

SHORTER CONTRIBUTION

Surface Swarming of Hyperiid Amphipod *Themisto japonica* in the Southeastern Region, Sea of Japan

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Abstract

A surface swarm of hyperiid amphipod, *Themisto japonica* was observed at night on October 15, 1984 off the coast of Joetsu City in the Sea of Japan. The swimming direction of the swarm frequently changed and its shape was ball-like or disk-like. Low estimate values of the density and biomass of the swarming population were $2.2 \times 10^4/\text{m}^3$ and $77\text{g}/\text{m}^3$ respectively. The percentage of juveniles of unidentified sex was 87%. Body lengths varied from 3.39 to 7.24mm (average 4.67mm). The contents were present in all stomachs of subsample specimens. A high percentage of specimens were taken with unidentifiable matter (96%) and crustacean remains (74%) in their stomachs.

Key words Swarming, hyperiid amphipod, *Themisto japonica*, Sea of Japan

Introduction

Swarms of planktonic crustacean were

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studied by many workers (CLUTTER 1969; HAMNER and CARLETON 1979; OMORI and HAMNER 1982; UEDA *et al.* 1983). CLUTTER (1969) suggested that adaptive significances of the swarm were in keeping location of habitat, reducing of feeding pressure, efficiency of mating, and control of population density. Swarming of copepods, mysids, amphipods, euphausiids and sergestids were reported. Studies done on swarms of the hyperiid amphipod were few in the works of NAIR (1972), *Hyperia sibaginis* STEBBING and of LOBEL and RANDALL (1986), *Anchylomera blossevilli* MULINE-EDWARDS.

We chanced upon a swarm of the hyperiid amphipod *Themisto japonica* BOVALLIUS in the Sea of Japan during the cruise of the R/V Mizuho-Mar. In the present paper, we have described our field observations and examined the population compositions and stomach contents of the swarming amphipods.

Materials and methods

When we were collecting water samples with Nansen water bottles on the cruise of the R/V Mizuho-Mar, a swarm of amphipods occurred at about at 19:00 on the night of October 15, 1984 at Sta. 1. This station was located 20 miles off Joetsu City in the southeastern region, Sea of Japan (Lat. $37^{\circ}26.9'N$, Long. $137^{\circ}58.4'E$) (Fig. 1) and the bottom depth was about 1050m. A part of the amphipods swarm was scooped by a landing net (net mouth diameter 0.2m mesh aperture 0.35

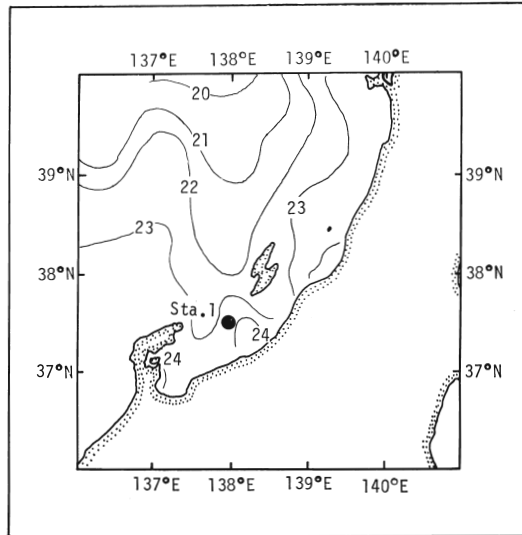


Fig. 1. The station observed swarming of *Themisto japonica*. Surface water temperature in the early part of October was shown from JAPAN SEA REGIONAL FISHERIES RESEARCH LABORATORY (1984).

mm). The collection was preserved in sea water of 5% buffered formalin. The specimen was measured for total body length, and the maturity stage was checked. Total body length was measured from the anterior margin of the head to the tip of the telson using a Kogakusha micrometer (precision ± 0.01 mm).

The maturity stages of *T. japonica* were as follows: Juveniles: oostegites were not visible, antenna 1 and 2 were unsegmented, and distinction of sex is unidentified. Adolescent and adult of female: oostegites were visible. Adolescent and adult of male: antenna 1 was segmented. Stomachs of the 50 specimens (total body length ranging from 3.71 to 6.35mm, average 5.02mm) were dissected and their contents examined under a microscope.

