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Influence of environmental factors, season and size at deployment on growth and retrieval of postlarval lion's paw scallop *Nodipecten nodosus* (Linnaeus, 1758) from a subtropical environment

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Abstract

The effect of seasonal variation of environmental factors on daily shell growth rates (DGR) of postlarval *Nodipecten nodosus* was studied at the southern distribution limit of the species in Santa Catarina State, Brazil. Five deployments of hatchery produced postlarvae (initial shell height 0.5 mm) in the sea-based nursery were carried out from August 2000 to September 2001, and DGR and percent retrievals were recorded. Chlorophyll-*a*, seston, salinity, dissolved oxygen and turbidity were measured weekly, and temperature was recorded hourly. Additionally, DGR and retrievals were compared for postlarvae maintained simultaneously in the sea- and land-based nurseries (initial shell height 0.5 mm), and also for post-larvae deployed in the sea-based nursery at different initial sizes (0.29–1.1 mm). Mean DGR was significantly lower in late winter–early spring 2000 (0.045 mm day^{-1}), intermediate in late winter–early spring 2001 (0.078 mm day^{-1}) and significantly higher in the other seasons (late spring–early summer, 0.152 mm day^{-1}; late summer–early autumn, 0.149 mm day^{-1} and late–autumn early winter, 0.130 mm day^{-1}). Temperature was the best predictor of growth, which was least at temperatures below 20 °C. Growth rate was also minimal during a period of low salinity and high turbidity. Mean DGR was significantly higher in postlarvae deployed in the sea-based nursery than in those maintained in the land-based nursery. Loss of postlarvae in the sea-based nursery was initially higher in collectors transferred earlier to the sea (ca. 2–3 weeks post-set; shell height 0.5–0.8 mm), but percent retrievals were similar after postlarvae deployed to the sea ca. 4–5 weeks post-set (shell height 1.1 mm) were retrieved simultaneously with those deployed earlier. At retrieval, postlarvae deployed approximately 2 weeks post-set were larger than those deployed subsequently, but spat deployed 1 week post-set attained a similar size to those deployed 2 weeks post-set. A strategy to deploy postlarvae in the sea-based nursery at a size circa 0.5 mm is proposed as more advantageous than keeping

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them longer in land-based facilities. In southern Brazil, there is a wide window of opportunity to deploy post-larval scallops in the sea-based nursery in which growth is maximized, except when water temperatures drop below 20 °C.

Keywords: Environmental factors; Growth; *Nodipecten nodosus*; Nursery culture; Postlarvae; Scallop; Brazil

1. Introduction

The lion's paw scallop *Nodipecten nodosus* is a promising aquaculture species in Brazil, and hatchery production is the only feasible approach to supply juveniles (Rupp, 1994; Uriarte et al., 2001). The intermediate step between the controlled hatchery situation and growout in the sea is known as nursery culture (Claus, 1981). The first phase of the nursery includes the period from metamorphosis to approximately 1 mm shell height, when postlarvae are cultured in land-based facilities, usually attached to monofilament collectors or other substrates. Unlike other bivalves that strongly attach to the substrate, scallop postlarvae, also known as spat, are extremely fragile and easily detach from collectors, being difficult to manipulate. Therefore, culturing them requires nursery strategies different from those used for some other molluscs. The second phase of nursery culture, when juveniles reach 5–10 mm in shell height, can be either land-based (upwellers, downwellers, recirculating, or flow-through systems), or carried out in the sea (Bourne and Hodgson, 1991). The sea-based approach consists of transferring spat collectors inside nylon mesh bags or in mesh-lined plastic trays directly to the sea after several weeks of land-based nursery, when spat are generally larger than 1 mm (Bourne and Hodgson, 1991; Uriarte et al., 2001). High losses are reported in both types of nursery culture. In the sea-based nursery, spat may experience high mortalities due to environmental factors such as salinity and temperature exceeding the limits of tolerance, smothering, predation or handling (Bourne and Hodgson, 1991). High mortalities in the land-based nursery have been explained by nutritional deficiencies resulting from the limited filter-feeding capability of early postlarvae (Whyte et al., 1992; Beninger et al., 1994), or infectious disease outbreaks commonly recorded in bivalve hatcheries (Elston, 1984).

After spat reach a certain size, growth in land-based nurseries is limited by nutritional deficiencies of the cultured microalgae (Bourne et al., 1989; O'Foighil et al., 1990; Coutteau and Sorgeloos, 1992; Whyte et al., 1992; Heasman et al., 1996). Furthermore, the cost of providing the increasing quantity of algae required is also a factor limiting the maintenance of spat for long periods under artificial conditions (De Pauw, 1981; Rhodes et al., 1981), requiring transfer of spat to the sea-based nursery as early as possible. However, deployment of spat may be constrained by the small mesh size required to retain them and by losses due to detachment, and this approach has not been well documented in the literature.

The study area lies near the southern distribution limit of *N. nodosus* in the southern hemisphere (Lat. 27°50′ S). Water circulation along the southeast coast of Brazil has been studied on meso- and large-scales, but no study has addressed the effects of abiotic and biotic environmental factors on growth and survival of marine bivalves in this region. According to the general model proposed by Emilsson (1961), the southeastern Brazilian coast is seasonally influenced by different water masses. Subsequent studies by Matsuura (1986), Brandini (1990), Castro and Miranda (1998), Sunyé and Servain (1998), and Borzone et al. (1999) have surveyed the neritic region beyond the 20 m isobath, including waters off Santa Catarina State. From these studies it can be inferred that during summer surface waters of the inner shelf off Santa Catarina State are influenced by Coastal Water (CW—salinity <35‰) or Shelf Water (SW—salinity 35–36‰), with high temperature (20–28 °C) and oligotrophic characteristics, whereas further offshore, warm, oligotrophic and high saline (>36‰) Tropical Water (TW) is present. In contrast, during winter (June to September) CW disappears and is replaced mainly by a coastal branch of the Malvinas Current (Sub-Antarctic Water—SAW), which is cold (<20 °C), hyposaline (as low as 29‰) and phytoplankton-rich (Sunyé and Servain, 1998). As a result, waters off Santa Catarina State are subject to a strong semi-