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Björn Gulliksen

MARINE INVESTIGATIONS AT JAN MAYEN IN 1972

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MARINE INVESTIGATIONS AT JAN MAYEN IN 1972

by

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ABSTRACT

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The benthic macro-flora and -fauna from 0 to about 100 m depth in the waters around Jan Mayen were sampled at 42 dredging stations and 17 diving stations during the period 1st to 25th of August 1972. Most of the material has been identified down to species level.

Only mites were found in the supralittoral zone. From the shoreline to about 6 m depth there was very little algal growth, and hydrozoans were the only sedentary animals present, together with the fish *Myoxocephalus scorpius* and the scyphozoan *Haliclystus* sp. The gastropods *Acmaea rubella* and *Margarites helicinus* were commonly observed on crustose corallines.

The dredge samples gave no indication of the *Astarte borealis - Macoma calcarea* at Jan Mayen, previously described by Devillers. The fauna on level bottom areas was very heterogenous and no distinct animal communities could be distinguished.

The benthos on rocky bottom areas showed a typical vertical zonation due to the light gradient and competition between the algae and the dominant sessile animal groups (Porifera, hydrozoans, actinians, bivalves, and ascidians) in the phytal zone (0 - ca. 30 m depth). The positions of the most conspicuous rocky bottom organisms on the substrate are described and illustrated with underwater photographs.

Colonization of the "new" grounds created by the 1970 volcanic eruption took place by lateral and vertical immigration. The sedentary animals found were hydrozoans and bryozoans, the motile animals primarily amphipods and nudibranchs. Three of the five algal species recorded on the "new" grounds were exclusive to this habitat, whilst most of the animal species were also recorded elsewhere at Jan Mayen.

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CONTENTS

INTRODUCTION

A volcanic eruption took place on the Norwegian island of Jan Mayen during September - October 1970 (Gjelsvik 1971, Siggerud 1972). During the summer of 1972, an expedition was arranged by the Norwegian Institute of Polar Research, mainly with the aim of mapping the "new" land and to study the geological and biological changes caused by the eruption. The expedition arrived at Jan Mayen on the 1st of August and departed on the 25th. The 96 ft sea rescue vessel R.K. "Sjöfareren" formed the headquarters for the whole expedition and provided transportation to different parts of the island.

This publication contains the results of the marine biological investigations of the virgin areas created by the eruption. To make a comparison of the flora and fauna of "old" and "new" grounds possible, the marine fauna and flora from 0 - ca. 100 m depth in the vicinity of the island were also studied, especially the benthic organisms on rocky bottom areas.

The first marine investigations at Jan Mayen were made in the summer of 1877 by the "Norwegian North Atlantic Expedition 1876-78." More extensive investigations were carried out five years later by the "Austrian Scientific Expedition 1882-83," published in 1886 in the monograph "Die österreichische Polarstation Jan Mayen." Among other expeditions which have yielded some information about the marine fauna and flora at Jan Mayen are the "Danish Ingolf Expedition 1877", the "Swedish zoological expedition to Spitzbergen, N.E. Greenland and Jan Mayen 1900," the "Michael Sars Expedition 1900", the "Danish East Greenland Expedition 1900", the French "Porquoi-pas Expeditions" in 1912, 1913, and 1926, the "Norwegian Fishery and Marine Investigations" of 1930 and 1931, and the American "Louise A. Boyd Arctic Expeditions" of 1937 and 1938.

AREA AND ENVIRONMENTAL CONDITIONS

Jan Mayen is situated between $70^{\circ}49'$ and $71^{\circ}10'$ N Lat., and between $7^{\circ}56'$ and $9^{\circ}5'$ W Long. It is located about 550 km NNE of Iceland and 430 km E of Greenland. The island is composed of volcanic rocks of tertiary origin (Fitch 1964, Fitch et al. 1965) on the Arctic continuation of the Mid-Atlantic Ridge between Greenland and northern Norway (Johnson & Heezen 1967, Johnson 1968, Hawkins & Roberts 1972). It is the northernmost large volcanic icland in the world (Siggerud 1971).

The waters surrounding the island are a mixture of cold water from the East Greenland Current and the relatively warmer water from the North Atlantic Current (Iversen 1936). The East Greenland Current, which follows the whole coast of East Greenland in a direction from north to south, has negative temperatures, from ÷ 1.7^{o} to 0^{o}, all the year round and salinities of about 32.0 - 34.5^{o}/oo. The Atlantic water is characterized by positive temperatures, from about 0^{o} to + 3^{o}, and salinities of about 34.7 - 35.0^{o}/oo (Ockelmann 1958). The upper water layers around Jan Mayen, down to about 50 m depth, attain a comparatively high temperature in summer (Iversen 1936). A few surface water samples were taken during the expedition in 1972. Temperature ranged from + 3.9^{o} to 5.0^{o} and the salinity between 33.85 and 34.39^{o}/oo.

The direction of the current around the island changes with the tide (Iversen 1936). The Austrian expedition found the southwest-going current at falling tide to be the strongest and its speed was estimated at 0.5 - 1.0 nautical miles/hour (0.26 - 0.51 m/sec), but could reach 1.5 - 2.0 nautical miles/hour (0.77 - 1.03 m/sec) (Boldva 1886).

The tidal range at Jan Mayen is relatively small. Taking the range of spring tides in Maria Musch Bay on the west side of the island as an example, the range between MHWS and MLWS is 1.10 m (Admirality Tide Tables 1970). The mean tidal range in Walrus Bay, based on observations from 17 June to 2 July in 1938, was found to be 2.69 feet (0.82 m) (Boyd 1948).

Ice conditions around Jan Mayen are quite variable. Some years, no ice is observed (Iversen 1936). Other years, as when the Austrian expedition overwintered in 1882-83, ice with a mean thickness of 8 - 10 m was seen to drift past the island (Wohlgemuth 1886). The mean Arctic ice limit in April for the period 1946-63 reached as far as Jan Mayen (Steffensen 1969). The ice conditions around the island may have changed substantially during the past few decades, due to the general rise of temperature in the Arctic and the adjacent latitudes (Zenkevitch 1963).

