ELTHUSA ALVARADOENSIS ROCHA-RAMÍREZ, CHÁVEZ-LÓPEZ & BRUCE, 2005 (ISOPODA, CYMOTHOIDAE) PARASITIZING THE INSHORE LIZARDFISH, *SYNODUS FOETENS* (LINNAEUS, 1766) ON THE CONTINENTAL SHELF OFF CENTRAL VERACRUZ, MEXICO

BY

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ABSTRACT

The prevalence, fecundity, and size distribution of the isopod, *Elthusa alvaradoensis*, parasitizing the inshore lizardfish, *Synodus foetens* on the continental shelf off central Veracruz, Mexico, were studied. A total sample of 136 fish with a 46.3% prevalence of *E. alvaradoensis* was obtained during a survey cruise in February, 1996. The isopods were preferentially located on the second and third branchial arches; the lesions ranged from a slight abrasion of the branchial filaments to their complete removal. Mean host size did not vary significantly between the parasitized and unparasitized fractions. Maximum total length for male parasites was 12 mm, while female size ranged from 14.5 to 26.3 mm. Parasite fecundity varied from 100 to 2280 eggs and was unrelated to female size ($p < 0.05$). Male parasites exhibit a positive allometric growth, while this is negative for females.

RESUMEN

Se estudió la prevalencia, fecundidad y distribución de tallas del isópodo *Elthusa alvaradoensis* parasitando el lagarto máximo, *Synodus foetens*, en la plataforma central de Veracruz, México. De la muestra total de 136 peces obtenida de un crucero de estudio en febrero de 1996, la prevalencia de *E. alvaradoensis* fue del 46.3%. Los isópodos fueron localizados preferentemente en el segundo y tercer

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arco branquial; las lesiones observadas fueron desde la abrasión de los filamentos branquiales hasta la remoción completa de los mismos. La talla promedio del hospedero no varió significativamente entre la fracción parasitada y la no parasitada. La longitud total máxima de las machos parásitos fue de 12 mm, mientras la talla de las hembras varió de 14.5 a 26.3 mm. La fecundidad del parásito osciló de 100 a 2280 huevos y no se relacionó con la talla de la hembra ($p < 0.05$). Los machos parásitos exhiben crecimiento alométrico positivo y negativo en las hembras.

INTRODUCTION

The cymothoid fauna of the Mexican portion of the Gulf of Mexico is still poorly known. Previous studies (Pearse, 1952; Overstreet, 1983, Kensley & Schotte, 1989; Cházaro et al., 2002; Winfield et al., 2002) suggest the presence of a significant number of species in the region. Rocha et al. (2005) reported the first record of the genus *Elthusa* in the tropical western North Atlantic

The inshore lizardfish, *Synodus foetens* (Linnaeus, 1776) is a carnivorous fish, very abundant along the continental shelf of the Gulf of Mexico, and often captured as shrimp by-catch. It is distributed from New England to southern Brazil, including Bermuda and the Bahamas, at depths ranging from 10 to 110 m (Fischer, 1978). Two species of cymothoid isopods have previously been recorded from *S. foetens*: *Lironeca texana* Pearse, 1952 off Padre Island, Texas (Pearse, 1952; Trilles, 1991) and *Cymothoa excisa* Perty, 1834, also from the Texas coast, occurring inside the mouth of the host (Kensley & Schotte, 1989).

Here we report on the occurrence of *Elthusa alvaradoensis* Rocha-Ramírez, Chávez-López & Bruce, 2005, parasitizing the lizardfish, *S. foetens*, off central Veracruz. The data come from a survey cruise conducted in February, 1996.

MATERIALS AND METHODS

The sampling area is located off the port of Alvarado (18°45′-19°0′N 95°40′-95°57′W) on the central continental shelf of Veracruz, Mexico (fig. 1). Trawling was conducted at night on 24-26 February 1996. The five stations surveyed were located 2.5 to 8 km off the coast, at depths ranging from 20 to 50 m. Thirty-minute trawls were conducted at each station using a 30 ft (approx. 10 m) otter trawl. All fish captured were weighed, measured (standard length), and fixed in 10% formalin. Isopods were removed from the branchial chambers of *Synodus foetens* and transferred to 70% ethanol; the degree of damage caused to the branchial filaments was recorded. No isopods were found in the mouth. All isopods were sexed and measured (total length and pereonite V width). Fecundity was estimated by counting the total number of eggs in each female; up to 200 eggs were measured from each batch and the degree of development of the embryos was recorded.

