

Seasonal abundance of sea cucumber larvae at Toliara Great Reef, Madagascar

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Abstract

The abundance of echinoderm larvae, in particular sea cucumber larvae, was assessed in the lagoon of Toliara Great Reef in southwest Madagascar from December 2000 to May 2002. More than 9000 echinoderm larvae were collected, 33% of which came from sea cucumbers. Mean larval density varied greatly depending on the season. Sea cucumber larvae were most abundant during the hot season (November to April) with an average of 77 larvae per 350 m³ as compared to 1 larva per 350 m³ during the cool season (May to October). Sea cucumber larvae were found in large numbers at the time temperatures dropped, accounting for 50% of the total number of echinoderm larvae observed. Sea cucumber larvae were not found in the plankton from June to October. Three different families of sea cucumbers were observed: Holothuriidae, Stichopodidae and Synaptidae. Holothuriidae were the most numerous, accounting for 86% of all sea cucumber larvae collected.

Introduction

In the early part of 20th century, almost all studies on echinoderm larvae focused on species found in Europe and North America (Mortensen 1921, 1931, 1937, 1938). Recently though, studies have investigated the larval development of tropical species (Byrne and Selvakumaraswamy 2002; Emler et al. 2002; McEdouard et al. 2002; Sewell and McEuen 2002). In Madagascar, only the larvae of a few species have been studied (Rasolofonirina 2004; Vaïtilingon 2004). At this time, no analysis of the diversity and seasonal abundance of echinoderm larvae in the Mozambique Canal has been made. The study described in this paper is the first to concentrate on echinoderm larvae found on the continental slope of southwest Madagascar. The 18-month study was carried out in the lagoon of Toliara Great Reef, and was designed to analyse the abundance of both sea cucumber and echinoderm larvae in that period.

Materials and methods

Plankton was collected from Toliara Great Reef (23°21'S and 43°40'E) from December 2000 to May 2002. Ocean water samples were taken once a week from the surface waters (0.5 m depth) using a pelagic net with a 150-µm mesh and a 35-cm opening. The net was pulled behind a boat at the end of a 10-m-long nylon rope for 13 minutes. The distance covered was about 900 m and the volume of seawater filtered for each plankton haul was 350 m³.

All plankton hauls were carried out at the same time of day (17:00) to reduce time-related fluctuations in physical or biological parameters.

After each haul, the sample was taken to the laboratory where it was set in formalin (10%) and seawater. Larvae were sorted and counted using a binocular microscope, and the contents of each sample were analysed. Four times a month, seawater temperature and salinity readings were taken at the same time as the plankton hauls. The different larval stages were determined and the taxa identified in line with the descriptions of Mortensen (1921, 1931, 1937, 1938), Byrne and Selvakumaraswamy (2002), Emler et al. (2002), McEdouard and al. (2002), Sewell and McEuen (2002), and Rasolofonirina (2004).

Results and discussion

Lagoon water temperatures and salinity showed some slight variations over the course of the year (Fig. 1). Two separate seasons could be noted in southwest Madagascar: a hot season (November to April) and a cool season (May to October), during which times mean ocean water temperatures were, respectively, above or below 26°C. Salinity was generally about 34‰, except during the rainy season (mainly January), when it decreased to about 31.5‰.

Table 1 shows the total number of larvae from the various echinoderm categories observed during the study period along with the respective percentages. No crinoid larvae were observed. Sea cucumber, echinid and brittle star larvae were found in almost identical proportions in Toliara Bay and accounted for, respectively, 33, 35 and 31% of the total number of echinoderm larvae collected. There were some starfish larvae but their numbers were low compared with the other three categories mentioned (1% of the total number).