MATERIAL AND METHODS

The benthos was sampled altogether at 42 dredging stations and 17 diving stations.

Dredge samples

Two types of triangular dredge were used. The "Chain-dredge" is especially designed to sample corals and is of a very rough and heavy construction. The frame of the dredge, which has a sideline of about 65 cm, is connected to the towing wire by three chains. The "Chain-dredge" was used exclusively from R.K. "Sjöfareren."

The smaller and lighter "Rowboat-dredge" has a frame with a sideline of about 50 cm. The frame is connected to the towing wire by a solid construction of three steel bars. This dredge was used both from R.K. "Sjöfareren" and the landing boat, an 18-feet inflatable rubber dinghy with a 25 HP outboard engine. A nylon rope was used for towing from the landing boat and a chain was attached just in front of the dredge to improve its sampling efficiency.

The sampling stations, shown in Figs. 1, 3, were located in the field by means of an echosounder (SIMRAD, Model 516-91) and radar (Kelvin Hughes, Type 17/9).

The usual procedure with the dredged material was to sieve part of it through a sieve with a mesh size of 0.5 mm, and part of it through a sieve with a mesh size of 1.0 mm. Large animals were sorted and fixed immediately. The residues in the sieves were preserved for later sorting under a dissecting microscope. The preservatives used were 80% alcohol or 4% formaldehyde. Some of the algae were dried.

The bulk of the material has been deposited in the Museum of the Royal Norwegian Society of Sciences and Letters, Trondheim, but some duplicates of ascidians have been donated to the Zoological Museum, Hamburg University.

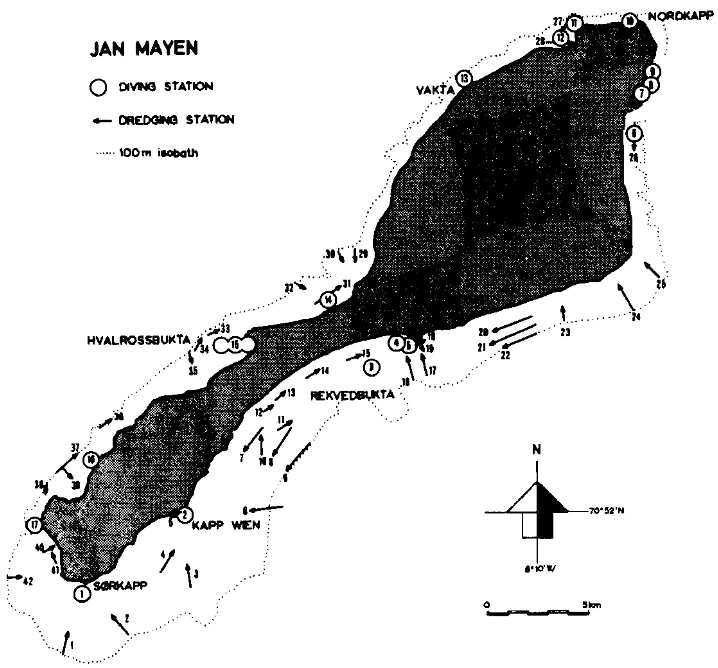

Fig. 1. Map of Jan Mayen showing the positions of the dredging- and diving stations. The diving stations are designated by a B after the station number in the text. The diving stations 7, 8, and 9 are located on the "new" grounds. (See also Fig. 3.)

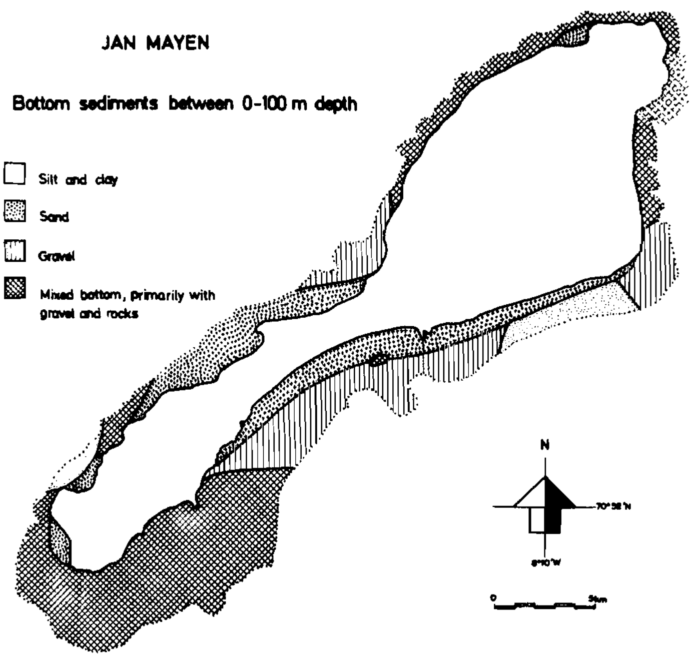

Fig. 2. Sketch map of the bottom substrates above 100 m depth at Jan Mayen. The "new" grounds are stippled on the NE part of the island.

