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Short Note

Predation on anchovy larvae by a pelagic chaetognatha, *Sagitta nagae* in the Sagami Bay, central Japan

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Abstract— Anchovy larvae were detected in the gut of *Sagitta nagae* collected near Ōshima Island in Sagami Bay during the night on 23 May 1996. *S. nagae* attacked the anchovy larvae actively when they encountered the aggregation of larvae. Generally, large animals consumed larger prey and there is a good correlation between body length of *S. nagae* and their prey size. Many *S. nagae* caught anchovy larvae from tail.

Key words: chaetognath, predation, anchovy larvae, Sagami Bay

Introduction

The phylum chaetognatha consists of some 100 species arranged in 22 Genera (Bieri 1991). Chaetognaths are present in every marine habitat, from the benthos to all zones of coastal waters and open oceans. Although small (2–120 mm), they are often abundant, and play an important role in the marine food web as the primary predators of copepods. The biomass of chaetognaths has been estimated as 10–30% of that of copepods in the world oceans (Grey 1930)

One of the earlest chaetognaths diet was reported by Busk (1856). In their guts he found fragments of minute fish, crustaceans and other chaetognaths. In another early report, Scott (1892) noted that *Sagitta* feeds on larval fishes, copepods and small amphipods. In recent studies the gut contents of chaetognaths have been quantitatively analyzed to allow estimation of the daily feeding rate and energetic budgets (Pearre 1981, Terazaki 1995).

Present study reports the predation on anchovy larvae by chaetognath collected from Sagami Bay, central Japan.

Materials and Methods

Zooplankton samples were collected with surface horizontal tows at 8 stations (Sts. 1–8) in Sagami Bay in the night of 23–25 May 1996 during the cruise of R/V Hakuho Maru (KH-96-2). A 160-cm ORI net with 0.67 mm mesh-size (Omori, 1965) was used for sampling and volume of water filtered was determined with a RGS flowmeter attached to the net ring.

Samples were preserved in 10% formalin seawater solution neutralized with hexamine. In the laboratory, the chaetognaths were classified to species level and the gut contents examined with a stereomicroscope.

Results

Four species, *Sagitta nagae*, *S. enflata*, *S. robusta* and *Pterosagitta draco* were identified, with *S. nagae* as dominant (more than 94%). Abundance of fish larvae, mainly anchovy (*Engraulis japonica*) was less than 400 individuals/m^3 except St. 3 (34–33N, 139–08E) near Ōshima Island. Abundance of fish larvae and *S. nagae* at St. 3 were 4550 and 2623, respectively.

Total 15 *S. nagae* which body length ranged from 12.0 mm to 20.0 mm consumed anchovy larvae at this station (Fig. 1). The size of larvae was 3.0–8.0 mm (4.9 mm in mean). Generally, large animals ate larger prey and there is a good correlation between body length of *S. nagae* and their prey size ($r=0.838$, $P<0.01$: Fig. 2). Except one individual, all *S. nagae* caught anchovy larvae from tail.

Discussion

According to previous reports, chaetognaths consumed herring larvae, red sea bream larvae, anchovy larvae, sardine larvae and squid larvae in the various waters of world oceans (Table 1). Anchovy larvae was consumed by *S. hexaptera* (Alvariño 1985) and *S. nagae* (Sugisaki unpublished).

Coastal shirasu (anchovy or sardine larvae) fisheries is

very popular in the Enshu-nada and Suruga Bay in the spring season (Funakoshi 1988, Yoo and Nakata 2001). Especially, fishery catch of anchovy larvae reached to 1200 tons in the Enshu-nada Sea from April to June in 1996. Abundance of fish larvae (mainly anchovy) at St. 3, is high according to the previous report in this area (Okazaki et al. 2003). Mass occurrence of anchovy larvae at this station might be caused the transportation from Enshu-nada Sea or Suruga Bay by the warm Kuroshio current.

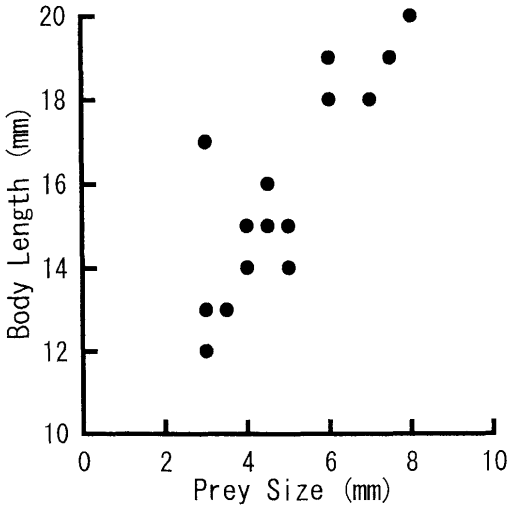

Fig. 1. Anchovy larvae in the gut of chaetognath, *Sagitta nagae* collected from Sagami Bay.

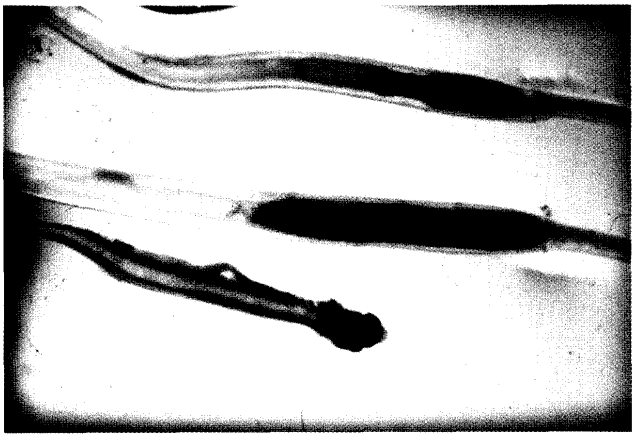

Fig. 2. Correlation between body length of predator (*Sagitta nagae*) and prey size (Anchovy larvae).

S. nagae does the diurnal vertical migration and migrates the surface layer after the sunset (Nagasawa and Marumo 1975) and active feeding was reported during the night (Nagasawa and Marumo 1972). Therefore, it might be suggested that *S. nagae* attacked actively the larvae in the night.

Many anchovy larvae were caught from tail part. Chaetognaths detect prey by sensing their movement. In the laboratory, attacks have been experimentally induced against low frequency vibrating probes placed within millimeters of the animal's body (Horridge and Boulton 1967, Feigenbaum and Reeve 1977). Fish larvae and other chaetognaths may be detected by their tail beat, although lateral motion alone may be sufficient (Feigenbaum and Reeve 1977). Rigid prey is manipulated by the hooks and eaten endwise, sticking out of the mouth for long periods of time in some cases. Soft-bodied prey such as fish larvae are sometimes folded over (Kuhlmann 1977). Therefore, anchovy larvae might be captured when they were moving away from *S. nagae*.

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Table 1. Predation on fish larvae by pelagic chaetognaths

Chaetognath species	Sampling area	Prey	Reference
Eukrohnia hamata	British Columbia	herring	Lee (1966)
Sagitta crassa	Seto Inland Sea	red sea bream	Fukuhara and Fukunaga (1984)
S. enflata	Toi Cape, southern Japan	squid	Araya and Otsuki (1955)
S. euneritica	Arabia Sea	sardine	Alvariño (1985)
S. hexaptera	Carifornia current	anchovy · sardine	Alvariño (1985)
S. nagae	off Sanriku	anchovy	Sugisaki (unpublished)
	Sagami Bay	anchovy	present study
S. robusta	Toi Cape, southern Japan	squid	Araya and Otsuki (1955)

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