

Deep-sea near-bottom swarms of pelagic amphipods *Themisto*: observations from submersibles

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SARSIA



Vinogradov GM. 1999. Deep-sea near-bottom swarms of pelagic amphipods *Themisto*: observations from submersibles. *Sarsia* 84:465-467.

Swarms of *Themisto abyssorum* and one of *Themisto libellula* (Hyperiidea, Hyperiididae) were observed during four dives of *Mir* deep-sea manned submersibles in the Norwegian and Greenland Seas at depths of about 1000 m. Concentrations of the amphipods in the most dense swarm were as high as 25-38 individuals per cubic meter in the layer 100-5 m above the bottom. However, such swarming does not seem to be obligatory for *Themisto*. The animals picked up (food?) particles directly from the seabed.

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Keywords: *Themisto*; near-bottom swarms; submersibles.

INTRODUCTION

Pelagic amphipods of the genus *Themisto* Guérin, 1825 (Hyperiidea, Hyperiididae) are a common component of plankton communities at temperate and high latitudes. *Themisto* plays a significant role in the diet of many fish, including herring. Many hyperiid species are symbionts of gelatinous planktonic animals, but *Themisto* are first of all free-living predators. *Themisto*'s tendency to form aggregations ("swarms") is well known (Vinogradov & al. 1982). For a long time *Themisto* swarms were found only in the surface layers and *Themisto* themselves were mainly considered as epipelagic animals, although it is known that individual amphipods can penetrate to depths of 2000-3000 m (Vinogradov & al. 1982). However, deep-water near-bottom swarms of *Themisto* have recently been twice detected in the Norwegian and Greenland Seas. It was unclear whether that phenomenon was unique until summer 1998, when near-bottom swarms of *Themisto* were again observed in the same seas.

NEW OBSERVATIONS

On 6-24 July 1998 near-bottom swarming of two *Themisto* species was observed during four dives of *Mir* deep-sea manned submersibles during the 40th cruise of the R/V *Akademik Mstislav Keldysh* in the Norwegian and Greenland Seas. The most dense swarm was noticed

on 16-17 July 1998 during the night diving of *Mir-1* to the Håkon Mosby Mud Volcano (Stn 3776, Norwegian Sea, 72°01'N, 14°44'E, depth 1270 m). The submersible twice came close to the bottom. At first only few *Themisto abyssorum* (Boeck, 1870) were observed in the near-bottom layer, but the second time at a distance of 100-5 m from the bottom the submersible passed through a dense swarm of *T. abyssorum*. The concentration of amphipods in the swarm was as high as 25-38 individuals per cubic meter (they were counted inside a wire cube within the observer's direct view). The amphipods, probably attracted by the submersible's searchlights, subsequently concentrated in a thin layer near the bottom; it was evident that some individuals were sitting on the sediments for a few seconds and picking up something. Unfortunately, at the time I had no equipment for amphipod collection. It is worth noting that the animals did not try to avoid the submersible or its searchlights.

Less intensive near-bottom swarms of *Themisto* were noticed on two other occasions during *Mir* dives in the course of a geological program:

1. 6 July 1998. Norwegian Sea, Vøring Plateau, 64°45'-64°47'N, 4°47'-4°48'E; depth 800 m. Daytime dives of submersibles *Mir-1* (Stn 3729) and *Mir-2* (Stn 3730). Bottom flat with separate table-like swellings (height 1-1.5 m, diameter 10-15 m). The swellings were covered in various benthic suspension-



feeders. *Mir-1* found one such swelling and “numerous amphipods” over it. Back on board the research vessel a single specimen of *T. abyssorum* was found in the push-core sediment sample. Dr. D.V. Voytov confirmed that the observed amphipods were similar. *Mir-2* found six swellings of this kind, and a slurp-gun sample was picked up from one of them. Four adult females of *T. abyssorum* were found in the sample.