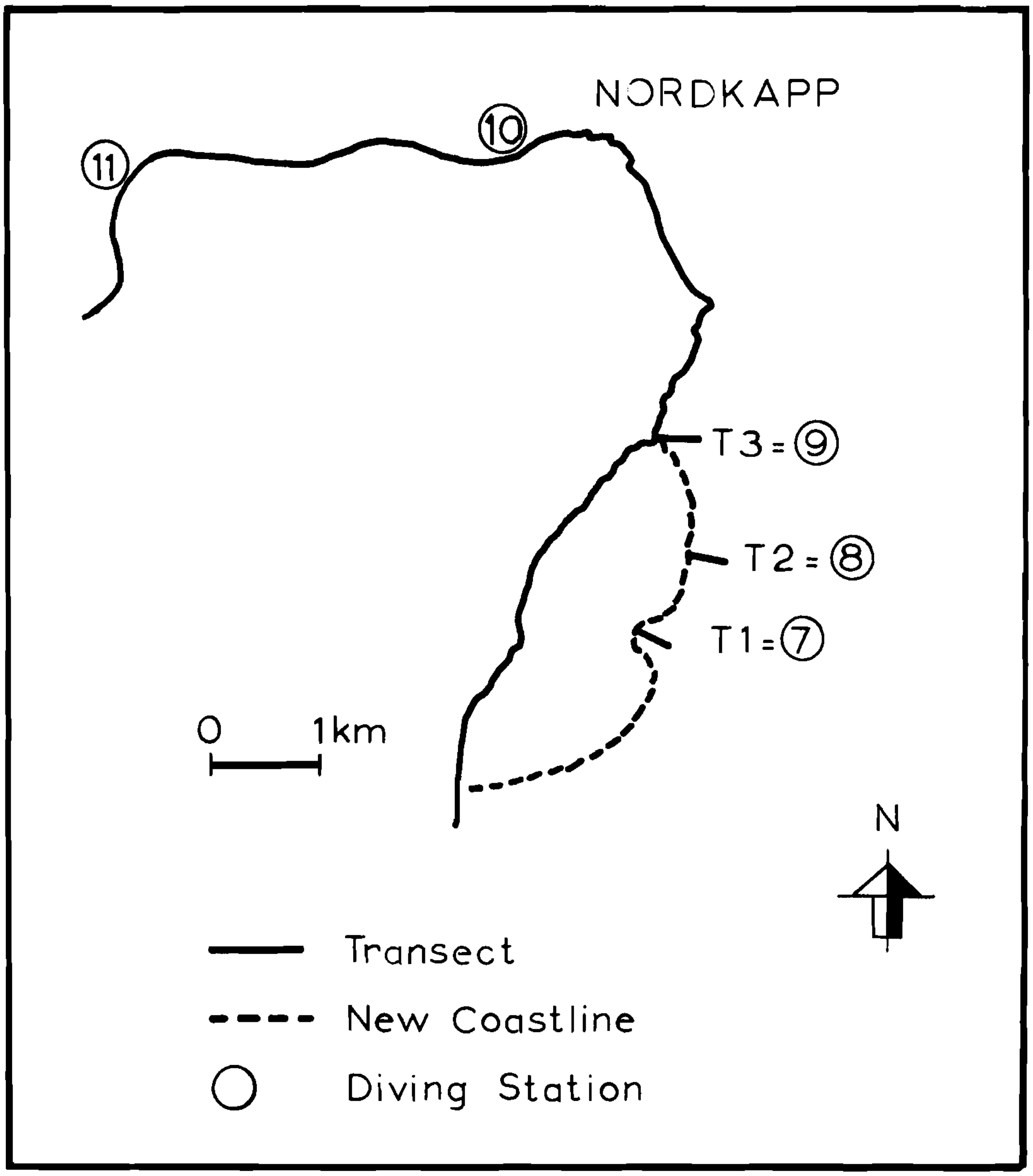

Fig. 3. The northern part of Jan Mayen with the "new" grounds. The transects 1, 2, and 3 are identical with the diving stations 7, 8, and 9.

Diving observations

SCUBA-equipment with compressed air was used. I concentrated on taking pictures of the bottom flora and fauna, because photography has been found to be one of the most valuable recording techniques now available to marine biologists.

Most of the photos were taken using a 35 mm Calypso/Nikkor II f/ 2.5 lens with a "Close-up" outfit. The photographed area when using the "Close-up" unit is (109 x 164) mm. This is a small area for giving reliable quantitative information, but on the other hand it is possible to identify many of the species. With only one month available for field work, it was considered more important to obtain a qualitative description of many localities, instead of a quantitative description of just a few stations. However, when several pictures are taken of the same locality, they can yield some indication of the densities of the different species.

Some bottom substrate samples and dominant organisms were also sampled by hand and a short description of the bottom was written down shortly after returning to the surface. This made species identifications from the photos easier.

Quantitative sampling, using a simple quadrat method, was tried at four diving stations, three of them being located on the "new" grounds. A 1/4 m^2 frame was randomly thrown on the bottom, at predetermined depths, along transects at right angles to the coast. The plants and animals inside the frame were sampled, preserved in 80% alcohol, and their weight determined after blotting for two minutes on filter paper. The results from the three stations on the "new" grounds were found to be unreliable, due to heterogeneous distribution and low biomass values, therefore only the results from Stn. 15 are included in the text.

The letter B has been added in the text to separate the diving stations from the dredging stations.

RESULTS AND DISCUSSIONS

Description of dredging stations (Fig. 1)

Stn. 1. 9 August 1972. Depth: 100-60 m. Chain-dredge. Hard bottom, some rocks in the dredge. Conspicuous faunal elements: *Ophiopholis aculeata, Chlamys islandica.*

Stn. 2. 9 August 1972. Depth: 80-50 m. Chain-dredge. Hard bottom, some rocks in the dredge. Conspicuous faunal elements: *Chirodota lævis, Onisimus edwardsi, Pagurus pubescens, Astarte borealis.*

Stn. 3. 8 August 1972. Depth: 82-75 m. Chain-dredge. Conspicuous faunal elements: *Ophiura sarsi, Myriotrochus rinkii, Ealus gaimardii, Sabinea septemcarinatus, Diastylis scorpioides, Chirodota lævis.*

Stn. 4. 8 August 1972. Depth: 62-24 m. Chain-dredge. Rocky bottom.

Stn. 5. 8 August 1972. Depth: 5 m. Rowboat-dredge. Rocky bottom with boulders and growth of *Phycodrys rubens* (L.) Batters, *Alaria pylaii* (Bory) J. Ag., *Laminaria digitata* (L.) Lamour. Conspicuous faunal elements: *Ophiopholis aculeata,* Hydrozoa.