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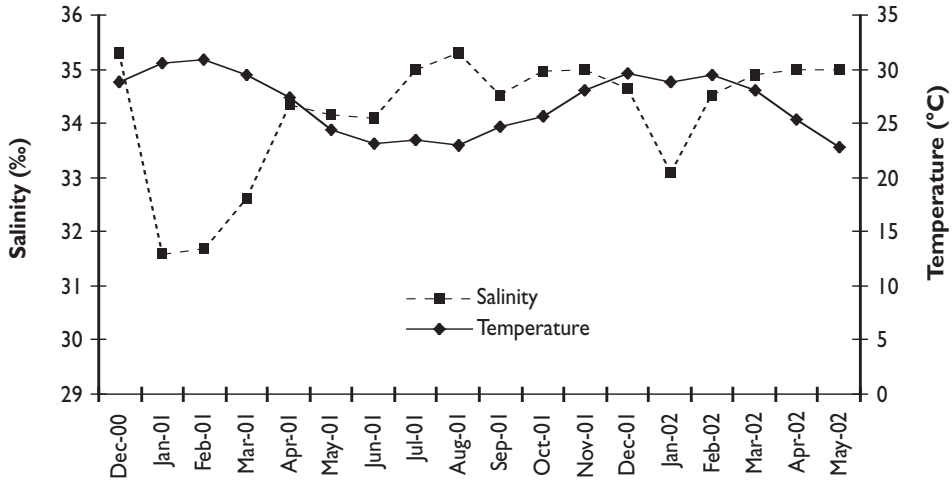
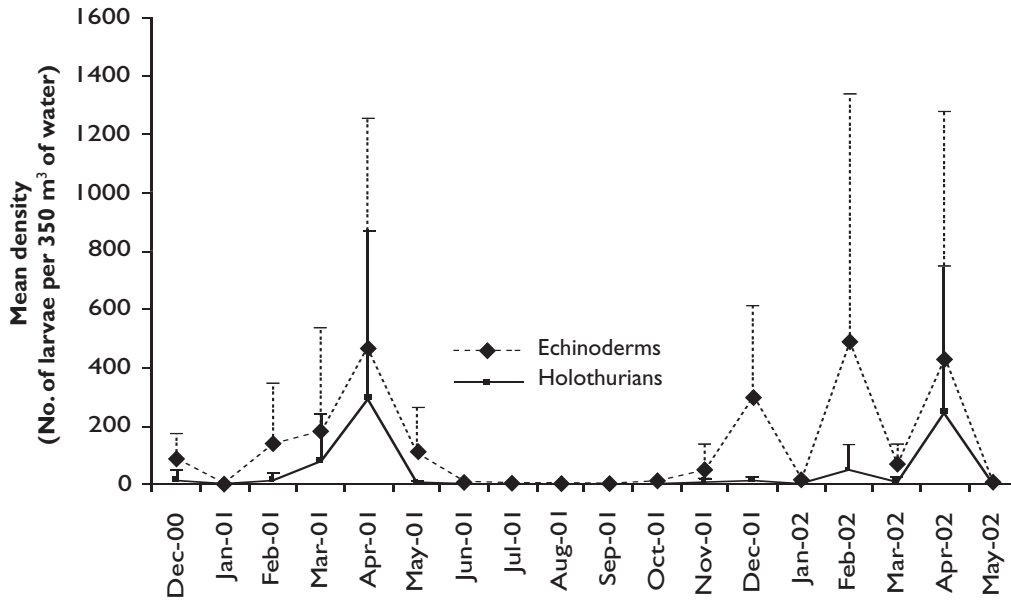


Figure 1. Seasonal variations in mean lagoon water temperatures and salinity at Toliara Great Reef.



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|-----------------------------|----|--|----|-----|-----|---|---|---|---|--|--|--|--|--|--|--|--|--|
| <i>Holothuriidae</i> larvae | ++ | | + | +++ | +++ | | | | | | | | | | | | | |
| <i>Stichopodidae</i> larvae | | | + | ++ | | | | | | | | | | | | | | |
| <i>Synaptidae</i> larvae | + | | + | ++ | + | + | + | + | | | | | | | | | | |
| Unidentified larvae | + | | ++ | +++ | +++ | | | | + | | | | | | | | | |

+: less than 10 larvae per haul (350 m³); ++: between 10 and 20 larvae; +++: more than 20 larvae

Figure 2. Mean monthly echinoderm (all categories combined) and holothurian larvae densities.

A total of 2954 sea cucumber larvae were collected, 222 of which could not be identified (i.e. 8% of the total number collected). The unidentified larvae mainly consisted of very young specimens for which the characteristics needed for identification were not yet visible. Holothuriidae larvae were, by far, the most numerous (86% of all sea cucumber larvae), followed by Synaptidae (5%) and Stichopodidae (1%).