2. 24 July 1998, Greenland Sea, Vestnesa Ridge (79°07'N, 6°10'E, depth 1231 m), *Mir-1* daytime diving (Stn 3795). During the dives pockmarks of methane seeping with bacterial mats were being investigated. A sediment sample was picked up by the net near one of the pockmarks. Twenty-five *Themisto libellula* (Lichtenstein, 1822), length 7-10 mm, probably swimming just near the bottom were found in this small sample. Most of them had been badly damaged by collected sediment during the submersible's emergence from the depths.

Collected amphipods were dissected. Most of their stomachs were empty, but part of a jellyfish tentacle was found in a stomach of *T. abyssorum* from Stn 3730, the detritus-like particles were found in the stomach of one of four *T. abyssorum* from Stn 3729 and small fragments of red crustacean chitin, presumably planktonic, (a small shrimp or a large copepod, like *Euchaeta*) were found in one individual of *T. libellula* from Stn 3795. No fragments of benthic organisms were found.

DISCUSSION

Four years earlier (22 July 1994) a similar dense near-bottom swarm of thousands of *Themisto abyssorum* (mainly near-adult females) were observed for the first time near the wreck of the nuclear submarine *Komsomolets* (73°43'N, 13°15'E, depth 1700 m) by the deep-sea manned submersibles *Mir-1* and *Mir-2* (Vinogradov & al. 1996), and over 300 specimens of *T. abyssorum* were caught by one of the benthal/epibenthal trawls performed by the R/V *Polarstern* at a depth of 317-320 m at 75°N along the eastern coast of Greenland (Brandt 1997). This is definitely a similar case, though it took place at a shallower depth. The new observations confirm that near-bottom swarms of this kind are not unique. However, these swarms also seem to be not obligatory

for *Themisto*. For example, excluding 22 July 1994, no observations of swarms of thousands of individuals were done during tens of dives at the *Komsomolets* wreck site in 1994 and 1995, but sometimes tens (and once, a few hundreds) of *T. abyssorum* were seen near the bottom (Vinogradov & al. 1996).

The occurrence of *Themisto* at great depths in the Norwegian and Greenland Seas can be explained by the regional hydrology: basins of these seas are filled with relatively homogeneous “local” waters that deepen in winter in anticyclonic gyres, allowing many species of animals to penetrate into non-specific deep layers (Vinogradov & al. 1996). The reasons why amphipods swarm in near-bottom layers are still unknown. Swarms cannot be a result of the concentration of amphipods over the bottom, limiting their diurnal migration. Diurnal migrations are known for *Themisto* (Bowman & al. 1982; Hiroki 1988); however, their vertical range is not great enough (a few hundred meters). Moreover, it is impossible to explain the observed night near-bottom swarming of *Themisto* by such migrations. I do not connect them with bottom methane seeping processes (the Vestnesa Ridge, the Håkon Mosby Mud Volcano). These seepages were merely the reason for making submersibles dives in these locations. No methane seepages were detected near the *Komsomolets* wreck or at the dive points at the Vøring Plateau.

The directly observed process of *Themisto* picking up particles from the bottom is of special interest. Unfortunately, the available material does not allow us to confirm directly that amphipods can eat either benthic organisms or benthal detritus. When the swarm near the *Komsomolets* wreck had been observed in 1994, the observers also reported that sometimes *T. abyssorum* sat on the bottom (for a few seconds) and picked up particles from it. However, only the mesoglea of jellyfish (aff. *Halopsis*) were discovered in the stomachs of a few animals which had been caught and dissected (Vinogradov & al. 1996). However, because of the lack of material the number of dissected amphipods was insufficient in both cases. This aspect of the problem remains open for future investigation.

ACKNOWLEDGEMENTS

I thank the *Mir* team for their cooperation. This work was partly supported by a grant from the Volkswagen Foundation.



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Accepted 25 May 1999 – Printed 30 December 1999
Editorial responsibility: Jarl Giske