Rev. Biol. Trop., 41 (1): 89-92, 1993

# Shell length at sexual maturity and spawning cycle of *Mytella guyanensis* (Bivalvia: Mytilidae) from Costa Rica

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(Rec.25-X-1991. Acep. 20-VIII-1992)

**Abstract:** A population of *Mytella guyanensis* from Costa Rica was studied for 12 months in order to determine shell length at sexual maturity, frecuency and duration of the spawning cycle under natural conditions. The smallest mature individual was 18 mm long. The mussels spawned from September through November and from February through April. Sexes were distinguishable in all individuals with a shell length greater than 30 mm. No evidence of protandry or hermaphroditism was observed. Sex ratios of *M. guyanensis* did not differ significantly of 1:1.

**Key words:** Sexual maturity, spawning cycle, Bivalvia, *Mytella guyanensis*.

Mussels have been a subjet of great interest in recent years due to their increasing commercial importance. Most studies are related to the reproductive characteristics of the genus *Mytilus* (Seed 1976), a species widely distributed in temperate waters. In tropical regions, with the exeption of the works by Carvajal (1969), Lunetta (1969) and Mandeli & Acuña (1975), very little information does exist with regard to tropical mussels.

*Mytella guyanensis* Lamark, 1918 is a common mussel that inhabits the mangrove ecosystem from Baja California to Perú (Keen 1971). Individuals are found on the muddy slopes of small channels, stuck to mangrove tree roots or half buried in mud. To date, in spite of its importance, the only information available is Sibaja's (1986) macroscopical observations on sexual maturity and Bolaños (1988) work on seed collection and growth. The goals of the present study were (1) to define shell length at sexual maturity and (2) to determine the frecuency and duration of the spawning cycle.

## MATERIAL AND METHODS

Specimens of *Mytella guyanensis* were collected from Ochoa Estuary, Colorado de Abangares, Golfo de Nicoya, Costa Rica (10°41' N, 85°6' W). Monthly collections were made from May, 1988 through April, 1989. Sample size varied from 46 to 90 mussels.

A total of 793 mussels were examined, of which 154 were used to determine length at first maturity. Four length categories were used (1) 13.9 - 17.9 mm, (2) 18.0 - 22.0 mm, (3) 22.1 - 26.1 mm and (4) 26.2 - 30.2 mm. The remaining individuals were employed to establish sex ratio and the reproductive cycle.

Histological sections of the viceral mass and mantle were fixed with Bouin. After inclusion in parafin, sections were sliced at 7 µm and stained with hematoxilin-eosine. A microscopic examination of the gonadal tissue was made before assigning individuals to any of the categories of gonadal condition, namely indifferent and mature.

For the histological study of the spawning cycle of adults (>30 mm in length), all individuals were assigned to a certain category of gonadal development, determined by the presence and degree of maturation of gametogenic cells in the follicles. These categories are a modification of those used for other species (Ropes 1968, Lozada and Reyes 1982, Brousseau 1984).

Categories of gonadal conditions.

Gametogenesis: Stage of multiplication, cell arrangement and progressive gametogenesis. In male the alveoli walls appear thin and show darkly stained spermatogonia, or with most follicles filled with spermatozoa. In females the alveoli contains a large number of elongated, stalked oocytes free in the alveolar lumen and bases attached to the alveolar wall.

Maximun maturity: Gonads are composed of darkly stained spermatozoa with their tails pointing toward the center of the lumen, forming concentric bands. Females show ripe oocytes laying free in the lumen of the follicle. They adopt a more globular shape.

Spent: Alveoli contain few spermatozoa in the center. the alveolar walls appear thickened. In females, few oocytes are still attached to the alveola and few residual ripe ova may remain in the alveolar lumen. In both sexes a lot of connective interfollicular tissue is present.

## RESULTS

Shell length and sexual maturity: Individuals of size 1 (Table 1) were determined as inmature in 90 % of cases. The mantle appears thin and transparent with only connective tissue cells; hence, no sexes were identified. In the remaining 10 %, sexual products were observed at 17.3 mm in two males. In individuals of size 2 (18.0 - 22.0 mm) sexes were identified in 66.7 % of the cases, showing different levels of gonadal development. Hence, it is possible to assert that *M. guyanensis* mature and spawn at a length between 18 and 22 mm. In individuals of size 3 (22.1 - 26.1 mm) only 4.2 % were inmature, while all individuals of size 4 exhibited different degrees of gonadal development.