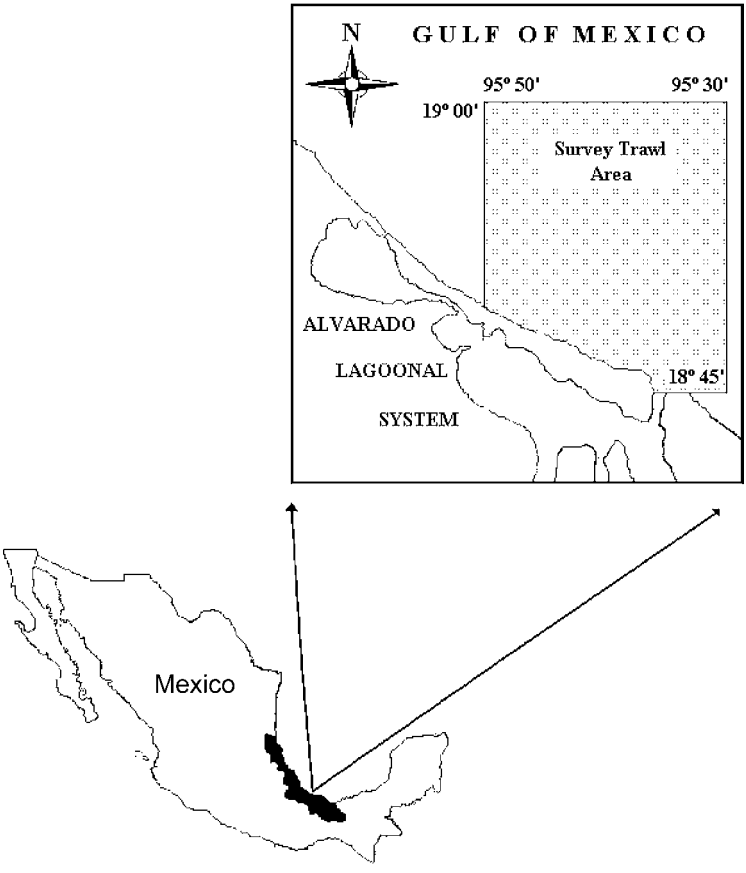

Fig. 1. Sampling area on the central continental shelf off Veracruz, Mexico.

Statistical analysis included Student's *t*-test to compare parasitized and unparasitized host length and weight, linear regression to estimate parasite growth, and fecundity.

RESULTS

A total of 136 *Synodus foetens* was captured off the port of Alvarado at a depth of 30 m; 63 (46%) were parasitized with *Elthusa alvaradoensis*. All isopods were found in the branchial chambers, with their heads oriented towards the buccal cavity; in the largest individuals the dorsal surface was pressed against the host's operculum, producing an externally visible, oval deformation. The most obvious effect caused by the isopod was the atrophy of the branchial filaments and, in some extreme cases, the complete removal of branchial arches. The isopods were

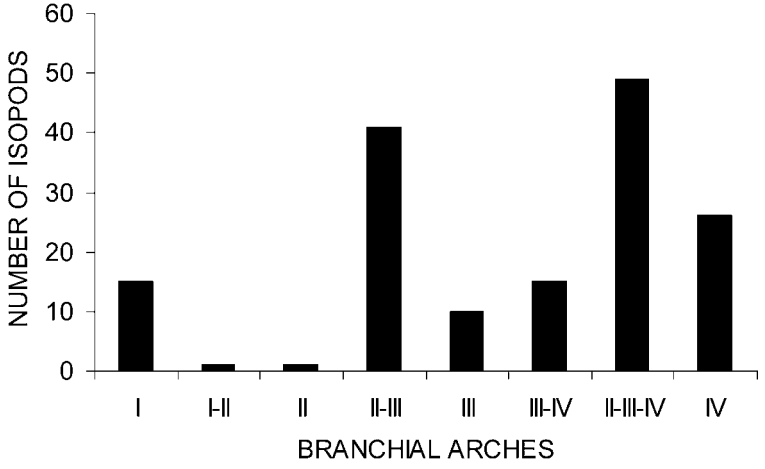

Fig. 2. Frequency distribution of isopods, *Elthusa alvaradoensis* Rocha-Ramírez, Chávez-López & Bruce, 2005, on the branchial arches of *Synodus foetens* (Linnaeus, 1766).

