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MARINE BIOLOGY

Zooplankton Distribution above the Lost City (Atlantis Massif) and Broken Spur Hydrothermal Fields in the North Atlantic According to the Data of Visual Observations

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Abstract—Three dives of *Mir* manned submersibles with plankton counts and two vertical plankton hauls with a BR net were carried out above the Lost City (Atlantis underwater massif) and the Broken Spur hydrothermal fields during cruise 50 of R/V *Akademik Mstislav Keldysh.* Above the Atlantis seamount, no significant increase in the plankton concentration was found. Above the Lost City field, the horizontal heterogeneity of the plankton distribution in the near-bottom layer and in the overlying water layers was shown. The near-bottom aggregations of euphausiids and amphipods previously reported by other scientists seem to be related to the attraction of the animals by the submersible's headlights rather than represent a natural phenomenon.

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In the research of the influence of the hydrothermal vent communities on the ocean bottom on the plankton abundance in the adjacent water layers, the studies of the hydrothermal fields located in the poorest oligotrophic regions of the ocean with a low primary production in the surface photic layer are of special interest [3]. In the North Atlantic, these are the fields lying below the waters of the chalistase at the center of the North Atlantic anticyclonic gyre. For a long time, only the hydrothermal fields lying at abyssal depths were known such as the Snake Pit, TAG, and Broken Spur fields. This situation changed in 2000 with the discovery of the Lost City hydrothermal field [12].

The Lost City hydrothermal field demonstrates unique features of the geological structure [9, 12]. It is located at a relatively shallow depth approximately 800 m over the top of the Atlantis underwater massif (30°07.5′ N, 42°07.2′ W) at the center of the North Atlantic chalistase (Fig. 1). On the bottom, isolated benthic animals typical for the hydrothermal communities are encountered; meanwhile, most of the animals are members of the background fauna, which form no noticeable accumulations [10, 13].

During cruises 47 (2002) and 49 (2003) of R/V *Akademik Mstislav Keldysh* in the region of the Lost City field, we studied the vertical and near-bottom distributions of the macro- and mesoplankton [4, 8]. The studies were performed within the frameworks of the program on the research of the impact of the production of the hydrothermal fields on the water column. During these studies, for comparison, we used the data on the plankton distribution in the upper 1000-m layer of the ocean obtained during cruise 47 in the region of the Broken Spur hydrothermal field (29°10′ N, 43°10′ W), which lies only 79 nautical miles away from the Lost City site (Fig. 1). This location was regarded as a background one, since the sea depths in the Broken Spur region exceeded 3000 m and the processes proceeding in the near-bottom do not influence the upper water layers.

During cruise 47, at the Lost City site, one dive of the *Mir* deep-sea manned submersible was performed with counts of the macroplankton in the water column with respect to the "large frame" 3 m^2 in area (see below for the description of the techniques). A comparison with the similar dive performed at the Broken Spur site showed that the positions of the peaks of the macroplankton abundance at both sites coincide with respect to depth, though the absolute values of the animal concentrations over the Lost City field were 2–3 times higher than those in the same water layer above the Broken Spur field ([8], see Table 2). It was suggested that in the Lost City area a local enrichment of the water column occurred owing to the bottom topography (the Atlantis massif, where the field is located, rises over the adjacent ocean floor by more than 2000 m). However, the results of a single dive of the manned submersible could not allow us to make a judgment on the existence (or absence) of a steady plankton enrichment in this region, more so the water flow over the top of the seamount evidently features

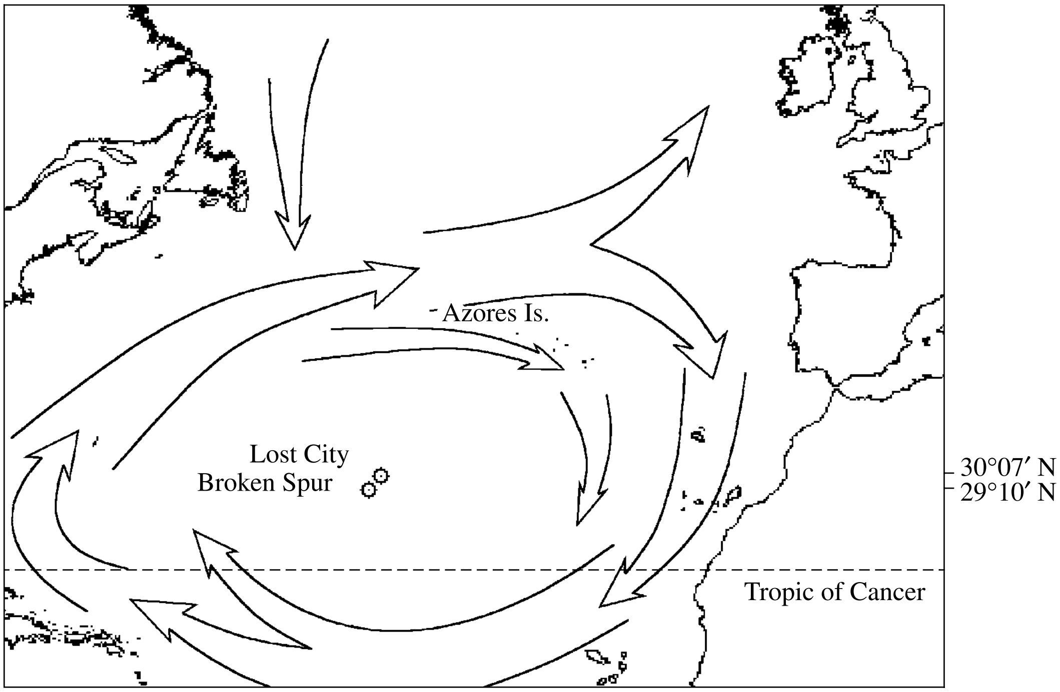

Fig. 1. Ocean of the Lost City and the Broken Spur hydrothermal fields at the center of the North Atlantic anticyclonic gyre.

vortices capable of producing mesoscale patchiness in the plankton distribution.

