Transport of *Ucides cordatus* (Decapoda: Ocypodidae) megalopae at various densities and durations.

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ABSTRACT

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Target areas for *Ucides cordatus* restocking programs are often located far from the laboratory where larval rearing is developed. During translocation, the larvae are submitted to highly stressful situations due to handling, packing, and transport activities. The aim of the present study was to assess the mortality rates of *U. cordatus* megalopae related to transport procedures. Megalopae at loading densities of 50, 150, and 300 ind.L^{-1} were packed in double polyethylene 12x25 cm plastic bags with 200 ml of marine water at salinity 30. The bags were filled with oxygen at a proportion of 1:2 parts of water and sealed tightly. The transport trepidations were simulated by the use of a shaker device (800 vibrations/minute) over periods of 3 and 6 hours inside of a dark container. When analyzed immediately after the transport simulation, one way ANOVA did not detect significant differences between survivorship rates observed in treatments and the control group in all tested conditions. However, 24 hours after simulation some of the tested densities resulted in significantly lower survivorships. The results demonstrated that *U. cordatus* megalopae can tolerate up to 6 hours of shaky transportation conditions at high densities with minimal mortality.

KEYWORDS: *Ucides cordatus; transport; stress; larvae; cannibalism.*

INTRODUCTION

The mangrove crab *Ucides cordatus* (Linnaeus, 1763), known in Brazil as "caranguejo-uçá", has a wide geographical distribution along the western Atlantic shores, from Florida (USA) to the Brazilian state of Santa Catarina. This crab is considered an important fishery resource for local populations throughout the Brazilian coast, particularly those surrounding estuarine systems (Glaser 2003).

The combination of overfishing, mangrove habitat degradation and, more recently, the Lethargic Crab Disease (DCL) (Boeger et al., 2005) has contributed to a drastic reduction of natural stocks of *U. cordatus* in several regions of Brazil. Among more classical measures, a possible alternative to help recover these populations is the mass production of megalopae in laboratory, followed by their release directly into the affected areas.

Different aspects of the necessary technology to achieve this goal have been developed by our research group since 2001, when the restocking efforts began. Currently, the annual production is over 1,000,000 megalopae per season (Silva et al., 2006). In the laboratory, ovigerous females captured from near mangrove areas are kept until eggs hatch. The larvae are cultivated in rearing tanks using live planktonic organisms and the females are returned to the original environment. The larvae go through 6 developmental stages until they reach the megalopa phase (Rodriges and Hebling, 1989). At this stage, they are released into specific mangrove areas, target of the stock-enhancement program. Usually, these areas are distant from the laboratory where the larviculture is being developed. Therefore, the larvae must be transported to the releasing regions and are submitted to stress due to handling, packing, and to transport movements

This kind of stressful situation was commonly related to mortality of youngsters in researches conducted with crab and shrimp species. In their transport simulation study, Quinitio and Parado-Estepa (2000) observed lower survivorship rates for *Scilla serrata* megalopae when compared to the results obtained by Hamid and Mardjono (1979) or, even, those of Smith and Ribelin (1984), in their work with shrimp species, under similar conditions. Quinitio and Parado-Estepa (2000) attributed the observed pattern to the cannibalistic behavior of *S. serrata* larvae. However, Ventura et al. (2008) observed that, under experimental conditions, cannibalistic behavior of *U. cordatus* megalopae is negligible, even in conditions of food deprivation.

The aim of the present study was to assess the mortalities rates of *U. cordatus* megalopae in transport.

MATERIALS AND METHODS

Megalopae, at loading densities of 50, 150, and 300 ind.L^{-1}, were packed in 12x25 cm double polyethylene plastic bags, filled with 200 ml of marine water at salinity 30. Bags were inflated with 100 ml of oxygen, at a proportion of 1:2 (part of oxygen: parts of water), and sealed tightly. No food was supplied. The transport trepidations were simulated by the use of a shaker device over periods of 3 and 6 hours inside of a dark container. The device was constructed using an engine (1/20 hp) eccentrically connected to a round plastic platform of 40cm of diameter. The platform, suspended by flexible cables, vibrated 800 times per minute with the force of the running engine. The larval survival rates were analyzed for each bag immediately after transport simulation. Then, experimental larvae were stocked in separate rearing vials at the density of 20 ind.L^{-1}. Marine water was added gradually to equalize larval densities. A control group of megalopae, not submitted to transport simulation, were also stocked in the same manner and kept in the same room as the resting larvae. Neither aeration nor food was supplied. The megalopae were maintained in these vials for 24 h (post-transport simulation) and after this period survivorship rates were analyzed again. The entire procedure was performed in an environmental room, under controlled temperature (26ºC). Experiment was conducted with five replicates for each treatment.