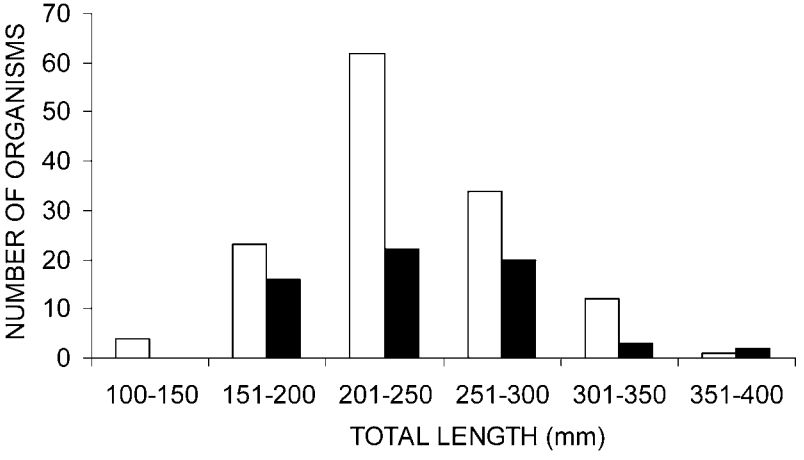

Fig. 3. Size frequency distribution of *Synodus foetens* (Linnaeus, 1766) non-parasitized (open bars) and parasitized (solid bars) by *Elthusa alvaradoensis* Rocha-Ramírez, Chávez-López & Bruce, 2005.

preferentially attached to branchial arches II, III, and IV, usually occupying more than one arch (fig. 2).

Host size varied from 113 to 371 mm, while the parasitized fraction ranged from 163 to 371 mm, the sizes with the heaviest prevalence being 160 to 250 mm (fig. 3). No significant differences were detected between the mean total lengths of parasitized and unparasitized hosts (t-test, $p > 0.05$). Host weight varied between 11.2 and 302 g, with the parasitized fraction weighing 22.2 to 302 g; no significant differences were found between the mean weight of parasitized and unparasitized hosts (t-test, $p > 0.05$).

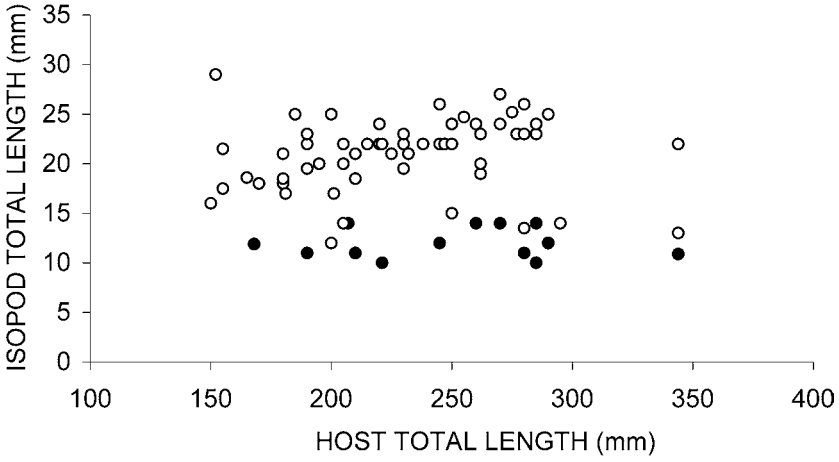

Fig. 4. Scatterplot of isopod *Elthusa alvaradoensis* Rocha-Ramírez, Chávez-López & Bruce, 2005, total length (open circles = females, solid circles = males) vs. total length of the host, *Synodus foetens* (Linnaeus, 1766).

A total of 86 isopods was obtained from the 63 parasitized *S. foetens*. Regarding the size composition, *E. alvaradoensis* males ranged in total length from 10 to 12 mm ($\bar{x} = 11.24 \pm 0.62$ mm, $n = 23$), while females ranged in size from 14.5 to 26.3 mm ($\bar{x} = 20.84 \pm 2.4$ mm, $n = 63$); all females were ovigerous. Single isopod occurrences were recorded in 41 (65%) of the 63 parasitized fishes, whereas multiple infestations were found in the remaining 22 fishes. In 21 of the multiple infestations two isopods were present, in 20 cases a male and a female were found, while only in one case two males were present. In one case three isopods, one female and two males, were found.