Another result of the observations in 2002 was the discovery of a large number of the euphausiids *Nematoscelis* aff. *tenella* in the near-bottom layer; it seemed that they form accumulations near the walls of the hydrothermal towers and over their tops. In addition to euphausiids, slurp-gun samples also contained the freely swimming amphipods–hyperiids *Paraphronima crassipes* (all of them were females with eggs in their gonads), two species of the *Primno* genus *P. brevidens*[1] and *P. latreillei*, and one individual of *Streetsia challengeri* [8]. In the spring of 2003, the American R/V *Atlantis* carried out studies at the Lost City site [13]. During this expedition, according to the observations from the *Alvin* deep-sea manned submersible near the Lost City mounds, swarming "deep-water" euphausiids and *Primno brevidens* were also registered; probably, they were attracted by the headlights of the submersible. Meanwhile, in the near-bottom net hauls performed in 2003 during cruise 49 of R/V *Akademik Mstislav Keldysh*, the number of euphausiids near the top of the Atlantis massif was small [4]. It remained unclear whether the accumulations of euphausiids and other plankters are actually confined to the hydrothermal mounds or the crustaceans were attracted by the submersibles that operated near the mounds (many euphausiids and hyperiids readily move toward light).

[1] The small North Atlantic form *P. brevidens* is sometimes regarded as an independent species *P. evansi* [14, 18].

The plankton studies with the use of the *Mir* deep-sea manned submersibles that were performed in the Lost City area during cruise 50 of R/V *Akademik Mstislav Keldysh* in August 2005 were aimed precisely at the solution of these two problems. During this expedition, additional underwater plankton observations were also performed in the region of the Broken Spur hydrothermal field; the upper 1000-m layer over this field was used for the sake of comparison as a reference layer. Meanwhile, the entire water column was examined in order to recognize the possible interannual changes in the plankton distribution that could influence the results of our studies.

MATERIALS AND METHODS

During dives of the *Mir-2* deep-sea manned submersible, the plankton in the water column was counted following the standard technique accepted in the expeditions of the Shirshov Institute of Oceanology, Russian Academy of Sciences [1, 8, 17, and others]. The plankton was counted during the downward movement of the submersible with respect to the "large frame" 3 m^2 in area formed by the extended manipulators of the vehicle, which held a reference rope (see the figure in [8]). The counts began at a depth of about 200 m, where the light from above could not hinder the observations of the transparent animals in the headlights of the submersible and it was possible to carry out the count at a submersion rate of 15–20 m/min. The identification of the animals, their abundance, and their size were recorded using a tape recorder. Simultaneously,

Table 1. Dives of the *Mir-2* deep-sea manned submersible with observations of the plankton distribution over the Broken Spur and Lost City hydrothermal fields during cruise 50 of R/V *Akademik Mstislav Keldysh* (2005)

Field	Station	Date	Dive no.	Depths of plankton counts, m	Local time of counts	Pilot of the submersible	Observer
Broken Spur 29°10′ N; 43°10′ W, sea depth 3050–3100 m	4793	Aug 24	25/404	200–3114 (down to the bottom)	3:55–6:58 p.m., upper 1000-m layer—3:55–4:40 p.m.	V.A. Nishcheta	G.M. Vinogradov
Lost City 30°07′ N; 42°07′ W, sea depth 750 m	4800	Aug 27	27/406	(180) 300*–1060 (down to 20 m from the bottom (slope))	1:00–1:50 p.m.	V.A. Nishcheta	A.L. Vereshchaka
	4803	Aug 28	28/407	150–1065 (down to the bottom (slope))	6:30–7:30 p.m.	V.A. Nishcheta	G.M. Vinogradov

* The moment of the onset of absolute darkness and the beginning of the confident counting.

every 10–20 m, depending on the plankton concentration, the depth of the vehicle was recorded. On board the vessel, these data were deciphered and averaged over selected depth intervals (20 or 50 m); in each layer, the abundance of different groups of animals was determined.

When a large frame is used, mostly macroplankton is accounted for. Meanwhile, the observer registers all the organisms with a length greater than 1–2 cm. Therefore, in addition to macroplankton in the standard meaning of this term (larger than 3 cm), large mesoplanktonic animals with transitional sizes were counted (mostly chaetognates and small hydromedusas as well as large euphausiids and juveniles shrimps). Appendicularia, whose length is as small as a few millimeters, could be excluded from our assessment as a typical representative of mesoplankton. Meanwhile, they construct mucous polysaccharide "houses" around their bodies, whose diameter ranges within 1–5 cm sometimes may reach 0.5 m and more. It should be noted that these cases are composed of organic matter and function as a single whole with the animal proper. Therefore, an appendicularia, together with its case, may be regarded as a single object and these animals may be regarded as macroplankton. Below, when describing the observations from submersibles, we use the term "macroplankton" precisely with this reservation.

In 2005, two dives of the deep-sea manned submersible (stations 4800 and 4803) in the Lost City area and one dive (station 4793) over the Broken Spur field were performed (see Table 1). At the Lost City site, the counts were carried out down to depths exceeding the position of the field proper, because the vehicle submersed down the slope of the suspended matter near its top.

During the operations in the near-bottom layer in the Lost City area, we performed special observations of the plankton transported over the field with the water flow. In order to do this, the vehicle was settled on the top of a 60-m-high carbonate hydrothermal mound and turned against the current; thus, the current with a velocity of 15 cm/s ran directly toward the observer (Fig. 2). The number of animals that passed every minute through the limited field of vision of the observer was counted. This way, we registered the horizontal heterogeneity in the plankton distribution at a strictly fixed depth of 735 m. Since the carbonate mound was elevated more than 60 m over the floor surface, we may assume that we examined a water layer not disturbed by the near-bottom turbulence.