RESULTS

Survivorship rates in all tested groups were high, most of them up to 90%. Immediately after transport, treatments in which larvae were submitted to three hours of simulation have showed no significant differences in relation to survivorship rates of larvae (F=1, p=0.41). However, 24 hours after simulation, survivorship rates in treatments in which densities were 150 and 300 larvae.L-1 were lower than that observed both in control groups and in the treatment with a density of 50 individuals.L-1 (Fig. 1).

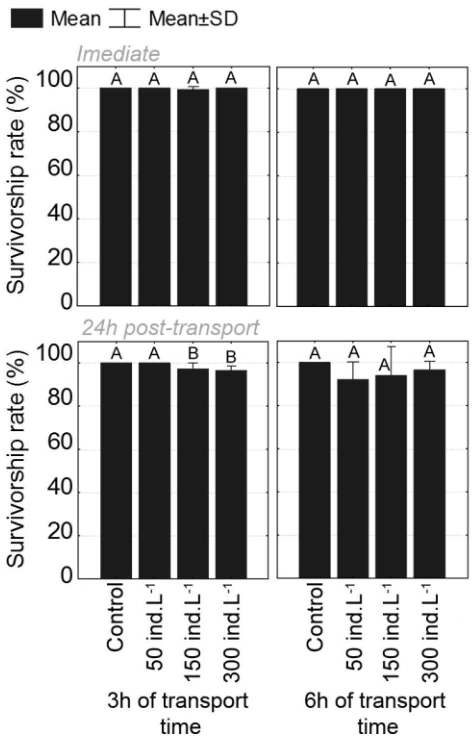

Figure 1 – Survivorship rates of *U. cordatus* megalopae submitted to transport simulations at different loading densities and durations, immediately and 24 hours after simulation. Letters over bars indicate homogeneous groups according to Fisher LSD Test with 5% of significance.

No significant differences were detected between survivorship rates of larvae submitted to six hours of transport simulation in any tested density, including control groups, both immediately (F=5.15 p =0.11) and 24 hours after simulation (F=0.9 p=0.46) (Fig. 1).

Factorial ANOVA did not detect interaction between density and time of transport time, neither immediately (F=2, p = 0.21) nor 24 hours of transport (F=36, p=0.69).

DISCUSSION

Survivorship rates observed in the experiment were similar to that obtained by similar experiments using other decapod crustaceans, specifically shrimp species. According to Hamid and Mardjono (1979), survivorship rates of up to 95% is attainable in transporting experiments with *Peneaus monodon*, at 500 to 600 postlarvae.l^{-1}, over 8h, at temperatures of 22^{o}C . *Litopenaeus vannamei* postlarvae can be packed and shipped at 190 ind.l^{-1} for 18 hours, at 18–20^{o}C, with negligible mortalities (Smith and Ribelin, 1984).

However, when comparing our results with the survivorship rates obtained in experiments conducted with other crab species, it is notable that *U. cordatus* megalopas show higher resistance to transport. Quinitio and Parado-Estepa (2000), studying the transport of *Scilla serrata* megalopae, have observed mean survivorship rates of 78% and 58% in two transport assays, conducted under density of 150 ind.l^{-1}, temperature of 22-24^{o}C, during 6 hours of transport simulation. Survivorship rates after transport were significantly affected by larval density and by the duration of transport simulation, especially 15 hours after the simulation. Considering the significant mortalities obtained, these authors suggest that optimal loading density of transport of *S. serrata* megalopae is 50 ind.l^{-1}.

The high survivorship observed in the experiments corroborates the results of Ventura et al. (2008), who report that *U. cordatus* megalopa shows cannibalistic behavior only over conspecific younger stages, with negligible mortalities related to cannibalism among megalopae, including in conditions of food deprivation.

However, after 24h of resting period, some of the treatments in which higher densities were tested showed decreasing survivorship rates. These significantly lower survival rates were detected in the results of the simulations that lasted for 3 hours, but were not detected in assays in which simulation time was 6 hours. Despite the absence of similarity in results obtained with 3 and 6 hours of transport simulation, this tendency could be an indication that using higher densities may significantly affect the survivorship of *U. cordatus* megalopae.

Based on our results, is possible to suggest that *U. cordatus* megalopae can be transported at loading densities of 300 individuals.l^{-1} during periods of up to 6 hours with minimal mortality. This information will help the establishment of the transport strategy for *U. cordatus* stock restorations programs.

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