Oceanographical observations were made for temperature, salinity, dissolved oxygen content, and chlorophyll *a* concentration at Sta. 1 (KITANI and NAGATA un-

published data).

Results

1 Oceanographic condition

Surface water temperature in the early part of October off the coast of Joetsu City ranges from 23 to 25°C (JAPAN SEA REGIONAL FISHERIES RESEARCH LABORATORY 1984). On the sampling day, air temperature was 17.2°C and the surface water temperature was cooler than normal at 21.4°C (Fig. 2). Mixed layers were observed formed between 0 and 30m depth. Salinity was low (33.7) from 0 to 30m depth and high (34.5) at about 70–100m depth. Dissolved oxygen contents were high (more than 5.0ml/l) above 300m depth. The maximum chlorophyll *a* concentration was 0.024mg/m³ at 48m depth, and the value was lower than concentrations for this season of other years (OHWADA 1971; KANO *et al.* 1984). *T.*

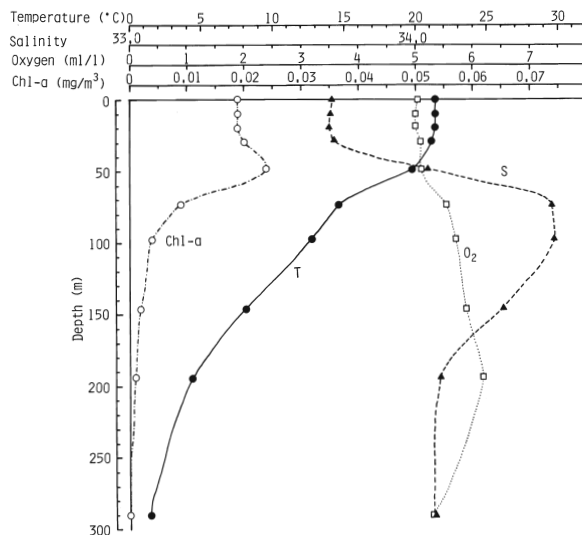


Fig. 2. Vertical profiles of temperature, salinity, dissolved oxygen contents and chlorophyll concentrations.

japonica inhibits cold water in the north Pacific (BOWMAN 1960). Surface water temperatures in the present study seemed to be higher than optimum for this species.

2 Field observation

A swarm was found the ship board at about 19:00 and at first appeared to be a shoal of small young fish. It swam in a nondirected motion at the sea surface near the vessel for about five minutes and then went away. Its shape changed from ball-like to disk-like and its size became smaller at 0.5–0.7m and larger at 2–3m. The color of the swarm was lustrous and whitish.

3 Population composition of swarm

The total individual number collected with landing net was 1355 individuals and the wet weight was 4.82g. Filtered volume by scooping with landing net was roughly estimated at 0.063m³. The volume was possibly underestimated. The estimated density and biomass of the swarm was

2.2×10^4 inds/m³ and 77g/m³.

The body lengths of the 231 specimens were measured body length (Fig.3). Body length ranged from 3.99mm to 7.24mm and the average length was 4.67mm (1SD=±0.62mm). Mode of length frequency was measured at 4.61–4.80mm. Juveniles of unidentified sex were 87.0% of specimens. Males were 9.6% and females were 2.6%. One female, 7.24mm long, was holding embryos in the brood pouch.

4 Stomach contents

In all of specimens, stomachs contained food and 70% of specimens had full stomachs. A high percentage of specimens were taken with unidentifiable matter (96%) and crustacean remains (74%) in their stomachs (Table 1). Thirty-eight percent of the stomachs contained tintinnids (for example, *Dadayiella* sp. and *Dictyocysta* sp.). A few diatoms and dinoflagellates were identified in each stomach. We believe that *T. japonica*

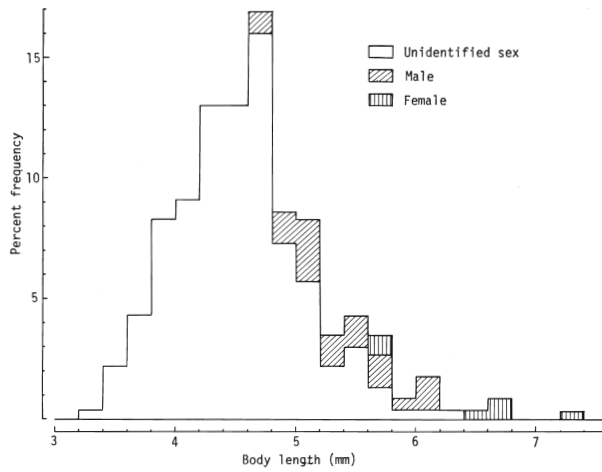


Fig. 3. Frequency distribution of body lengths of swarming *Themisto japonica*.