In addition, at each of the two sites, the entire water column was sampled by a series of nighttime hauls using a BR 113/140 plankton net with an opening 1 m^2 in area. The hauls were processed following the standard techniques [8 and many others]. In this paper, we do not consider the results of these hauls in detail; meanwhile, selected data obtained are used for the sake of comparison.

In the Broken Spur area, we also carried out a probing of the water column using a CTD probe of the Rossette set and plotted curves of the vertical distribution of the water temperature and salinity.

RESULTS AND DISCUSSION

Broken Spur Site

The distribution of plankton over the Broken Spur hydrothermal field was typical of the abyssal fields of the Mid-Atlantic Ridge [8]. The total plankton biomass in the water column here was extremely small, which is characteristic of the central regions of the chalistase. According to the data of the net hauls, the abundance of mesoplankton (wet weight) in the upper 1500-m water layer was only 7.1 g/m^2 (4.3 g/m^2 with no account for gelatinous animals). The net hauls performed here in September 1996 showed an even lower value of the wet mesoplankton biomass in the same layer equal to approximately 2.5 g/m^2 [5].

According to the observations from the manned submersible during cruise 50 of R/V *Akademik Mstislav*

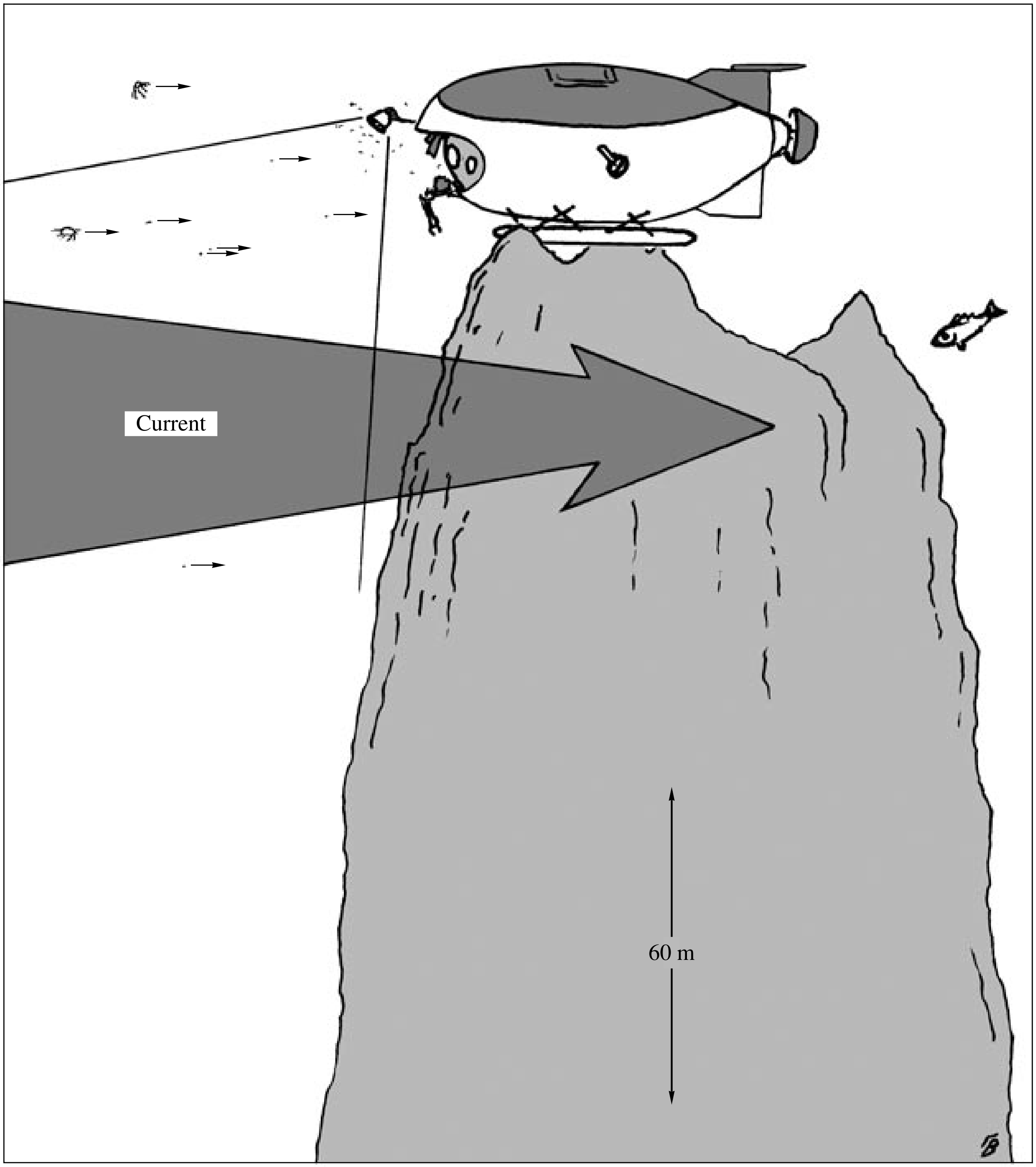

Fig. 2. Schematic of observations of plankton in the incident water flow during the operations on the Lost City mounds.

Keldysh, the total abundance of macroplanktonic animals in the waters of the main pycnocline was 0.15–0.20 ind./m^3, while deeper than 1000 m, it did not exceed 0.05 ind./m^3 (half of which was represented by gelatinous plankton and appendicularia with their cases). The total abundance of the principal groups of animals in the waters of the main pycnocline is presented in Table 2. The growth in the macroplankton amount (the upper boundary of the peak of abundance in the pycnocline) started at a depth of 250–300 m.

