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Selective predation by the zoarcid fish *Thermarces cerberus* at hydrothermal vents

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Abstract

This study investigates predation by the vent zoarcid fish *Thermarces cerberus* through gastrointestinal analyses of 27 specimens collected with the submersible ALVIN at vents at 9°50′N on the East Pacific Rise. *T. cerberus* fed most frequently on gastropod mollusks (mainly *Lepetodrilus elevatus)* and amphipod crustaceans (mainly *Ventiella sulfuris*). Species found occasionally in high abundance included the swarming amphipod *Halice hesmonectes* and the snail *Cyathermia naticoides*. Other items also found in gastrointestinal tracts, but in very low numbers, included polychaete worms, crustaceans and unidentified tissue clumps. The comparison between the size distribution of *L. elevatus* limpets ingested by *T. cerberus* and those found attached to vestimentiferan tubes suggest that the fish may selectively prey on large limpets. If the selective removal of large *Lepetodrilus* spp. limpets by *T. cerberus* does occur, then it would have potential community-level consequences at hydrothermal vents, since these mobile gastropods appear to inhibit the settlement of sessile vent species, including tube-building worms. Our results suggest possible direct and indirect effects of *T. cerberus* on benthic community structure at hydrothermal vents on the East Pacific Rise.

Keywords: Predation; Vent fish; Deep sea; Hydrothermal vents; Diet; East Pacific Rise

1. Introduction

Deep-sea hydrothermal vents commonly have low diversity of physiologically specialized predators and experience few visits by opportunistic

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predators from surrounding habitats, likely because of the toxicity of hydrogen sulfide found at vents to non-specialized organisms (Voight, 2000). Zoarcid fishes are specialized predators commonly found in sulfide-rich habitats such as hydrothermal vents, cold seeps and whale skeletons (Desbruyères and Segonzac, 1997; Sibuet and Olu, 1998; Biscoito et al., 2002). Zoarcids of the genus *Thermarces* are conspicuous members of deep-sea hydrothermal vent communities of the East Pacific Rise (Cohen et al., 1985; Rosenblatt and Cohen, 1986; Biscoito et al., 2002). The taxonomy of the species inhabiting the hydrothermal vents near 9°N at the East Pacific Rise (EPR) has been debated among ichthyologists (Rosenblatt and Cohen, 1986; Geistdoerfer and Seuront, 1995; Biscoito et al., 2002), but we will follow the recommendations by Biscoito et al. (2001), and refer to all the specimens we collected at this site as *Thermarces cerberus*. None of the fish collected for this study had the dusky brown coloration typical of the other *Thermarces* species found at the 9°N East Pacific Rise site (Biscoito et al., 2001).

T. cerberus lives among the vestimentiferan worm communities (vestimentiferans are now considered to be members of the polychaete family Sibloglinidae, but will be referred to herein as vestimentiferans to differentiate them from other sibloglinids; Rouse, 2001) and near high-temperature vents along the East Pacific Rise, in 8–12 °C waters (Geistdoerfer and Seuront, 1995). Geistdoerfer and Seuront (1995) described the diet of *T. cerberus* as dominated by amphipods, with limpets as the second most abundant prey items. Fragments of vestimentiferans have been reported in *T. cerberus* stomachs (Rosenblatt and Cohen, 1986; Geistdoerfer and Seuront, 1995), but these reports remain ambiguous because disturbance events caused by research submersibles could make broken vestimentiferan remains available to fish (Rosenblatt and Cohen, 1986).

Though predation has been shown to directly and indirectly influence natural aquatic communities through complex webs of species interactions (Paine, 1969; Menge et al., 1994; Hixon and Brostoff, 1996), biological interactions have been generally considered to play relatively minor roles in determining the structure of hydrothermal vent communities (Tunnicliffe and Juniper, 1990; Van Dover, 1995). But recent predatory exclusion experiments at the East Pacific Rise vents (Micheli et al., 2002) suggest that *T. cerberus* influences the structure of hydrothermal vent benthic communities by consuming mobile gastropods and indirectly reducing their grazing on recruits of mobile and sessile invertebrates, including vestimentiferans. The present study analyzes the composition and size of prey items in guts of *T. cerberus* individuals caught using the submersible ALVIN in order to understand the fish's role as a predator in potentially structuring hydrothermal vent animal communities on the East Pacific Rise.

2. Methods

T. cerberus specimens were collected at two hydrothermal vent sites ('East Wall' and 'Biovent') along the axial valley on the East Pacific Rise (9°50′N, 104°17′W) at depths that ranged between 2490 and 2520 m. Detailed description of the physical and chemical characteristics of this vent field can be found elsewhere (Detrick et al., 1987; Haymon et al., 1991; Lutz et al., 1994). Fish were caught from among or near megafaunal communities dominated by vestimentiferan tubeworms (mainly *Riftia pachyptila*) or vent mussels (*Bathymodiolus thermophilus*).

A total of 27 *T. cerberus* specimens was collected and analyzed, eight specimens in 1998, 13 in 1999, and six in 2000. Specimens were captured at the 'East Wall' ($n = 24$) and 'Biovent' ($n = 3$) sites. Samples were pooled between the two sites for subsequent analyses because of the similar invertebrate communities and close proximity (800 m) of these sites (Mullineaux et al., 2003), and the potentially high mobility of *T. cerberus* (G. Sancho, personal observation). Fish were captured alive with a multi-chambered suction sampler attached to the submersible ALVIN. On reaching the surface they were transferred immediately to a cold room in order to minimize decomposition of the gut contents. Within 2 h, each fish was measured (total length, and when possible standard length and weight), sexed and dissected, with preservation of the stomach and intestines sepa-