Isopod size was not correlated to host size, neither in general, nor by separate sexes (males, $n = 23$, $r = 0.007$; females, $n = 63$, $r = 0.11$) (fig. 4).

As expected, the width-length relationship for male and female isopods was different, with males showing positive allometry ($W = 1.608TL - 7.31$, $r = 0.87$, $p < 0.01$) and females negative allometry ($W = 0.354TL + 1.25$, $r = 0.84$, $p < 0.01$).

Isopod fecundity ranged from 100 to 2280 eggs ($\bar{x} = 611 \pm 504$) and was unrelated to total length but significantly correlated to body width (number of eggs $= 87.929W - 112.58$, $r = 0.22$, $p < 0.05$). Eggs were classified into four different groups. In the first stage, eggs were undifferentiated, white, spherical, measuring 0.37 ± 0.04 mm. In the second stage, eggs could be spherical, ovoid, or slightly rhomboidal, light brown, had a more rigid consistency, and measured 0.5 ± 0.09 mm. In the third stage, white embryos were visible, the cephalic portion was discernible although no eyes could be seen, measuring 0.8 ± 0.12 mm. The

last stage corresponds to the manca larva, with eyes, antennae, and six pairs of pereiopods; these measured 1.1 ± 0.11 mm.

DISCUSSION

The presence of cymothoid isopods in the fish community off the port of Alvarado has been recorded since 1992 (R. Chávez-López and A. Rocha-Ramírez, unpubl. data). The coastal fish community in the area is composed of 158 species (Pélaez-Rodríguez et al., 2005), of which only, besides this new record, the bluntnose jack, *Hemycaranx amblyrhynchus* (Cuvier, 1833) is known to be parasitized by isopods, i.e., by *Cymothoa caraibica* Bovallius, 1885.

Interestingly, of the five species representing the family Synodontidae in the area (*Synodus foetens*, the offshore lizardfish, *S. poeyi* Jordan, 1877, the sand diver, *S. intermedius* (Spix & Agassiz, 1829), the Brazilian lizardfish, *Saurida brasiliensis* Norman, 1935, and the snakefish, *Trachinocephalus myops* (Forster, 1801)), only *S. foetens* is parasitized by isopods, suggesting a very high host specificity.

Lironeca texana and *Cymothoa excisa*, previously recorded from *S. foetens*, have not been found in the southwestern Gulf of Mexico; the former species has only been recorded off Padre Island, Texas (Pearse, 1952; Trilles, 1991), while the latter has a widespread distribution in the northern Gulf of Mexico and the Caribbean (Kensley & Schotte, 1989).

Similar to other isopod-fish associations, *Elthusa alvaradoensis* parasitizes adult fishes, with the initial infections appearing in hosts measuring 163 mm TL. The smallest parasitized hosts harboured female isopods, suggesting that the initial infection may occur at a smaller host size.

Although it has been suggested that high isopod prevalences, as well as the parasitization of several related species in the same area, may be the result of the schooling behaviour of the host species (Brusca, 1978; Alvarez & Flores, 1997), the high specificity recorded for *E. alvaradoensis* suggests a well-developed host-selection behaviour.

In contrast with *Cymothoa exigua* Schiödte & Meinert, 1884, parasitizing the Pacific red snapper, *Lutjanus peru* (Nichols & Murphy, 1922), where there is a positive relationship between female isopod size and host size (Alvarez & Flores, 1997), in the case of *E. alvaradoensis*, female isopod size does not increase with host size. This pattern suggests that all lizard fish size classes larger than 160 mm are equally vulnerable to infection. It also suggests, since all female isopods were ovigerous, that they may become ovigerous in the first moult after changing sex.

The fecundity of *E. alvaradoensis* is among the highest recorded for cymothoid isopods. Without attempting to present an exhaustive list, the maximum number

of eggs found in several species is as follows: *Mothocya bohlkeorum* Williams & Williams, 1982, 170 eggs; *Glossobius hemiramphi* Williams & Williams, 1985, 586 eggs; *Kuna insularis* Williams & Williams, 1985 (cf. also 1986), 669 eggs; *Renocila kohnoi* Williams & Williams, 1987, 219 eggs; *R. yamazatoi* Williams & Williams, 1987, 354 eggs. All those cases count less than half of what has been found for *E. alvaradoensis* (2280 eggs). However, *Anilocra physodes* (Linnaeus, 1758) can produce up to 1600 eggs (Trilles, 1964).

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