Meanwhile, the observed pattern of the macroplankton distribution is rather conservative and almost completely reproduces the pattern obtained three years ago during the observations from submersibles performed in 2002. Both the general distribution of the animals and the distribution of the principal taxa and ecological groups in these two surveys demonstrate a striking similarity (Figs. 3a–3d).

The only noticeable difference was the fact that in 2005 no near-bottom peak of the appendicularia abun-

Table 2. Abundance (ind./m^2) of the main groups of planktonic animals in the 250- to 900-m water layer at the Broken Spur and Lost City sites according to the counts from the submersible in 2002 and 2005

Site	Year	Station	Date	Gel	Siph	Cten	Med	App	Dec	Chaet	Cycl
Broken Spur	2002	4349	June 29	17.7	2.0	1.7	4.7	4.0	2.0	12.0	11.3
	2005	4793	August 24	23.5	1.3	1.3	5.0	13.5	5.0	14.7	15.0
Lost City	2002	4368	July 4	29.7	1.1	9.7	15.0	4.1	7.4	18.0	26.7
	2005	2800	August 27	15.7	2.3	5.7	4.7	3.0	1.7	14.3	17.3
		2803	August 28	42.2	6.0	4.5	7.3	23.3	1.7	11.2	8.3

Note: Gel—gelatinous plankton and cases of appendicularia, totally; Siph—siphonophores; Cten—ctenophores; Med—medusas; App—appendicularia; Dec—pelagic shrimps; Chaet—chaetognats; Cycl—cyclotons. The data of 2002 are presented after [8].

dance was observed at the Broken Spur site (Fig. 3b). Previously, the near-bottom increase in the appendicularia abundance was noted in all the deep-water dives of manned submersibles in the North Atlantic both in the reference areas and over hydrothermal fields [4, 6–8, 16]; it was least prominent (though noticeable) precisely in the abyssal regions below the center of the chalistase. The absence of the near-bottom peak of the appendicularia abundance during the submersible dive in 2005 is most probably occasional and results from the general low plankton abundance in the lower part of the water column.

The distribution of macroplankton in the reference upper 1-km water layer over the Broken Spur hydrothermal field was typical of the depths of the main pycnocline. Peaks of the animal abundance are also registered near the hydrological boundaries. In particular, a clearly manifested impact on the distribution of both individual groups and the macroplankton as a whole is produced by the boundary of the layer of the Mediterranean waters marked by a cusp in the salinity curve (Fig. 4).

Among the interesting and characteristic gelatinous animals encountered in the water column at the Broken Spur site, we should note a large (4–5 cm) nontransparent red medusa *Aeginura grimaldii* at a depth of 876 m, a *Solmissus* at a depth of 930 m, a 2-cm-long red tentaculate ctenophore with a pointed aboral top at a depth of 1288 m, an aberrant "two-handed" medusa *Solmundella bidentaculata* at a depth of 1550 m (hanging with its top down), and a lobate ctenophore with large 10-cm lobes reminding us of butterfly wings (in their shape) at a depth of 2914 m. Among the nongelationous animals, an orange 1.5-cm nemertine at a depth of 2017 m (it held a vertical position in the water and bent as a leech) and a large hyperiid of the *Lanceola* sp. at a depth of 2645 m should be noted. The *Lanceola* freely swam in the water rather than rested upon a host gelatinous animal.[2]

[2] A similar freely swimming *Lanceola* was encountered by us in 2003 during the dive in the region at 9° N on the East Pacific Rise; meanwhile, over the Charlie–Gibbs fracture zone, *Lanceola* settled over small gelatinous animals (or on large flakes of "sea snow") were observed from manned submersibles [16].

Lost City Site

Observations in the water column. The distribution of plankton at the Lost City site strongly resembles that observed at the same depths at the Broken Spur site (Fig. 5a). Similar to the Broken Spur field, the increase in the macroplankton abundance started at a depth of 250–300 m. It is interesting that, approximately at the same depths, a decrease in the abundance of large copepods was observed. Deeper, the number of macroplanktonic animals remained relatively high down the slope of the mountain; that is, the peak of the plankton abundance related to the main pycnocline extended down to the bottom. Approximately from a depth of 850 m, deep-water forms such as red chaetognats of the *Eukrohnia* genus were encountered.

There was no visible increase in the amount of plankters over the Lost City field as compared to similar depths in the Broken Spur field. Meanwhile, a significant mesoscale patchiness in the animal distribution was actually observed. During two dives to the Lost City field performed with an interval of one day, the abundance of selected groups of animals (for example, appendicularia or cyclotons) differed by several times (Figs. 5b, 5d; Table 2). In so doing, they could be both greater and smaller than the corresponding values in the Broken Spur field. At the same time, the abundance and distribution of other animal groups, for example, chaetognats, observed over the Lost City and Broken Spur fields were virtually the same (Fig. 5c, Table 2). Since in different dives the abundance of individual animal groups both increased and decreased, the resulting variations were mutually compensated and almost did not if the total macroplankton abundance in the water column (Fig. 5a).

Naturally, the results of a single dive that encountered a rich patch in the water (as probably happened in 2002, see Table 2) may produce an impression of a significant plankton enrichment in the region of the Atlantis massif [8]. Only the observations performed during successive dives helped to clear up the situation.

