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JOURNAL OF CRUSTACEAN BIOLOGY, 33(1), 137-139, 2013

Journal of Crustacean Biology

ESTABLISHED POPULATIONS OF *PARACERCEIS SCULPTA* (ISOPODA) IN THE NORTHERN GULF OF MEXICO

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ABSTRACT

A population of the isopod *Paracerceis sculpta* Holmes, 1904 was found in Port Aransas, Texas in Northern Gulf of Mexico in 2009, the first report of the species in the Gulf of Mexico. The last large isopod survey in the area was conducted in 1981 implying that *P. sculpta* invaded some time in the last 28 years. Here, we show size frequency distributions of 858 individuals, alpha males (mean length = 5.48 mm ± 0.09 SE), pre-alpha males (3.94 mm ± 0.15), females (2.76 mm ± 0.03) and juveniles (1.24 mm ± 0.02). Beta and gamma males are absent in Texas, a major contrasting difference between the invasive and native populations.

KEY WORDS: alternative mating strategies, invasive species, isopod, range expansion

DOI: 10.1163/1937240X-00002112

INTRODUCTION

The intertidal isopod *Paracerceis sculpta* Holmes, 1904 is a model organism for understanding alternative mating strategies (Shuster, 1990; Shuster and Wade, 1991) because of its 3 different male morphs (Shuster, 1987). Alpha males are the largest individuals with enlarged pleotelsons and elongated uropods, who guard cavities of their common habitat, the calcareous sponge *Leucetta losangelensis*. Within these cavities alpha males maintain a harem composed of one or more females. Beta males are morphologically similar to females (although they possess male sexual anatomy) and behave like females to infiltrate harems and mate (Shuster, 1987). Finally, gamma males are very small relative to the other two morphs (although they too possess male sexual anatomy) and are able to sneak undetected into harems (Shuster, 1987). The three male morphs are genetically determined and are subject to longevity and growth to maturity tradeoffs (Shuster and Wade, 1991). These tradeoffs maintain the three male morph frequencies within a given population.

The native range of *P. sculpta* occurs from 32°N in California south to 18°N along the Mexican Pacific coast (Espinoza-Pérez and Hendrickx, 2001). In recent years however, *P. sculpta* has been collected from multiple sites along subtropical habitats. These sites include Australia (Hewitt and Campbell, 2001), Brasil (Pires, 1981), Europe (Rodriguez et al., 1992), and Hong Kong (Bruce, 1990). However, there are no exhaustive surveys of this species outside its native range. Published accounts show fewer than 10 individuals in most cases, which are not enough individuals to begin assessing population structure and morphological differences relative to native populations. In the late 1970's there was an exhaustive taxonomic survey of isopods in Port Aransas, Texas (Clarke, 1978) that yielded no specimens of *P. sculpta*. Here, we present data from 858 individuals collected in Port Aransas in 2009 representing the first detailed account of the occurrence of this species in the Gulf of Mexico.

MATERIALS AND METHODS

Populations of *P. sculpta* were first found in the marina of the University of Texas Marine Science Institute in April 2009, predominantly an oyster reef habitat on which *Pachygrapsus transversus* (Gibbes, 1850) and several amphipod, mud crab, and polychaete species occur (Munguia, unpublished data). The climate in Port Aransas is subtropical, with high (summer) temperatures averaging 32°C and low (winter) temperatures averaging 8°C. The area is quite arid, with average monthly rainfall being less than 0.5 cm with September and October receiving the most precipitation (data obtained from the University of Texas Marine Science Institute).

These first collections of *P. sculpta* occurred in traps used for a survey of small crustaceans. Traps consisted of PVC pipes (10 cm diameter × 20 cm length) tethered to a rope and suspended 0.3-1.0 m from the surface. *Paracerceis sculpta* tend to aggregate, and individuals were easily collected using these contraptions. Population density was not measured, but a survey aimed at identifying *P. sculpta* recruitment patterns was established (in preparation). Traps were collected after short periods of time (24, 48, or 96 hours) or long periods of time (7 days), using zip-log bags, and brought to the lab where contents were sieved and all individuals counted and identified under a dissecting scope. This method has proved to be effective in bringing hard substrate to the surface with minimal loss of individuals (Munguia and Miller, 2008).