Stn. 6. 8 August 1972. Depth: 116-60 m. Chain-dredge. Rocky bottom. Conspicuous faunal elements: *Ophiopholis aculeata, Strongylocentrotus droebachiensis*, Porifera, Bryozoa.

Stn. 7. 21 August 1972. Depth: 30 m. Rowboat-dredge. Gravel and sand. Conspicuous faunal elements: *Astarte borealis,* Bryozoa, *Pagurus pubescens.*

Stn. 8. 21 August 1972. Depth: 60 m. Rowboat-dredge. Gravel. Conspicuous faunal elements: *Astarte borealis, Pagurus pubescens, Ophiura sarsi, Chirodota lævis.*

Stn. 9. 21 August 1972. Depth: 90 m. Rowboat-dredge. Gravel. Conspicuous faunal elements: *Ophiura sarsi, Sabinea septemcarinatus, Pagurus pubescens.*

Stn. 10. 4 August 1972. Depth: 90-40 m. Chain-dredge. Gravel. Conspicuous faunal elements: *Astarte borealis, Strongylocentrotus droebachiensis, Serripes groenlandicus.*

Stn. 11. 4 August 1972. Depth: 40 m. Chain-dredge. Gravel, pebbles. Conspicuous faunal elements: *Astarte borealis, Chone infundibuliformis, Hiatella arctica, Ophiopholis aculeata.*

Stn. 12. 6 August 1972. Depth: 15-20 m. Rowboat-dredge. Sand, gravel. Conspicuous faunal elements: *Astarte borealis, Strongylocentrotus droebachiensis.*

Stn. 13. 6 August 1972. Depth: 15-20 m. Rowboat-dredge. Sand.

Stn. 14. 6 August 1972. Depth: 20-25 m. Rowboat-dredge. Sand. Conspicuous faunal elements: *Astarte borealis, Mya truncata.*

Stn. 15. 6 August 1972. Depth: 15 m. Rowboat-dredge. Sand.

Stn. 16. 3 August 1972. Depth: 100-30 m. Chain-dredge. Gravel. Conspicuous faunal elements: *Ophiura sarsi, Hiatella arctica, Pagurus pubescens.*

Stn. 17. 3 August 1972. Depth: 100-40 m. Chain-dredge. Fine gravel, sand. Conspicuous faunal elements: *Sabinea septemcarinatus, Strongylocentrotus droebachiensis, Pagurus pubescens, Ophiura sarsi.*

Stn. 18. 8 August 1972. Depth: 5-10 m. Rowboat-dredge. Sand. Driftweed: Probably *Laminaria saccharina* (L.) Lamour with *Pylaiella littoralis* (L.) Kjellman. Conspicuous faunal elements: *Nuculana pernula*, Hydrozoa.

Stn. 19. 8 August 1972. Depth: 5-10 m. Rowboat-dredge. Sand. Driftweed: *Halosaccion ramentaceum* (L.) J. Ag., *Alaria pylaii* (Bory) J. Ag. Conspicuous faunal elements: Nemertina.

Stn. 20. 19 August 1972. Depth: 30 m. Rowboat-dredge. Soft bottom. Conspicuous faunal elements: *Astarte borealis, Cnemidocarpa mollispina.*

Stn. 21. 19 August 1972. Depth: 60 m. Rowboat-dredge. Soft bottom. Conspicuous faunal elements: *Astarte borealis, Astarte montagui, Ophiura sarsi, Eugyra glutinans.*

Stn. 22. 19 August 1972. Depth: 100 m. Rowboat-dredge. Soft bottom. Conspicuous faunal elements: *Ophiura sarsi, Nuculana pernula, Chlamys islandica, Cnemidocarpa mollispina, Photis tenuicornis, Gitanopsis inermis.*

Stn. 23. 3 August 1972. Depth: 35-90 m. Chain-dredge. Black, volcanic sand. Conspicuous faunal elements: *Astarte borealis, Nuculana pernula, Nepthys ciliata, Pelonaia corrugata.*

Stn. 24. 19 August 1972. Depth: 40-100 m. Rowboat-dredge. Pebbles and gravel. Conspicuous faunal elements: *Hemithyris psittacea, Ophiopholis aculeata, Chone infundibuliformis.*

Stn. 25. 6 August 1972. Depth: 90-40 m. Chain-dredge. Gravel. Conspicuous faunal elements: *Ophiura robusta, Chone infundibuliformis, Ophiopholis aculeata, Strongylocentrotus droebachiensis.*

Stn. 26. 19 August 1972. Depth: 30 m. Rowboat-dredge. Sandy bottom, rocky bottom. Conspicuous faunal elements: *Pseudalibrotus litoralis, Onisimus edwardsi, Strongylocentrotus droebachiensis, Cucumaria frondosa.*

Stn. 27. 7 and 10 August 1972. Depth: 40-100 m. Chain-dredge. Rocky bottom, sandy bottom at shallower depths. Conspicuous faunal elements: *Cnemidocarpa mollispina,* Hydrozoa.

Stn. 28. 15 August 1972. Depth: 20-15 m. Rowboat-dredge. Sandy bottom. Conspicuous faunal elements: Amphipods.