The two submersible dives over the Lost City field were performed during different parts of the light part of the day. At station 4800, the plankton in the water column was counted at 1:00 to 2:00 p.m., while at sta-

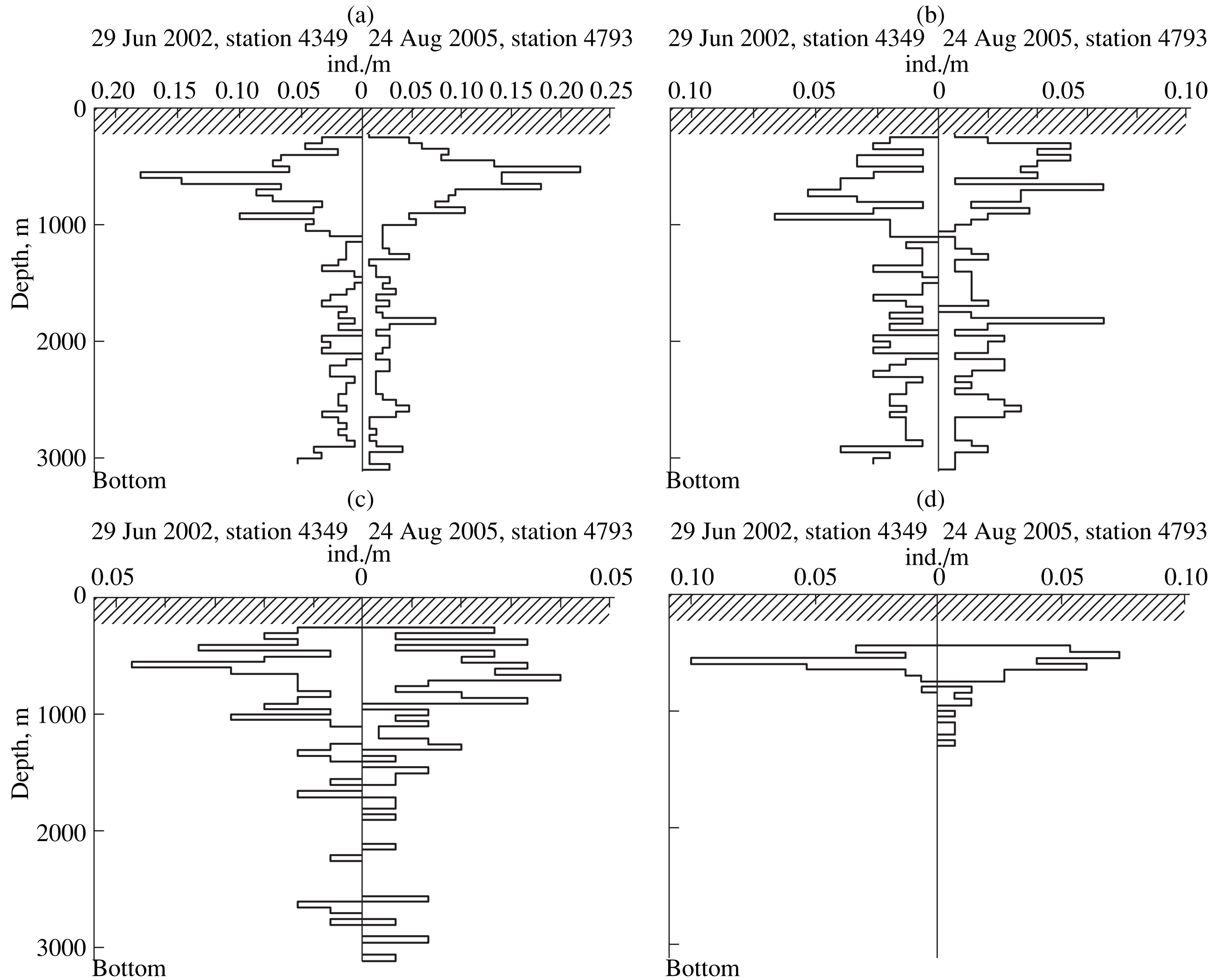

Fig. 3. Vertical distribution of macroplankton in the region of the Broken Spur field according to the observations from manned submersibles in 2002 and 2005 (counts in the "large frame"). (a) Total macroplankton; (b) gelatinous animals and cases of appendicularia (the near-bottom abundance peak is marked by an asterisk); (c) chaetognats; (d) cyclotons. The upper illuminated layer where no counts were performed is hatched.

tion 4803, the counts were performed from 18:30 to 19:30 (local time). At this time, some plankters had already started their evening rise to the upper layers (for example, the first macroplanktonic fishes—hatched fishes—were noted at a depth of 520 m at station 4800 and at a depth of 280 m at station 4803); this resulted in a certain upward shift (approximately from 500–600 to 400–500 m) of the depth of the occurrence of the maximum microplankton abundance (Fig. 5a, marked by the arrows).

Among the animals encountered in the water column at station 4800, it is interesting to note a few medusas *Aeginura grimaldii* encountered at depths of 500 and 800–900 m and two hyperiids *Streetsia challengeri* at depths of 580 and 620 m; the latter swam freely in the water rather than rested over a subatrate. At station 4803, we should note leptocephals at depths of 260 and 610 m; *Solmissus* at 560 m; two 10-cm-long wide cestide ctenophores at 820 and 840 m (previously, such ctenophores were repeatedly encountered over the Broken Spur field [8]); two hyperiids of the *Platyscelus* genus at about 830 m; and three large (>10 cm) lobate ctenophores at depths of 640, 680, and 920 m.

Near-bottom layer As was noted before, the Lost City field sharply differs from the other fields by the fact that it is located on the top of an underwater massif; therefore, it is washed by the waters of the main pycnocline with high concentrations of planktonic animals. In addition, the white carbonate towers of the hydrothermal mounds here reach a height of 60 m and penetrate into the passing water flow inhabited by pelagic fauna. When the submersible passed near the bottom, chaetognats and planktonic fishes, more often cyclotons and rarer mictophides and hatched fishes (Sternop-

