Annual reproductive cycle and growth of the pen shell *Atrina maura* (Pterioidea: Pinnidae) on sand-bottom culture in the Ensenada Pabellones lagoon system, Gulf of California, Mexico

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**ABSTRACT**

The reproductive cycle and growth of the pen shell, *Atrina maura*, which was cultured in the Ensenada Pabellones lagoon system, Gulf of California, from March 2008 to March 2009, is described in this article. Histological techniques and the condition index were used to determine its reproductive condition. The sex ratio was 0.57 females:1.72 males within the population studied. There were no differences ($\chi^2$, $p < 0.05$) in shell length (SL) between males and females. The mean length of the sampled specimens ranged between 50.99 ± 4.86 mm and 218.16 ± 8.87 mm. The histological results confirmed that *A. maura* is a gonochoristic organism that presents synchronous development of the gonads. The maturity and spawning phases were observed throughout the study period, with the exception of March and May 2008. The frequency of the gonad development stages obtained per month suggests that this species reproduced two times annually, with one important reproductive period from June to September, a minor reproductive period from November to February, and two resting periods as follows: July to August and January to February 2009.

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**Introduction**

Studies on the gonadal changes of commercial species of bivalves are essential for understanding their reproductive habits. Particularly, information on the time and duration of spawning is important for successful mariculture because it provides the proper time for harvesting heavy animals. The pen shell *A. maura* (Sowerby, 1835) is a pinnid bivalve that is widely distributed along the eastern Pacific coast from Baja California Sur, Mexico, to Peru, where it lives on sand or mud flats, forming dense aggregations from intertidal to 24 m depths (Schultz & Huber 2013). The adductor muscle of this mollusk, which is known as “callo”, is considered a delicacy in many countries (Gongora-Gomez et al. 2011), but its increasing demand has led to intensive and uncontrolled commercial fishing, which seriously threatens natural populations (Camacho-Mondragón et al. 2012).

Despite its commercial importance, research on *A. maura* is scarce and has focused mainly on its growth (Aragón-Noriega 2013), evaluation of microalgae for feeding juveniles (Lora-Vilchis et al. 2004), and fisheries (Aragón-Noriega 2013), as well as on aspects of population dynamics (Ahumada-Sempoa et al. 2002). There is also information about the reproduction of this bivalve (Ángel-Pérez et al. 2007; Ángel-Dapa 2008; Camacho-Mondragón et al. 2008, 2012, 2015), but these studies were conducted on natural populations. Some reports are available on the standardization of culturing techniques (Mendo et al. 2011) and reproductive aspects under laboratory conditions (Enriquez-Díaz et al. 2003). Nevertheless, there is a lack of research related to its growth and physiological performance in culture.

It is well known that the reproductive cycle of marine invertebrates is affected by environmental factors such as water temperature, latitude, salinity, photoperiod, and food availability (Byrne 2011), which directly influence reproductive processes such as gonad development, the production of gametes, and spawning (Brown-Peterson et al. 2011). In addition to the aforementioned environmental factors, there are other factors inherent to culture conditions (high density, food competition, oxygen demand, and predation) that pressure the reproductive response of organisms (Mendo et al. 2011). Although it is not clear how such factors regulate the gametogenic cycles of organisms, their variation or interaction can induce annual, semianual, or continuous reproductive cycles (Velayudhan et al. 2011).