Stn. 29. 11 August 1972. Depth: 90-35 m. Chain-dredge. Conspicuous faunal elements: *Monoculodes borealis, Ophiura sarsi, Hiatella arctica.*

Stn. 30. 11 August 1972. Depth: 90-60 m. Chain-dredge. Rocky bottom, gravel. Conspicuous faunal elements: *Ophiopholis aculeata, Astarte montagui, Ophiura robusta.*

Stn. 31. 11 August 1972. Depth: 40 m. Chain-dredge. Hard bottom. Conspicuous faunal elements: *Strongylocentrotus droebachiensis, Hiatella arctica.*

Stn. 32. 11 August 1972. Depth: 110-25 m. Chain-dredge. Hard sandy bottom. Conspicuous faunal elements: *Ophiura sarsi.*

Stn. 33. 10 August 1972. Depth: 60-70 m. Chain-dredge. Hard bottom. Conspicuous faunal elements: *Serripes groenlandicus.*

Stn. 34. 10 August 1972. Depth: 75-80 m. Chain-dredge. Hard sandy bottom. Conspicuous faunal elements: *Ophiura sarsi.*

Stn. 35. 10 August 1972. Depth: 100-30 m. Chain-dredge. Hard bottom. Conspicuous faunal elements: *Ophiopholis aculeata*, *Strongylocentrotus droebachiensis*, *Hiatella arctica*.

Stn. 36. 10 August 1972. Depth: 80-50 m. Chain-dredge. Mixed bottom, primarily with gravel and rocks. Conspicuous faunal elements: *Molgula griffithsii*, *Ealus gaimardii*, *Astarte borealis*.

Stn. 37. 10 August 1972. Depth: 100 m. Chain-dredge. Hard bottom. Conspicuous faunal elements: *Ophiura sarsi*.

Stn. 38. 10 August 1972. Depth: 100-50 m. Chain-dredge. Soft bottom. Conspicuous faunal elements: *Photis tenuicornis*, *Brachydiastylis resima*, *Gitanopsis inermis*, *Axinopsida orbiculata*, *Nuculana pernula*, *Astarte borealis*.

Stn. 39. 14 August 1972. Depth: 100-40 m. Chain-dredge. Soft bottom. Conspicuous animals: *Ophiura sarsi*, *Monoculodes latimanus*, *Ophiura robusta*, *Ophiopholis aculeata*, *Spirontocaris spinus*, *Ealus gaimardii*.

Stn. 40. 10 August 1972. Depth: 20-15 m. Rowboat-dredge. Sandy bottom. Driftweed: *Acrosiphonia sonderi* (Kütz.) Kornmann, *Alaria pylaii* (Bory) J. Ag., and a fragment of *Laminaria*, probably *L. hyperborea* (Gunn.) Foslie with *Rhodymenia palmatia* epiphytic. Conspicuous faunal elements: *Astarte borealis*.

Stn. 41. 10 August 1972. Depth: 10-15 m. Rowboat-dredge. Sandy bottom. Driftweed: *A. sonderi*. Conspicuous faunal elements: Amphipods.

Stn. 42. 9 August 1972. Depth: 100-40 m. Chain-dredge. Gravel. Conspicuous faunal elements: *Astarte borealis*.

Description of diving stations (Figs. 1, 3)

Stn. 1B. 23 August 1972. Depth: 18-20 m. Scoured, rocky bottom with crevices. Gravel in the deepest crevices. Conspicuous faunal elements: *Strongylocentrotus droebachiensis*, *Gersemia rubiformis*, and *Ophiopholis aculeata* inhabiting different species of Porifera. Plants: *Crustose corallines*.

Stn. 2B. 23 August 1972. Depth: 10-12 m. Large rocks and boulders covering the bottom. Accumulations of gravel and sand between the rocks and boulders. The algal growth concentrated on the rocky bottom. Conspicuous faunal elements: *Hiatella arctica*, *Acmaea rubella*, *Dendrodoa grossularia*, *Caprella* sp., *Gammarellus homari*, *Ischyroceros* sp., and hydrozoans. Plants: *Rhodomela subfusca* (Woodw.) Ag., *Phycodrys rubens* (L.) Batters, *Anthithamnion boreale* (Gobi) Kjellm., *Ptilota pectinata* (Gunn.) Kjellm.

Stn. 3B. 22 August 1972. Depth: 10-17 m. Scoured, rocky bottom which was quite steep. Large growth of *Alaria pylaii* (Bory) J. Ag. down to about 12 m depth. The reef, "Nansenflua", marked at 2 m depth on the map (Norwegian Polar Institute 1959) was not relocated, and 10 m was the shallowest depth recorded. Conspicuous faunal elements: Porifera with *Ophiopholis aculeata*, *Tealia felina* var. *crassicornis*, and *Hiatella arctica*. Porifera were most common on the vertical surfaces, *T. felina* on the more level surfaces and *H. arctica* reached its highest densities in the rock grooves.

Stn. 4B. 3 August 1972. Depth: 15 m. Sandy bottom with ripple marks well developed. The plants sampled were driftweed floating about just above the bottom. Conspicuous faunal elements: The amphipod *Pseudalibrotus glacialis*.

Stn. 5B. 4 August 1972. Depth: 0-5 m. Dive along the side of the small rock south of Eggöya (Norwegian Polar Institute 1959). Sparse algal growth and few epifaunal elements.

Conspicuous faunal elements: *Caprella* sp., *Gammarellus homari*, *Ischyrocerus* sp., *Haliclystus* sp., and *Acanthocottus scorpius*. Plants: *Halosaccion ramentaceum* (L.) J. Ag. f. *subsimplex*, *Phycodrys rubens*, *Audouinella membranacea* (Magnus) Papenfuss, *Halosiphon tomentosus* (Lyngb.) Jaasund.

Stn. 6B. 21 August 1972. Depth: 15-18 m. Scoured rocky bottom with stripes and grooves. The rocky bottom is probably strongly scoured by ice, either from the sea or from calving of the two glaciers Frielebreen and Prins Haralds Bre. Conspicuous faunal elements: *Tealia felina* var. *crassicornis*, *Strongylocentrotus droebachiensis*, *Hiatella arctica*, *Ischyroceros* sp. Plants: *Crustose corallines*.