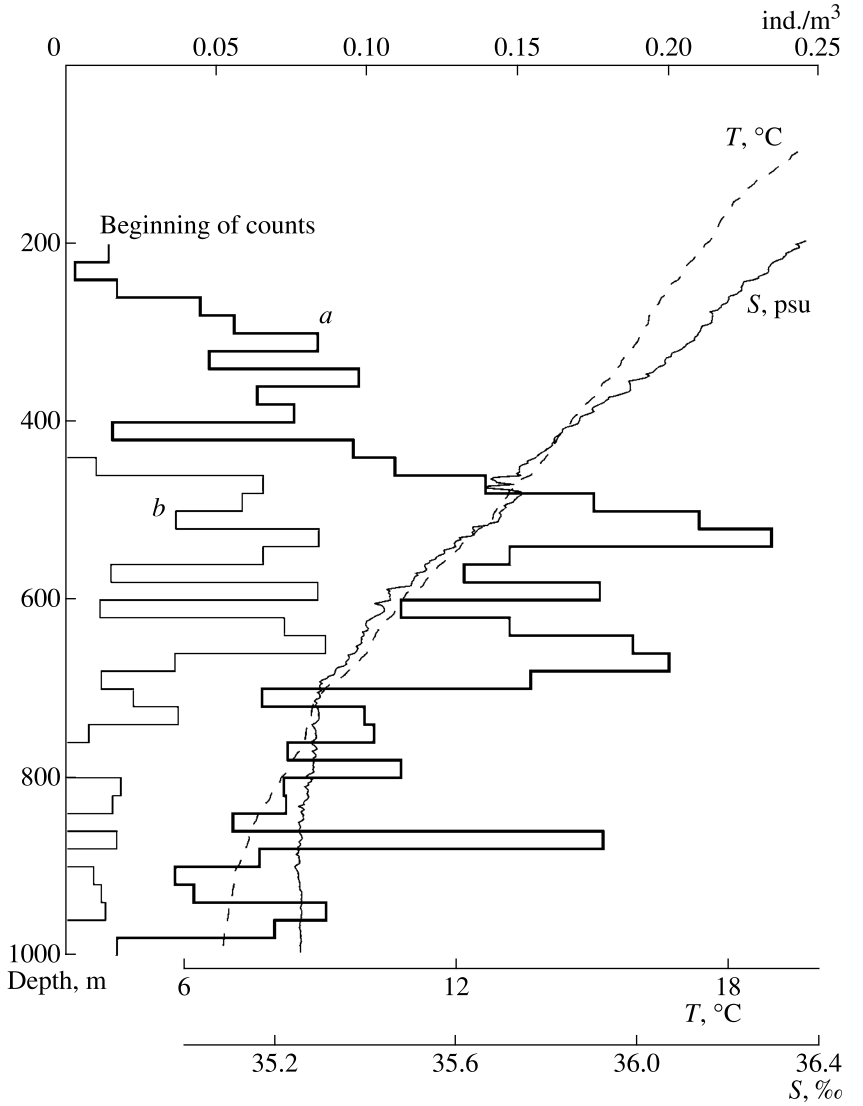

Fig. 4. Vertical distribution of the total abundance of (*a*) macroplankton and (*b*) macroplanktonic fishes–cyclotons in the layer of the main pycnocline in the Broken Spur region (counts in the "large frame," 2005). The curves of the salinity (solid line, *S*) and temperature (dashed line, *T*) by the CTD probing data are also shown.

tychidae), as well as small mysids and pelagic shrimps were noted. Euphausiids were rather abundant, though it was difficult to define their actual number since the crustaceans actively gathered in the light of the vehicle and swarmed near its headlights. Special observations carried out when the submersible rested on the top of the ~60-m-high tower marked as Exomar-12[3] proved that the euphausiids of the *Nematoscelis* genus are driven passed the bottom and the mound with the current rather than keep themselves near them. After the vehicle was settled on the top of the mound, we switched off all the lights both inside and outside the submersible. Ten minutes later, the lights were switched on again. What happened was that all the plankters that accumulated near the vehicle were moved away by the passing current and no new animals were observed near the portholes of the submersible. Then, the current repeatedly delivered euphausiids and hyperiids; they didn't pass the lights and actively moved to them, thus, gradually forming a new swarm. As a result of being retained near the lights of the submersible, the crustaceans gradually concentrated in the observer's field of vision (Fig. 6) producing an impression of the existence of near-bottom swarms.

In addition to euphausiids, the swarms observed in 2005 also contained (though in smaller amounts) the hyperiids *Platyscelus ovoides* (freely swimming in the water, mostly with their backs down) and *Primno*, as well as juveniles of the Sternoptychidae fishes–hatched

[3] A characteristic feature of this mound was a 1-m-long sea perch that permanently remained near its top.