Table 1. Frequency of occurrence (by percentage) of various items in 50 stomachs of swarming *Themisto japonica*.

	per cent
Diatoms	42
Dinoflagellates	42
Cilicoflagellates	12
Tintinnids	36
Radiolarians	2
Foraminifera	6
Crustacea	74
unidentifiable matters	96

definitely do not feed on phytoplanktons. SHEADER and EVANS (1975) confirmed *Parathemisto gaudichaudi* (GUERIN) was carnivores and suggested phytoplankton entered the gut during cleaning and not during feeding.

Discussion

The swarming of *T. japonica* have not been reported at night. CHEBANOV (1965) noted high densities of this species at night in the summer in the Bering Sea, and most of the plankton number (58200 inds/m³) at 0–5cm layer collected with

a neuston net were *T. japonica*. But *T. japonica* in CHEBANOV's work were possibly *T. pacifica*. BOWMAN (1960) suggested that Russian workers had not distinguished the *T. japonica* from the *T. pacifica*. It is unknown if the occurrence of swarming of the *T. japonica* was frequent or not. OKIYAMA (1965) found *T. japonica* to be all of the stomach content constitution in some squid *Todarodes pacificus* STEENSTRUP specimens at night in autumn. FUKATAKI (1967) showed that stomach contents of Pink Salmon *Oncorhynchus gorbuscha* (WALBAUM) in March contained a single food item of *T. japonica* in certain cases. The relationship between the occurrence of swarms of *T. japonica* and single components of stomach content needs to be more completely examined. Swarms of hyperiid amphipods were observed near *H. sibaginis* at night off Cochin (NAIR 1972), and the high density of the swarm was 79 inds/m³ by vertical net haul. *A. blossevilli* were observed in the daytime near surface water in the coastal region of Hawaii (LOBEL and RANDALL 1986).

The causal factor for the formation of

T. japonica swarming hasn't been determined. CLUTTER (1969) mentioned increased of mating efficiency was one adaptive significance of mysid swarm. Swarms of crustaceans that related to reproductive behavior was reported in copepods (UEDA *et al.* 1983), euphausiids (NICOL 1984, ENDO 1984) and sergestid (OMORI and HAMNER 1982). Swarming specimens of *H. sibaginis* consisted of males (NAIR 1972). Sex ratio of male to female of the swarm population was 29.5 : 70.5 in *A. blossevilli*. Nineteen percent of the females were holding eggs and 3% were brooding larvae (LOBEL and RANDALL 1986). As the swarm population of *T. japonica* consisted mostly of immature individuals in the present study, the formation of swarm did not seem to be directly related to reproductive behavior.

Stomach fullness of swarming *T. japonica* in the present study was high, and *T. japonica* seems to have fed actively. BROWN *et al.* (1979), ENDO (1984) and NICOL *et al.* (1987) reported euphausiids swarming have been feeding. ENDO (1984) suggested swarming euphausiid, *Euphausia pacifica* HANSEN, have not fed actively compared with non-swarming ones.

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日本海南東域でみられた端脚類 *Themisto japonica* のスォーム

広 田 祐 一 ・ 勢 村 均

新潟県上越市沖の日本海海面において、1984年10月15日夕刻、くらげのみ端脚類 *Themisto japonica* のスォームが観察された。スォームは、幅0.5mから3mの球形または円盤状で、形を変えながら移動した。密度は低く見積って、 2.2×10^4 個体/m³、77g/m³と推測される。構成している個体の体長は3.39mmから7.24mmの範囲であり、平均4.67mmであった。また87%の個体が雌雄の判別ができない幼体であった。またすべての個体の胃中に内容物が認められ、大部分の個体で甲殻類の殻が認められた。