



FULL LENGTH ARTICLE

Aspects on the reproduction of eared horse mussel, *Modiolus auriculatus* (Krauss, 1848) in Red Sea, Egypt



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Abstract The reproductive cycle of the eared horse mussel, *Modiolus auriculatus*, was followed for one year from February, 2011 to January, 2012 based on 240 individuals collected from Hurghada, north coast of Red Sea, Egypt. The gonadal maturation of *M. auriculatus* was examined by means of macroscopic and histological preparations of the mantle. Annual cycle with periods of growth, maturity and discharge of gonadic products occurs simultaneously in both sexes. Ripe individuals were observed throughout the year. The largest number of spawning for the individuals occurred from March to June and July for the population. So, it was clear to identify one heavy spawning period for this species. Sexation of *M. auriculatus* did not differ significantly from 1:1. Sexes were distinguishable in all individuals at the ripe stage with a shell length greater than 3.00 cm. A direct positive correlation was observed between gonad index and water temperature.

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Introduction

Mussels have been a subject of great interest in recent years due to their increasing commercial importance. Most studies are related to the reproductive characteristics of the species widely distributed in temperate waters. Very little information

exists with regard to tropical mussels (Cruz and Villaobos, 1993). Eared horse mussels of mytilidae are widely distributed in the world they occur in several seas of the tropical and sub-tropical regions. *Modiolus auriculatus* is a sedentary organism and is subjected to a wide range of environmental conditions. The interaction between reproductive processes and environmental changes may assume great importance for the well-being of the population.

Nevertheless, few studies have been carried out on the eared horse mussels *M. auriculatus* in the Red Sea such as on bio-monitors for heavy metal levels (Hamed and Emará (2006); ecology and distribution Fshelson (1971), Oliver (1992) and

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Zuschin and Oliver (2005)). However, information is lacking on the reproduction of *M. auriculatus*.

The aim of the present study was to characterize the gonadal cycle of the mussel *M. auriculatus* in the Hurghada area of the Red Sea of Egypt, to determine the timing of reproductive development and spawning. Analyzing sex ratios and annual trends in gonad index were done. The data obtained provide a basis for the sustainable management of natural populations.

Materials and methods

The reproductive cycle and the gonadal index of *M. auriculatus* in the area of study [Map 1](#) were studied from February 2011 to January 2012 at 3–5 m depth. A total of 240 living specimens of the eared mussel, *M. auriculatus* of a size range from 1.36 cm to 6.02 cm in shell length were collected monthly.

Collection was done by hand and mussels were freshly examined. Each individual of the mussel was first cleaned from the extraneous bio-fouling organisms such as external parasites by scraping it from the ventral and dorsal shells. Lengths of collected specimens were measured to the nearest 0.1 mm using vernier calipers.

