Deep-Sea Research I 80 (2013) 25–36

Contents lists available at SciVerse ScienceDirect

Deep-Sea Research I

journal homepage: www.elsevier.com/locate/dsri

Trophic ecology of deep-sea Asteroidea (Echinodermata) from eastern Canada

Katie S.P. Gale [a,*], Jean-François Hamel [b], Annie Mercier [a]

[a] Department of Ocean Sciences, Memorial University, St. John's, Newfoundland and Labrador, Canada A1C 5S7
[b] Society for the Exploration and Valuing of the Environment, Portugal Cove-St. Philips, Newfoundland and Labrador, Canada A1M 2B7

ARTICLE INFO

Article history:
Received 19 March 2013
Received in revised form
22 May 2013
Accepted 7 June 2013
Available online 19 June 2013

Keywords:
Diet
Stable isotopes
Benthos
Northwest Atlantic
Sea star
Bathyal

ABSTRACT

Asteroids (sea stars) can be important predators in benthic communities and are often present in ecologically important and vulnerable deep-sea coral and sponge habitats. However, explicit studies on the trophic ecology of deep-sea asteroids are rare. We investigated the diets of seven species of deep-sea asteroid from the bathyal zone of Newfoundland and Labrador, eastern Canada. A multifaceted approach including live animal observations, stomach content analysis, and stable isotope analysis revealed the asteroids to be either top predators of megafauna or secondary consumers (mud ingesters, infaunal predators, and suspension feeders). The stable isotope signatures of *Ceramaster granularis, Hippasteria phrygiana,* and *Mediaster bairdi* are characteristic of high-level predators, having $\delta^{15}N$ values 4.4‰ (more than one trophic level) above *Ctenodiscus crispatus, Leptychaster arcticus, Novodinia americana,* and *Zoroaster fulgens.* We present strong evidence that corals and sponges are common food items for two of the predatory species, *C. granularis* and *H. phrygiana*. During laboratory feeding trials, live *H. phrygiana* fed on several species of soft coral and *C. granularis* fed on sponges. Stomach content analysis of wild-caught individuals revealed sclerites from sea pens (e.g. *Pennatula* sp.) in the stomachs of both asteroid species; *H. phrygiana* also contained sclerites from at least two other species of octocoral and siliceous sponge spicules were present in the stomachs of *C. granularis.* The stomach contents of the secondary consumers contained a range of invertebrate material. *Leptychaster arcticus* and *Ctenodiscus crispatus* feed infaunally on bulk sediment and molluscs, *Zoroaster fulgens* is a generalist infaunal predator, and the brisingid *Novodinia americana* is a specialist suspension feeder on benthopelagic crustaceans. This study provides a foundation for understanding the ecological roles of bathyal asteroids, and suggests that some species may have the potential to be important modulators of deep-sea benthic communities.

1. Introduction

Non-chemotrophic deep-sea food webs depend on the surface production of organic material, including phytodetritus, particulate organic material (POM), and food-falls (animal carcasses), that is either seasonal or localized; hence, food limitation is common in deep-sea ecosystems (Gage and Tyler, 1991; Sokolova, 2000). With limited food input and low densities of organisms, most areas of the deep sea appear to promote opportunistic feeding behaviors. Predatory specialists are rare, whereas deposit-feeders are more common in deep than in shallow waters (Carey, 1972; Gage and Tyler, 1991).

Many species of sea star, or asteroid (Echinodermata: Asteroidea), are known to be important predators in benthic communities worldwide and in some cases can be integral to shaping food webs (Paine, 1966; Menge, 1982). The feeding behaviors of many polar and temperate shallow-water species have been shown to strongly influence local biodiversity. For example, the Northeast Pacific asteroid *Pisaster ochraceus* maintains space availability in the rocky intertidal by preying on mussel beds (Paine, 1966), and the Antarctic asteroid *Odontaster validus* feeds on the larvae of sponge predators, removing pressure on the sponges and allowing them to flourish (Dayton et al., 1974).

Asteroids are found throughout the world's oceans at bathyal and abyssal depths (Carey, 1972; Howell et al., 2002; Hendrickx et al., 2011), but information on the biology of most deep-sea species remains scarce. Although the diets of a number of deep-sea asteroids have been described from stomach contents (e.g., Carey, 1972; Mah, 2007), the general and trophic ecology of most species have received little attention. Some species, particularly those in the family Goniasteridae, have been suggested to be important predators of cold-water corals (Krieger and Wing, 2002; Mah et al., 2010), but it is still unclear whether deep-sea asteroids

* Corresponding author. Tel.: +1 709 864 3247.
E-mail addresses: kgale@mun.ca (K.S.P. Gale), jfhamel.seve@gmail.com (J.-F. Hamel), amercier@mun.ca (A. Mercier).

0967-0637/$ - see front matter © 2013 Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.dsr.2013.05.016