Table 1. Number and percentage of echinoderm larvae collected at the Toliara Great Reef.

| Taxa | No. | Percentage |
|---------------|-------------|------------|
| Holothuroidea | 2954 | 32.4 |
| Holothuriidae | 2547 | 86 |
| Stichopodidae | 32 | 1 |
| Synaptidae | 153 | 5 |
| Unidentified | 222 | 8 |
| Echinoidea | 3209 | 35.2 |
| Ophiuroidea | 2822 | 31.0 |
| Asteroidea | 123 | 1.4 |
| Total | 9108 | 100 |

Figure 2 gives the seasonal abundances of echinoderm and sea cucumber larvae. Echinoderm larvae were found almost always in significant numbers from November to May, whereas their mean density was nearly zero outside that time period (maximum 15 larvae per 350 m³ of sea water). Density peaks were observed in April 2001 (467 larvae per 350 m³ of sea water) and in February and April 2002 (respective means of 488 and 429 larvae per 350 m³ of sea water).

Seasonal abundances of sea cucumber larvae roughly followed the profile for echinoderm larvae (Fig. 2). Mean larval density reached a very high peak in April with 295 larvae per 350 m³ of sea water in 2001 and 248 larvae per 350 m³ of seawater in 2002. These peaks coincided with the drop in mean ocean water temperatures between March and April (a decrease of about 3°C).

A comparison of the mean number of larvae throughout the hot period (228 echinoderm larvae on average per plankton haul, 34% of which were sea cucumbers) and the cool period (19 echinoderm larvae, 5% of which were sea cucumbers) clearly shows that larval abundance was greatest during the six-month hot period.

Holothuriidae larvae were generally found in the water column from November to April, Stichopodidae from November to March, and Synaptidae from November to July. Nevertheless, larval abun-

dance was low for all three families in January because in January 2001, no sea cucumber larvae were found, and in January 2002, only a few Holothuroidea larvae were recorded.

Table 2 shows the numbers and percentages of the various stages of sea cucumber larvae collected. Most larvae were auricularia (94%), generally in an early phase (i.e. the larval body did yet display all the lateral projections). The other larvae were metamorphosing or were doliolaria larvae. A few specimens were embryos in the process of transforming into auricularia larvae.

Table 2. Number and percentage of different stage holothurian (Holothuroidea) larvae.

| Stage | No. | Percentage |
|-------------------|-------------|------------|
| Embryo | 131 | 4.43 |
| Early auricularia | 2226 | 75.36 |
| Late auricularia | 545 | 18.45 |
| Metamorphosing | 35 | 1.18 |
| Doliolaria | 17 | 0.58 |
| Total | 2954 | 100 |

All the results indicated that the hot season is the period when echinoderm larvae, particularly sea cucumber larvae, are abundant, especially at the end of that period. This agrees with the results given in scientific literature about the reproductive cycle of tropical sea cucumbers (Conand 1989; Mara et al. 1997; Rasolofonirina 2004). In the Toliara region, the reproductive cycles of just a few sea cucumbers are known (Mara et al. 1998; Rasolofonirina 1997; Rasolofonirina et al. 2005). Those sea cucumbers have annual reproductive cycles. Mature specimens can be found throughout the year but they are much more numerous in late summer. Egg laying in tropical sea cucumbers is generally linked to an increase in seawater temperatures and is spread out over a fairly long period (Hyman 1955). This hot period corresponds to an abundance of phytoplankton in the environment — phytoplankton that serves directly as food for echinoderm larvae. The low density of larvae during the cool season can be explained by the fact that most larvae cannot withstand the drop in seawater temperatures and/or the lack of food (decrease in phytoplankton biomass).

Metamorphosing sea cucumber larvae and postlarvae were only found occasionally in the plankton. The scarcity of these larvae in the water column can be explained by the increase in their weight and the regression of their cilia. This scarcity was probably also due to the brief length of the metamorphosis process, which generally does not last more than an

hour (Hyman 1955), and to the high level of larval mortality that characterises this phase.

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