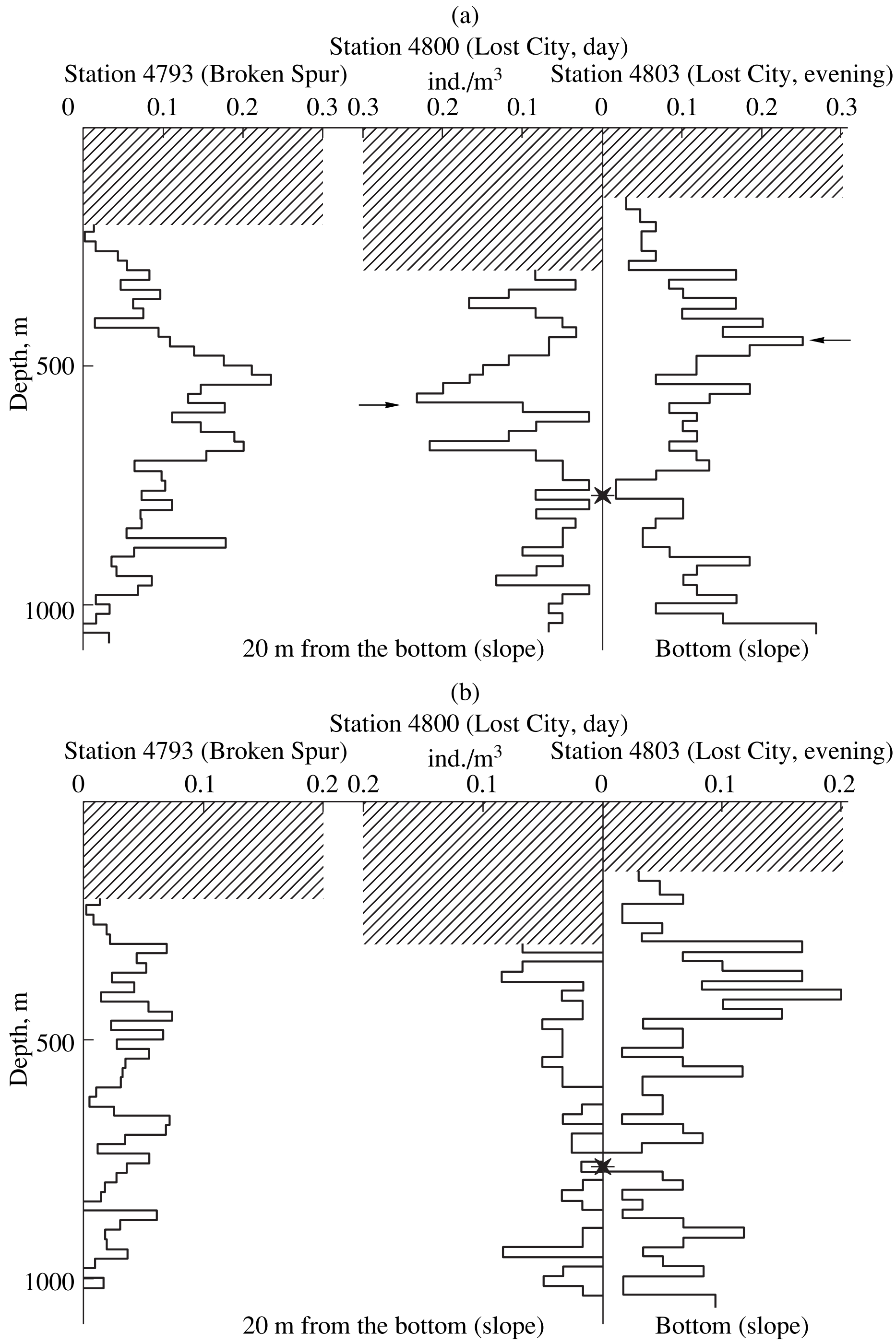

Fig. 5. Vertical macroplankton distribution in the Lost City region according to the observations on two dives of the manned submersible (on the right) and the distribution of the same groups in the upper 1-km water layer at the Broken Spur site (on the left) in 2005 (counts in the "large frame"). (a) Total macroplankton; (b) gelatinous animals and cases of appendicularia (the near-bottom abundance peak is marked by an asterisk); (c) chaetognats; (d) cyclotons. The upper illuminated layer where no counts were performed is hatched; the asterisks mark the depths of the Lost City field and the top of the Atlantis massif.

fishes; all of them are common representatives of the fauna of the waters at this and shallower depths. They were encountered both in net hauls and in the water column according to the observations from the manned submersible. Meanwhile, no *Paraphronima crassipes*, which were abundant in 2002, were encountered in 2005.

In order to test our visual determinations, we sampled the swarm concentrated near the light with the use of a slurp-gun. The sample contained numerous *Nema-*