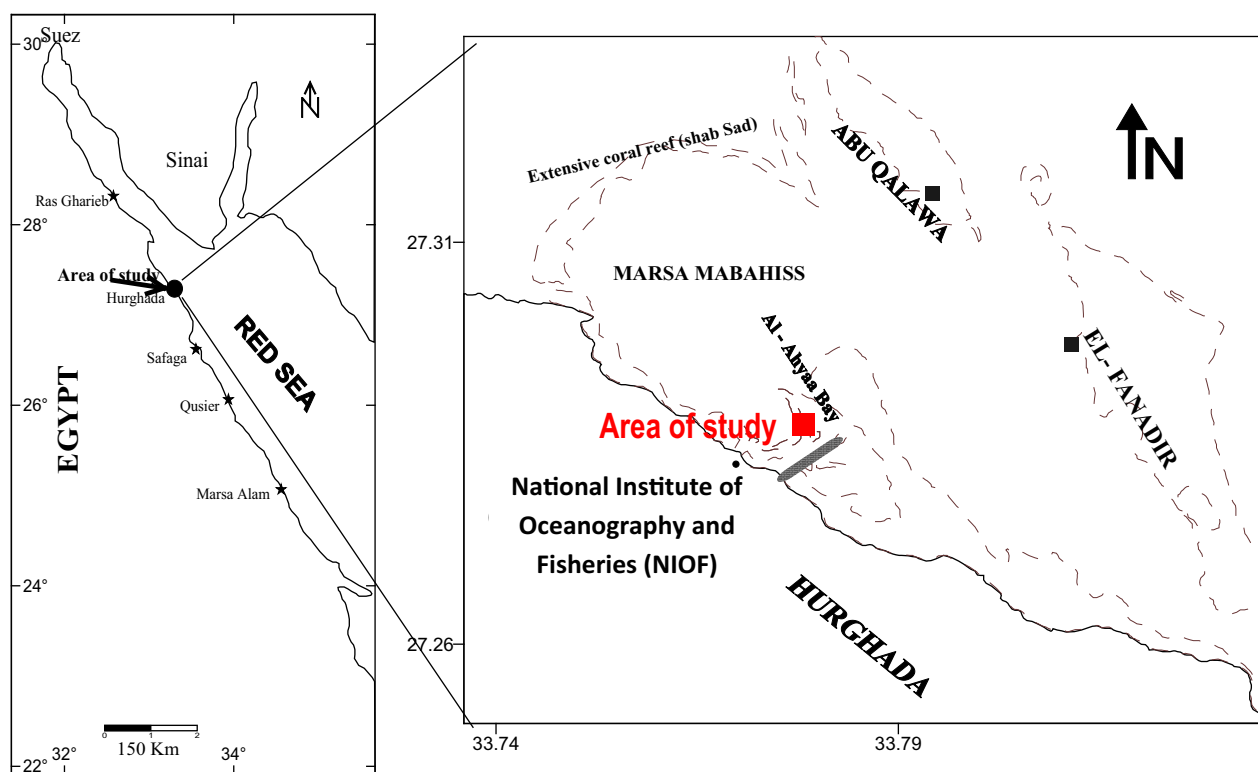
Histological analysis

After dissection of the mussel, the soft body was removed from the shell, the mantle and gills were then folded back to expose the body of the mussel adjacent to the foot. From macroscopic observation male gonads appear whitish in color and change to a creamy fluid during the spawning season, while sexually

matured ripe females have dark yellow to orange gonads. Gonads tissue surrounded the digestive gland, and in the late ripe phase, extended into the mantle. Gonads were separated from the tissue and immediately fixed in Bouin's fixative according to [Lowe et al. \(1982\)](#), washed with 50% ethanol, and stored in 70% ethanol until processing. Tissue samples were dehydrated in an ascending alcohol series, cleared in Xylene and embedded in paraffin wax. Several sections (5–7 μ m) were cut, the tissue sections were deparaffinized with toluene, rehydrated with water, and then stained with hematoxylin and counterstained with eosin [Bancroft and Stevens \(1982\)](#). Each section was examined at 100 \times magnification using a compound microscope (compound microscope Xs₂ – 107 T) and photographed with a Digital camera (solution Disk TP 6031od, processing for software ver. 3.2). The stained gonad preparations from each mussel were classified into different developmental stages. The classification consisted of six main stages early development⁽³⁾, late development⁽⁴⁾, ripe⁽⁵⁾, spawned⁽²⁾, spent⁽¹⁾ and resting⁽⁰⁾ according to [Walker and Power \(2004\)](#).

A description of the gonad histological stages is shown in [Table 1](#). The mean gonad index (MGI) values were obtained for each sampling month and for both sexes to estimate the proportion of early and late developing, ripe, spawning, spent and resting individuals.

The mean Gonad index (MGI) for each sample is then determined by multiplying the number of each stage by the numerical ranking of the stage and dividing the sum of these products by the total number of individuals in the sample. The index can vary from zero, if the entire population is spent or resting, to five when fully developed and ripe, ([Gray et al., 1996](#)).



Map 1 Sampling area of *M. auriculatus* in Hurghada, Red Sea.

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