Stn. 7B. (Transect 1, Fig. 3). 25 August 1972. The bottom consisted of rounded rocks and boulders. The 30 m isobath lay ca. 50 m from the shore. Bottom life was very sparse from the shoreline down to 10 m depth, with no algae and only a few amphipods. From 10 m to 30 m depth an increasing number of nudibranchs, *Dendronotus* spp., were present. Their density was estimated at 1-2 individuals/m^2. Some of the individuals had spawned and characteristic egg-strings were found attached to the substrate. Hydrozoans and bryozoans were common below 15 m depth and large fronds of *Alaria pylaii* (Bory) J. Ag. appeared below 20 m depth.

Stn. 8B. (Transect 2, Fig. 3). 1 and 2 August 1972. This transect was not as steep as transect 1 and the 30 m isobath was found about 150 m from the shore. Few stones and boulders were found on the rocky bottom, it looked very "clean" and volcanic sand was found only in crevices. No animals were found in the sand. The animal growth was most dense at 15-20 m depth and the individuals recorded were *Monostroma* sp., *Acrosiphonia sonderi* (Kutz.) Kornmann, *Porphyra miniata* (C. Ag.) C. Ag., and *Halosiphon tomentosus* (Lyngb.) Jaasund. Amphipods, *Gammarellus homari*, *Gammarus setosus*, *Ischyroceros* sp., with the highest densities occurring from 5-10 m depth and nudibranchs (*Dendronotus* sp.) were the most numerous animals. Individuals of the scyphozoan *Haliclystus* sp. were found attached to algae. Colonies of hydrozoans and bryozoans were also common below 15 m depth.

Stn 9B. (Transect 3, Fig. 3). 25 August 1972. This transect had approximately the same angle of slope as transect 2, but more sand had accumulated on the bottom. The same four species of algae from transect 2 were also recorded here, in addition to long fronds of *Alaria pylaii* below 15 m depth. Two different species of nudibranchs were observed, *Dendronotus* sp. and *Coryphylla stimpsoni* (Verill). Hydrozoans, bryozoans, and amphipods were common, as also the schypozoan *Haliclystus* sp. In addition there were some animals not previously recorded on the "new" grounds, viz. the sea urchin *Strongylocentrotus droebachiensis* (O.F. Müller), the snail *Buccinum* sp., and the fish *Myoxocephalus scorpius* (L.).

Stn. 10B. 24 August 1972. Depth: 10-12 m. Rocky bottom probably heavily scoured by ice. Very sparse algal growth. Conspicuous faunal elements: *Strongylocentrotus droebachiensis, Tealia felina* var. *crassicornis*, and Porifera with *Ophiopholis aculeata.*

Stn. 11B. 13 August 1972. Depth: 18-20 m and 25 m. Large rocks and boulders; some gravel had accumulated between them. Algal growth dominated on the rocks and boulders at 18-20 m, while the vegetation was more sparse at 25 m depth. Conspicuous faunal elements: *Tealia felina* var. *crassicornis, Gersemia rubiformis, Strongylocentrotus droebachiensis,* and Porifera with *Ophiopholis aculeata.* The actinians and sea urchins sat on top of boulders, while the Porifera, with the brittle stars, sat on the vertical sides of the boulders. On the gravel it was possible to observe the lophophores of the brachipods, the tubes of the polychaetes and the siphons of the molluscs. Amphipods (*Aeginina longicornis, Caprella* sp.*, Gammarellus homari, Sympleustes glaber*) were common just above the bottom everywhere. Plants: *Crustose corallines, Dilsea integra* (Kjellm.) Rosenv., *Euthora cristata* (L.) J. Agardh, *Desmarestia viridis* (Müll.) Lamour.

Stn. 12B. 15 August 1972. Depth: 20 m. Sandy bottom with ripple marks. Conspicuous faunal elements: (*Onisimus (?) edwardsi*).

Stn. 13B. 14 August 1972. Depth: 25 m. Both the bottom substrate, the flora and the fauna appeared almost identical with the conditions observed at 25 m depth at Stn. 11B.

Stn. 14B. 12 August 1972. Depth: 8 m. Sandy bottom with ripple marks. Conspicuous faunal elements: Amphipods.

Stn. 15B. 11 August 1972. Sandy bottom with ripple marks. Quantitative transect study with 1/4 m^2 samples collected at 5 m, 10 m, and 16 m depth. The upper 4 - 5 cms of the sediment were removed and sieved through a sieve with a mesh size of 0.5 mm. The faunal biomass values (determined as the alcohol preserved weight) were: 5 m depth: 5.04 g/m^2; 10 m depth: 0.92 g/m^2; 16 m depth: 0.04 g/m^2. The amphipods have been excluded from these results because they aggregated in clusters when the sediment was stirred up, which would have yielded erroneous results if they had been included. Conspicuous faunal elements: Amphipods, denser populations in the shallower waters. High densities of the ascidian *Eugyra glutinans* were recorded at 7 m depth.

Stn. 16B. 22 August 1972. Depth: 25 m. Rocky bottom with boulders. Sparse algal growth on the boulders. Conspicuous faunal elements: *Tealia felina* var. *crassicornis*, *Strongylocentrotus droebachiensis*, and aggregations of *Cucumaria frondosa* on the bedrock and on top of the boulders. Porifera with *Ophiopholis aculeata* and the ascidian *Didemnum albidum* on the vertical sides of the boulders.

Stn. 17B. 17 August 1972. Depth: 30 m. Large boulders, with accumulated gravel between them. Conspicuous faunal elements: *Tealia felina* var. *crassicornis*, *Gersemia rubiformis*, and *Strongylocentrotus droebachiensis* dominated on top of the boulders, Porifera with *Ophiopholis aculeata* on the sides of the boulders. Plants: *Crustose corallines*.