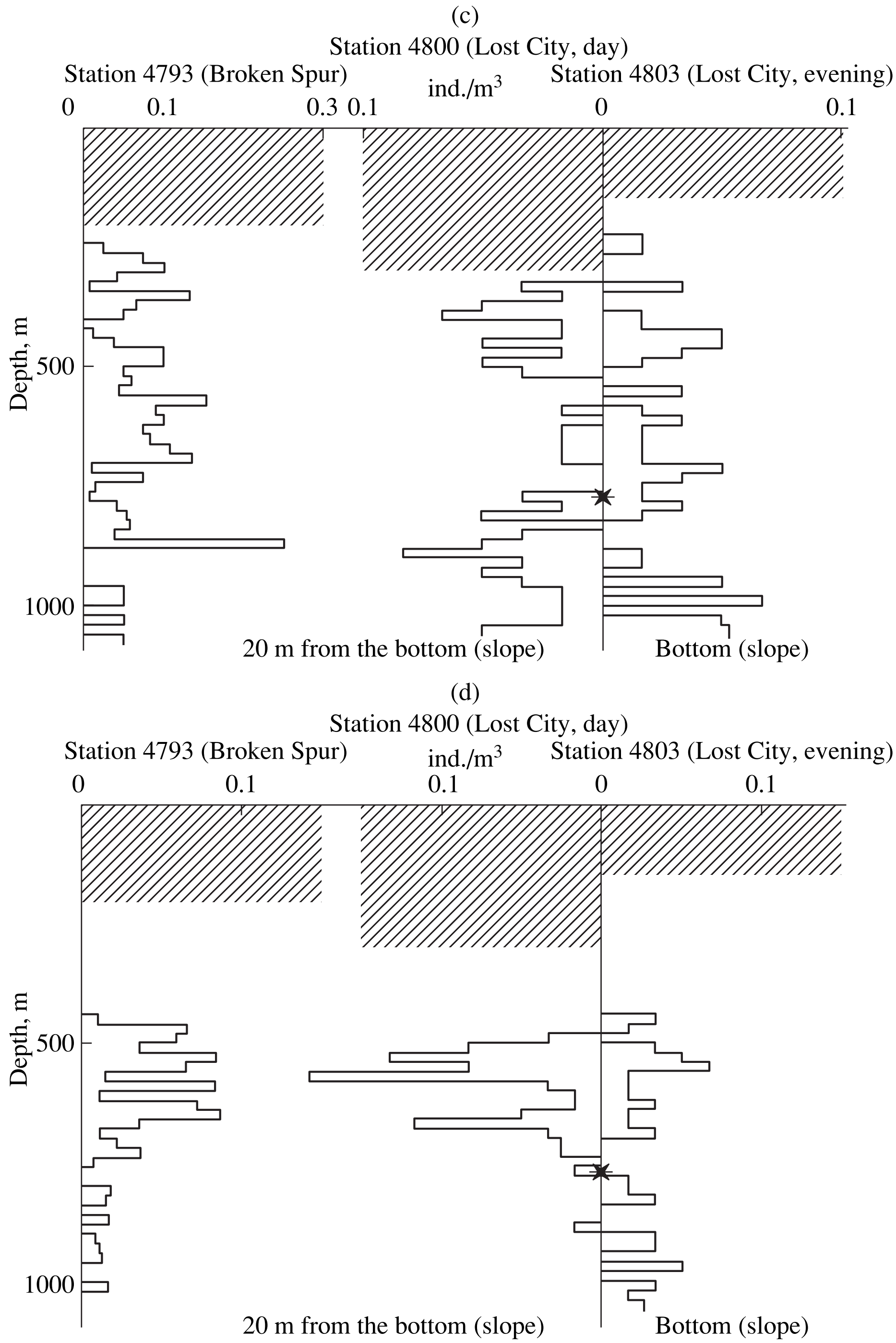

Fig. 5. (Contd.)

toscelis tenella and *N. atlantica* and a single male of *Primno latreillei*.[4] The slurp-gun sampled no hyperiids–plasticellide; meanwhile, two individuals of *Platyscelus ovoides*, which were attracted by the submersible's lights, were found in the containers for geological samples, which were taken from the top of the same mound in the described and previous dives.

Periodically, all these animals (along with chaetognats and cyclotons) were also encountered at the foot of the mounds; there, they were transported immediately above the bottom. It should be noted that all of them represent a steady and rich flux of food, which is available for the benthic and nectobenthic inhabitants of the Lost City area, including benthopelagic fishes.

[4] Visually, more solid and thickset *Primno*, probably *P. brevidens* (=*P. evansi*), were noted in the swarm.

Fig. 6. The Lost City hydrothermal field, station 4803, sea depth 734 m, the top of a hydrothermal mound. Euphausiids attracted by the headlights of the submersible (shot from inside the submersible).

A quantitative registration of the plankton driven with the current was carried out on the top of the Exomar-12 mound for 20 min. The vehicle rested with its lights on at the edge of an escarpment turned toward the current (see Fig. 2), which delivered the plankton that in the daytime dwells in the lower part of the main pycnocline to the field of vision of the observer. Copepods were most numerous; smaller numbers of euphausiids of the *Nematoscelis* genus, chaetognats of the *Eukrohnia* genus, and syphonophores Calicophorida were encountered. For all these groups, the standard deviations were greater than the mean abundances; that is, the horizontal inhomogeneity in the near-bottom plankton distribution was extremely high.

Judging from the differences in the absolute numbers of individual groups of plankton in the water column during reruns of the submersible, one can reach a conclusion about the great general horizontal heterogeneity in the plankton distribution in the water. This feature seems to be typical of pelagic zones on the whole: the bottom topography near seamounts provides the appearance of various meso- and microscale vortices capable of enhancing the inhomogeneities in the plankton distribution.

As to the benthopelagic invertebrates, one can find the amphipods–eusirides *Bouvierella* aff. *curtirama* permanently concentrated in the 10- to 15-cm thick near-bottom layer at the sites of hydrothermal fluid ("shimmering water") seepages. As it was shown by our observations in 2002, the crustaceans sometimes swim over the substrate and sometimes rest on it. They often settle over bacterial materials near moires and swarm there. They are also abundant at the bases of the mounds over brittle fragments of corals, spicules of sea urchins, etc. Near the tops of the mounds surveyed in 2003, crustaceans were rare [8]. Meanwhile, during the operations in 2005 on the very top of the Exomar-12 tower, in the warm shimmering water, dozens of *Bouvierella* were observed. The crustaceans were confined to the near-bottom layer 10–15 cm thick and virtually did not leave the region of the "glittering" water. Their behavior here slightly reminded us of the swarming of the amphipods–pardaliscids *Halice hesmonectes* in the jets of the hydrothermal vents in the fields of the East Pacific Rise [15]. Meanwhile, in the Lost City hydrothermal field, amphipods do not form such dense and crowded swarms and do not demonstrate a behavior that might allow their staying at the same place, which is characteristic of *H. hesmonectes* [11]; in addition, as was mentioned before, they often settle on the ground. *Bouvierella* shows a more universal behavior than being just specialized dwellers of the zones of hydrothermal seepages.

Summarizing our new observations, we can suggest that the distribution of macroplankton in the water column over the Atlantis massif is quite typical of the depths of the main pycnocline at the center of the North Atlantic chalistase, though the influence of the mountain seems to enhance the mesoscale horizontal patchiness in the animal distribution. On the whole, no noticeable increase in the abundance of plankton in the water column of the Lost City field as compared to the corresponding depths in the region of the Broken Spur field though, both in 2002 and in 2005, outbursts of abundance of selected groups (cyclotons, appendicularia, and others) were observed. Meanwhile, they were not validated in reruns of the submersible and were probably caused by local hydrological features and the resulting patchiness in the plankter distribution. Thus, the swarming of planktonic animals near the mounds of the Lost City field happens to be caused by the attracting effect of the headlights of the submersibles. It is characteristic that an approximately similar set of planktonic animals (euphausiids, platiscelids, as well as large hyperiids of the *Phronima* genus) was observed near the lights of the submersible during the near-bottom operations in the Menez Gwen hydrothermal field in 2003 [4]. The Menez Gwen field lies at 37°50.5′ N (far to the north of the Lost City field) at a similar depth (about 850 m), and it is also washed by the waters of the main pycnocline, which carry abundant plankton.

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