RESULTS AND DISCUSSION

We collected and measured 858 individuals collected over five months (April-August, 2009) and sorted them into four different classes, juveniles, females, pre-alpha males, and alpha males. Alpha males were the largest individuals (mean length = 5.48 mm ± 0.09 SE) (Fig. 1) followed by pre-

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DOI:10.1163/1937240X-00002112

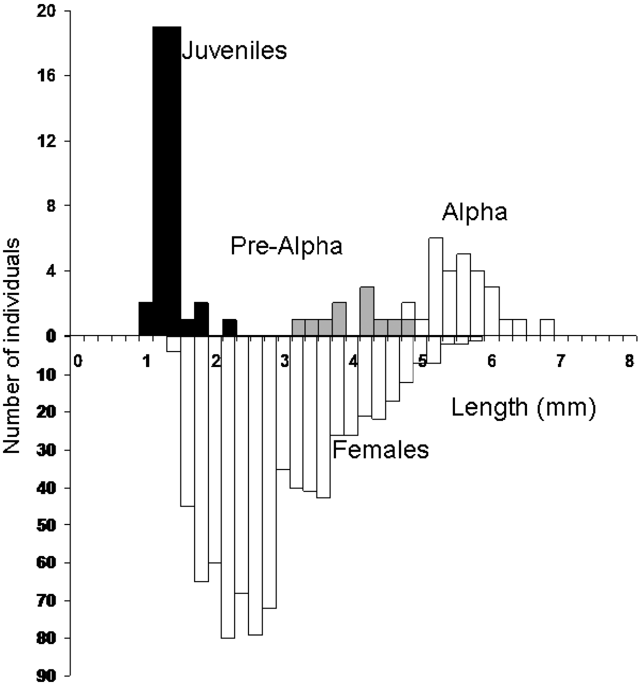

Fig. 1. Size frequency distribution for *Paracerceis sculpta* adults (white bars), pre-alpha (gray bars) and juveniles (black bars). Data are the total number of isopods collected between April and August 2009. Bottom panel shows females. Juveniles could not be identified as either male or female. Note different scales on the *y*-axis.

alpha males (3.94 mm ± 0.15), females (2.76 mm ± 0.03), and juveniles (1.24 mm ± 0.02). Juveniles do not show the reproductive structures that adult isopods have, e.g., enlarged penes or oöstegites, and therefore cannot be sexed. Pre-alpha males are larger than most juvenile individuals; they are further distinguishable from females and juveniles by their possession of slightly more robust pleotelsons and thickened uropods relative to those of females, although not possessing the conspicuously elongated uropods observed in alpha males. Observations suggest that mature alpha males may suppress final development in pre-alpha males within aggregations; when pre-alphas are separated from a large group and placed in individual containers, they develop long uropods after molting and look exactly like a mature alpha within 24 hours.

In Port Aransas, the common encrusting sponge *L. losangelensis* has not been found. *Paracerceis sculpta* in Texas occurs along hard substrate, inhabiting crevices within oyster reefs. This shift in habitat is not atypical, as other invasive populations of *P. sculpta* have been shown to occur on hard substrate and even soft-sediment areas (Espinoza-Perez and Hendrickx, 2001; Hewitt and Campbell, 2001). *Paracerceis sculpta* is abundant during the warm months from April through October. During colder months it is rarely found in crustacean survey traps, suggesting individuals move to other habitats, to deeper water, or become more sedentary.

The Texas population appears to be missing beta and gamma males; their absence could be a result of a genetic bottleneck as individuals were transported to the novel habitat given that male morphs are genetically determined (Shuster, 1989; Shuster and Sassaman, 1997). Beta and gamma males have a shorter lifespan relative to alpha males (Shuster and Wade, 1991). If animals were transported in ballast water or as residents of fouling species on the hull of ships (Hewitt and Campbell, 2001), then perhaps only alpha males were able to colonize new locations. This pattern would be consistent with other reports of non-native populations of *P. sculpta*, where only alpha males were found but no records of beta or gamma males exist (Pires, 1981; Bruce, 1990; Rodriguez et al., 1992; Hewitt and Campbell, 2001). Lack of alternative mating morphs could have rapid and profound changes in mating strategies and life history traits.

We estimate that *Paracerceis sculpta* invaded the Gulf of Mexico within the last 30 years. Given the rapid proliferation of this species as recorded in recent surveys (see Hewitt and Campbell, 2001 for a map of introductions), we could expect *P. sculpta* to be found in other areas of the Gulf of Mexico. However, a recent extensive taxonomic survey of Gulf of Mexico isopods does not list *P. sculpta* among the sphaeromatids in this region (Schotte et al., 2009). The implications behind this rapid proliferation are yet unknown, but transporting individuals across large expanses of water could create genetic bottlenecks, which may result in strong population-level differences between invasive and native genotypes.

ACKNOWLEDGEMENTS

We would like to thank Kristen Duszak, Charlotte Heron, Louisa Torrance, and Rebecca Pizano for assisting with field surveys.

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RECEIVED: 15 August 2012.
ACCEPTED: 6 September 2012.
AVAILABLE ONLINE: 17 October 2012.