Table 1. Species and number of species from dredging and diving stations (excluding specimens from underwater photos). The diving stations are denoted by a B. The number of species or colonies are shown in parentheses after the station number. (+) means empty shell, ½ means one valve of the Bivalves, (A) = common, (B) = few individuals or colonies, (C) = one individual or colony. (Preliminary list. A complete list, with treatment of the different groups by specialists, will be published later, if necessary)

PORIFERA

Porifera sp. indet. 1(B), 5(C), 6(A), 9(C), 11(A), 24(A), 36(B), 39(B), 2B(C), 6B(B), 11B(A), 13B(B)

COELENTERATA

Hydrozoa sp. indet. 5(A), 7(B), 9(C), 10(C), 11(C), 12(A), 16(C), 17(B), 18(C), 20(B), 21(A), 22(A), 24(C), 27(C), 29(A), 30(A), 31(A), 34(C), 39(A), 40(A), 5B(A), 8B(A), 11B(A)

Haliclystus sp. 5(1), 2B(2), 5B(2), 8B(1), 9B(2)

Gersemia rubiformis (Ehrenberg) 6(C), 25(C), 6B(4), 11B(3) 13B(2)

Actinaria sp. indet. 1(B), 8(A), 11(A), 17(C), 21(C), 22(C), 25(C), 29(C), 31(C), 36(A), 37(C), 38(B), 39(A), 6B(2), 11B(2), 13B(1)

BRYOZOA

Bryozoa sp. indet. 1(B), 2(B), 3(B), 6(A), 7(A), 20(C), 21(A), 22(A), 23(A), 24(A), 25(A), 29(B), 30(B), 31(B), 36(A), 38(A), 39(B), 7B(A), 11B(A)

BRACHIOPODA

Hemithyris psittacea (Gmelin) 24(26), 25(2), 30(1+)

MOLLUSCA

Bivalvia

Nuculana pernula (Müller) 3(2), 9(5), 22(108), 36(1), 37(1), 38(36)

Yoldiella frigida (Torell) 22(6), 23(2), 39(4)

Dacrydium vitreum (Möller) 22(43,½+), 23(7), 29(2), 38(2)

Musculus laevigatus (Gray) 39(1,½+)

Chlamys islandica (Müller) 1(5), 6(4,½+), 8(1), 16(1), 22(22,5+), 23(5), 24(8), 25(20), 30(3,½+), 31(1), 36(1), 37(1), 38(2), 39(7)

Table 1. cont.

Similipecten groenlandicus (Sowerby) 3(2,½+), 22(1)

Limatula subauriculata (Montagu) 42(1)

Thracia myopeis (Beck) Möller 1(1), 7(3,(7,12½)+), 10(2), 21(3), 22(½+), 23(6), 29(9), 36(½+), 38(2)

Cuspidaria subtorta (G.O. Sars) 22(4)

Astarte montagui (Dillwyn) 7(1), 21(52), 23(14)

A. montagui (Dillwyn) var. *striata* (Leach) G.O. Sars 2(5), 8(1), 24(4), 25(3), 30(7), 36(3)

A. montagui (Dillwyn) var. *typica* (Hägg) 2(2), 8(1), 24(5), 25(5), 30(3), 38(1)

Astarte borealis (Schumacher) 2(10), 3(9), 7(50), 8(22), 10(19), 11(47), 12(11), 20(48), 21(250), 23(150), 24(11,½+), 25(8), 29(7), 36(10), 38(20), 40(11), 42(25)

Astarte sp. indet. 21(9), 23(5), 29(2), 38(13)

Thyasira equalis (Verrill and Bush) 22(3,½+), 38(2,½+)

Axinopsida orbiculata (G.O. Sars) 22(3), 23(2), 29(4), 38(24),

Serripes groenlandicus (Brugiére) 3(1), 7(1,(1,½)+), 10(3,2½+), 11(1,½+), 12(½+), 15(1), 16(7), 17(2), 20(2), 21(6,2½+), 22(4,½+), 23(2), 29(1,1+), 30(½+), 31(½+), 32(½+), 33(1,4½+), 36(1), 37(1), 38(1), 39(4,½+), 42(2)

Mya truncata L. 3(1), 7(3, 2½+), 10(1,½+), 14(1), 16(1), 17(1), 21(3,1+), 22(8,1+), 23(7), 29(6), 31(1), 33(½+), 34(1, 2½+), 38(5), 39(2)

Hiatella arctica L. 1(1), 2(4), 3(2), 5(3), 6(½+), 7(2,1+), 8(3), 10(1), 11(11,½+), 12(1,(1,3½)+), 16(20), 17(3), 21(1), 22(5), 23(1,½+), 24(9,½+), 25(½+), 26(1), 29(10), 30(1,(1,2½)+), 31(2,½+), 35(1), 36(1,½+), 38(10,½+), 39(1), 42(3,1+), 5B(1), 6B(5), 11B(1), 13B(2)

Cyrtodaria kurriane Dunker 38(2)

Prosobranchia

Acmaea rubella (Fabricius) 6B(4)

Lepeta caeca (Müller) 22(5,1+), 25(2)

Margarites helicinus (Phipps) 5(1), 2B(12)

Margarites groenlandicus (Gmelin) 22(1), 25(1), 36(1), 11B(3)

Lacuna pallidula (da Costa) 29(4)

Epitonium greenlandicum (Perry) 24(3), 25(1)

Natica clausa Broderip and Sowerby 3(1), 21(1), 25(1), 38(3), 39(1)

Amauropsis islandicus (Gmelin) 29(1)

Lunatia pallida (Broderip and Sowerby) 7(3), 8(1), 9(3), 16(3), 17(5), 21(4), 22(6,2+), 24(1), 25(1) 38(1)

Buccinum spp. (not yet determined)

Table 1. cont.