Sex ratio: Out of 449 individulas examined, 227 (50.6 %) were females and 222 (49.4 %) were males. In the sample, the proportion of females in all size-classes did not differ significantly from one-half. Male and female gonads were distinguishable in all size-classes studied (>30 mm).

TABLE 1

*Number and percentage of mussels,* Mytella guyanensis, *in indifferent or gonadic maduration stage*

| Size (mm) | Indifferent | Mature | |
|---|---|---|---|
| | | males | females |
| 13.9-17.9 | 18 (90.0%) | 2 (10.0%) | 0 (0.0%) |
| 18.9-22.0 | 16 (33.3%) | 30 (60.3%) | 2 (6.4%) |
| 22.1-26.1 | 22 (4.2%) | 24 (49.8%) | 22 (46.0%) |
| 26.2-30.2 | 0 (0%) | 16 (42.1%) | 22 (57.9%) |

Annual cycle: The gonad structure of *M . guyanensis* fits well the one described by Lozada and Reyes (1982) in *Perumytilus purpuratus* (Lamark 1819).

The macroscopic and histological study reveals that the annual cycle with periods of growth, maturity and discharge of gonadic products occurs simultaneously in both sexes.

Mature individuals (gametogenesis, ripe, and spawning) were observed throughout the year. The largest number of ripe individuals occurred from July through September and from December through January. Although spawning occurred year round it was possible to identify two heavy spawning periods: one from August through November and another from February through April (Fig. 1).

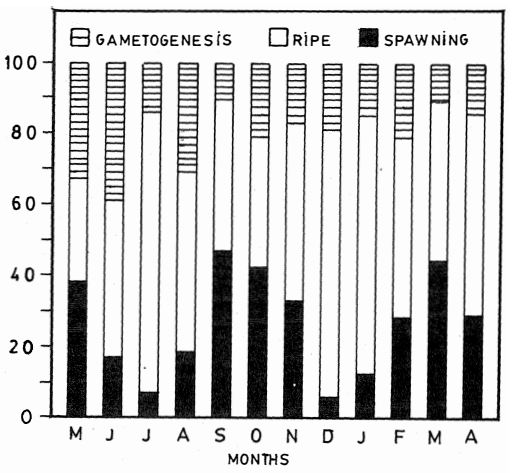


Fig. 1. Monthly variation of development of the *Mytella guyanensis* gonad.

## DISCUSSION

*Mytella guyanensis* is a dioecious bivalve as indicated by Sibaja (1986). As in other mussels (Sastry 1979), males and females can be macroscopically distinguished by the color of the gonads. Female gonads exhibit a yellow coloration while the gonads of males are brown, varying in both from light to dark, depending on the amount of eggs or sperm.

*M. guyanensis* is a strict gonocoric species as many other mussels (Seed 1976). As in other species, such as *Artica islandica* Linnaeus (Ropes and Murawski 1980) and *Anadara grandis* Broderip (Cruz 1986), females of *M. guyanensis* require a longer gonadal development period than males.

Length at first maturation is similar to that reported for other mussels by Lozada *et al.* (1971), Griffiths (1977) and Suckaneck (1981) and for mactrids by Ropes (1979). The later author has indicated that length at first maturation corresponds to a fourth or fifth of the maximum total length. In *Mytella guyanensis* in fact, first maturation occurs at one fourth of total length, *i.e.* at between 18 and 22 mm (maximum total length is around 79 mm).

The sex ratio (1:1) follows that reported for other tropical mussels (Velez and Martínez 1967) as well as for temperate species (Sunila 1981, Kautsky 1982, Brousseau 1983).

In general, the results of our work are not in accordance with those reported by Sibaja (1986). This author proposed a 30 -35 mm total length for the species to reach first maturation, a sex ratio of 3.47 females for each male, and a single spawning period (April). These differences are a consequense of Sibaja's method (1986), which was based on macroscopic observations of the colour and appearance of the gonads. The method is quite unreliable as has it been pointed out by Kinsgtons (1974), who compared the results of Boyden (1971) on *Cardium edule* (Linnaeus) and *Cardium glaucum*, (Poiret) using histological techniques.

## ACKNOWLEDGMENTS

We thank Jorge Rodríguez for his suggestions, Jorge Alfaro for the critical review of the manuscript, and Estrella Lizano for her assistance.

## RESUMEN

Se estudió una población de *M. guyanensis* durante doce meses desde el punto de vista reproductivo. El ejemplar más pequeño clasificado como maduro midió 18 mm. Se determinaron dos picos de desove al año; uno de setiembre a noviembre y el otro de febrero a abril. No se encontró evidencia de hermafroditismo. La proporción sexual fue 1:1.

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