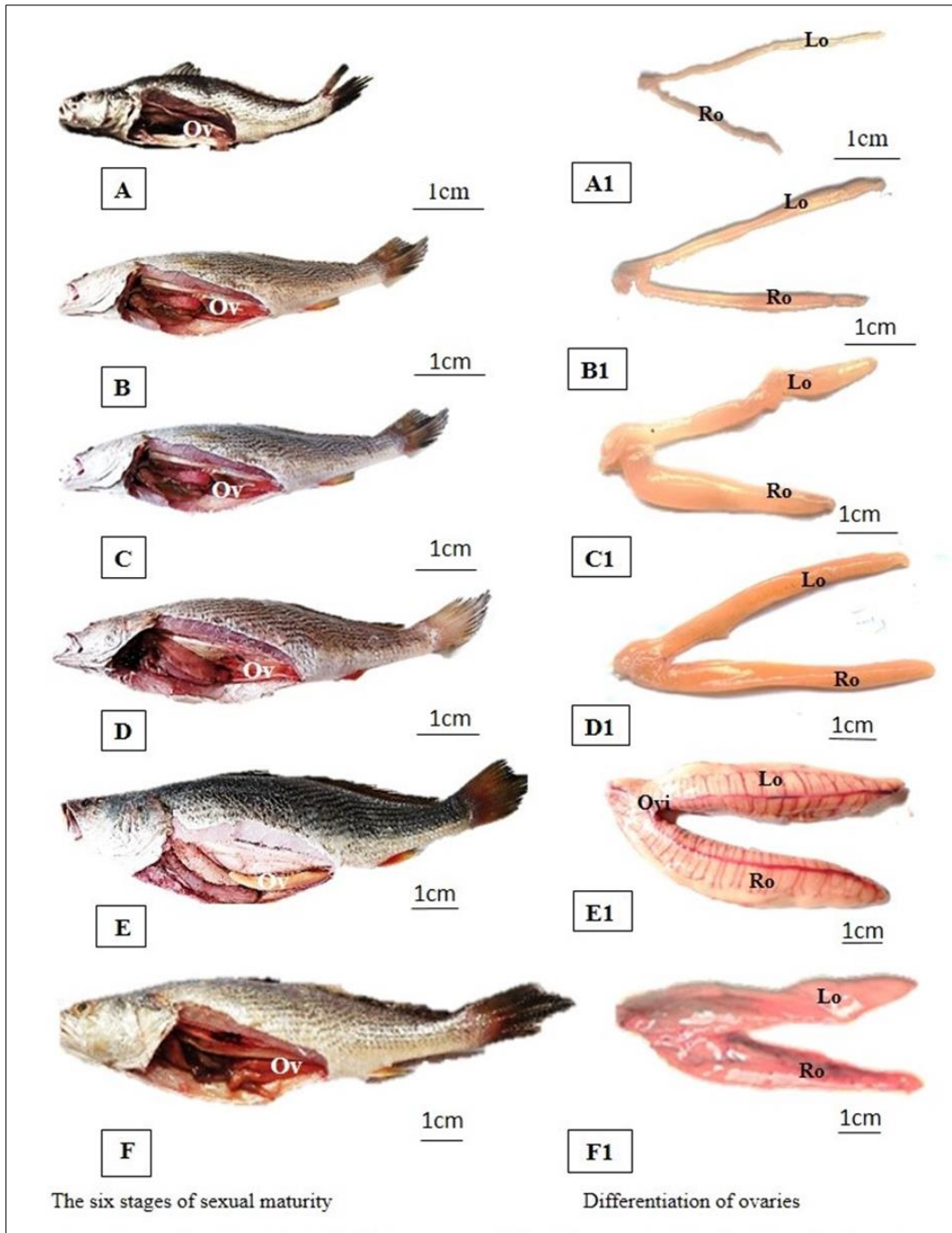
The ovary is developed (Figures 1 D and 1 D1) with the two lobes of equal size. They are 6.2 cm long and each have a diameter of 0.9 cm. The orange-colored ovary weighs 4.8 g. The oocytes are visible through the transparent ovarian wall but cannot be expelled by finger pressure. The blood vessels have a diameter of 1.2 mm.

3.5. Stage 5

The highly developed ovary (Figures 1 E and 1 E1) occupies the entire visceral cavity. The two lobes are the same length and measure 7.43 cm. The two lobes have the same diameter equal to 1.1 cm. The orange-colored ovary weighs 6.87 g. It is transparent and much vascularized with intensified branching. The oocytes are clearly visible and can be expelled by finger pressure on the abdomen.

3.6. Stage 6

The development of the ovary has regressed (Figures 1 F and 1 F1). It has two lobes of equal size, each 5.57 cm long. Both lobes have the same diameter, equal to 0.6 cm. The reddish ovary weighs 3.80 g. Both lobes are flaccid and contain residual oocytes. The blood vessels are barely visible.



A: juvenile female at stage 1; A1: ovary of the female at stage 1; B: juvenile female at stage 2; B1: ovary of the female at stage 2; C: adult female at stage 3; C1: ovary of the female at stage 3; D: adult female at stage 4; D1: ovary of the female at stage 4; E: adult female at stage 5; E1: ovary of the female at stage 5; F: adult female at stage 6; F1: ovary of the female at stage 6; Ov : ovary; Ovi: oviduct; Ro : right ovary; Lo : left ovary

Figure 1 Scale of sexual maturity and evolutionary aspect of the ovaries during maturity in the female of *Pseudotolithus typus*

4. Discussion

The morphological study of *Pseudotolithus typus* shows that there is no external morphological difference between the female and the male. No sexual dimorphism allows to distinguish the male from the female. The sex of the fish was determined after dissection. The description of the gonads was made according to the morphological characteristics such as color, size, granulation and vascularization. The ovaries are formed by two elongated lobes of generally unequal size, which fuse completely at the posterior end to form a short oviduct. The morphological characteristics of the ovaries vary according to the stages. This variation allows to obtain 6 stages of sexual maturity. The size and diameter of the ovaries increase from stage 1 to stage 5 because during their maturation, the ovaries are the places of concentration of nutrients for an increasingly high number of sex cells. The diameter and size of the ovaries decrease at stage 6 after spawning and they are empty and flaccid. The blood vessels increase in volume and branch to meet the increasing needs of the ovaries. They ensure the circulation of blood, nutrients and vitellogenin in the ovaries. Similar results have been described in *podamasy jubelini* by [5] and in *Cloroscombrus chrysurus* by [6]. The present work indicates that the ovaries of *Pseudotolithus typus* are made up of two lobes. These results are consistent with those of [7] who found that the majority of fish have ovaries formed by two lobes. These same authors indicate that the ovaries of fish present a great morphological variability linked to the species. They observe a single lobe in most chondrichthyans and in the garfish. The present study shows that the morphological differentiation of ovaries in *Pseudotolithus typus* occurs in 6 stages. Stages I and II are the immature stages and stages III, IV, V and VI are the mature stages. These results are similar to those of [8] and [6] who found 6 stages of sexual maturity respectively in females of *Pseudotolithus elongatus* and *Cloroscombrus chrysurus*. However [9] note 8 stages in females of *Pseudotolithus elongatus*. [10] describe 7 stages of sexual maturity in females of *Pseudotolithus senegalensis*.

5. Conclusion

At the end of this study, we note that the differentiation of the ovaries of females of *Pseudotolithus typus* occurs in 6 stages of sexual maturity. Females at stage 5 are in the spawning period. In terms of fish farming, individuals at this stage correspond to the genitors to be selected.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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