Oenopota trevelliana (Turton) 9(1), 17(1), 21(2), 22(7), 23(2), 29(2)

Nudibranchia

Dendronotus robustus Verrill 21(2)

Dendronotus sp. indet. 9B(1), 11B(1)

Coryphella stimpsoni (Verrill) 11B(2)

Coryphella salmonacea (Couthouy) 13B(1)

Trinchesja viridis (Forbes) 11B(1)

POLYCHAETA

Eunoë nodosa (M. Sars) 3(3), 23(2)

Antinoëlla sarsi sarsi (Kinberg) 3(4), 12(3), 29(1), 42(3)

Harmothoë fragilis Moore 23(1), 37(1)

Anaïtides mucosa (Oersted) 3(3), 16(1), 17(1), 25(1), 32(1)

Eteone longa (Fabricius) 40(1)

Syllinae sp. indet. 13B(2)

Autolytinae sp. indet. 5B(1)

Nereis pelagica L. 11(1), 17(1), 24(3), 11B(1)

Nephtys ciliata O.F. Müller 2(1), 16(1), 17(5), 23(36), 25(6) 29(5), 42(5)

Nothria conchylega (M. Sars) 2(1)

Lumbrinereis fragilis (O.F. Müller) 17(1), 23(2), 39(1)

Spio filicornis (O.F. Müller) 13B(23)

Polydora sp. (*P. giardi* Mesnil?) 38(1)

Polydora sp. 29(1)

Cirratulidae sp. indet. 29(1)

Travisia forbesii Johnston 7(2), 21(2), 29(1)

Owenia fusiformis Delle Chiaje 7(3), 21(3), 29(1), 38(1)

Myriochele sp. 9(3), 22(1), 23(4), 37(1), 38(2), 39(1)

Ampharete baltica Eliason 7(1)

Ampharete finmarchia (M. Sars) 3(1), 9(1), 17(4), 23(13), 29(4), 39(2)

Ampharete sp. indet. 39(1)

Anobothrus gracilis (Malmgren) 22(1), 23(9)

Ampharetinae sp. indet. 21(1), 38(1)

Melinna cristata (M. Sars) 22(1), 23(18), 29(1), 38(1)

Terebellides stroemi M. Sars 23(2)

Table 1. cont.

Laphania boecki Malmgren 8(1), 17(3)

Polymnia nesidensis (Delle Chiaje) (?) 11B(1)

Chone infundibuliformis Kröyer 11(30), 24(17), 25(100)

Chone infundibuliformis Kröyer (?) 2(1), 8(3), 23(7), 29(10), 42(1), 12B(2)

Sabellidae sp. indet. 22(B), 23 (B), 29(B), 32(B), 34(B), 38(B), 39(B)

Pomatoceros triqueter (L.) Driftwood, Maria Musch Bay

Spirorbis spp. 2(B), 17(B), 29(B), 30(B)

CRUSTACEA

Mysidacea

Mysis oculata (Fabricius) 3(7), 17(14), 40(1)

Cumacea

Brachydiatylis resima (Kröyer) 22(16), 23(3), 29(1), 38(70)

Diastylis scorpioides Lepechin 3(11), 16(1), 17(9), 21(9), 22(4), 23(2), 29(1), 38(1), 39(1),

Pleurogonium inerme G.O. Sars 22(2)

Pleurogonium spinosissimum G.O. Sars 22(2), 23(1)

Tanaidacea

Typhlotanais finmarchicus G.O. Sars 38(1)

Isopoda

Isopoda sp. indet. 38(17)

Amphipoda

Onisimus edwardsi Kröyer 2(30), 20(1), 24(13), 26(16), 32(1), 40(3), 42(7), 12B(1)

Pseudalibrotus glacialis G.O. Sars 4B(6)

Pseudalibrotus litoralis G.O. Sars 16(2), 26(23), 28(3), 41(1)

Anonyx nugax (Kröyer) 3(13), 17(1), 21(1), 22(2), 39(1), 42(3)

Gitanopsis inermis G.O. Sars 20(1), 22(59), 32(2), 37(1), 38(33), 39(18)

Metopa sp. indet. 22(1)

Paroediceros lynceus (M. Sars) 7(1), 17(1), 21(6), 42(1)

Paroediceros propinquus (Goës?) G.O. Sars 21(1), 39(2)

Westwodilla brevicalar (Goës) 29(1), 39(3)

Monoculopsis longicornis (Boeck) 21(2)

Table 1. cont.

Monoculodes borealis Boeck 3(6), 17(3), 21(18), 38(1), 39(5)

Monoculodes latimanus (Goës) 3(1), 21(1), 22(10), 29(23), 32(1), 38(16), 39(78)

Syrrhoe crenulata Goës 22(1), 38(2), 39(3)

Parapleustes pulchellus (Kröyer) 29(1)

Sympleustes glaber (Boeck) 39(1), 11B(1)

Eusirus cuspidatus Kröyer 42(2)

Rhachotropis aculeata (Lepechin) 3(1), 17(1), 39(1)

Gammarellus homari (J.C. Fabricius) 24(2), 2B(2), 5B(13), 8B(5), 11B(1)

Gammarus setosus Dementieva 8B(1)

Photis tenuicornis G.O. Sars 22(72), 38(78), 39(3)

Ischyrocerus spp. (*I. anguipes* Kröyer or *I. megalops* G.O. Sars) 20(1), 22(3), 29(5), 32(7), 38(38), 39(5), 40(2), 2B(3), 5B(6), 6B(2), 8B(1)

Erichthonius megalops (G.O. Sars) 1(2)

Corophium crassicorne Bruzelius 20(3), 21(1), 22(1), 29(2)

Paradiluchia sp. indet. 22(2)

Aeginina longicornis (Kröyer) 11B(10)

Caprella sp. indet. 20(1), 21(1), 36(1), 39(1), 2B(4), 5B(5), 11B(2)

Parathemisto libellula (Mandt) 9(1)

Decapoda

Spirontocarus spinus (Sowerby) 3(10), 17(4), 22(2), 25(5), 36(2), 39(21), 42(1)

Lebbeus polaris (Sabine) 22(1), 39(1)

Ealus gaimardii (H. Milne Edwards) 2(4), 3(16), 6(7), 16(1), 17(13), 22(4), 24(1), 25(2), 36(11), 39(21)

Pandalus borealis Kröyer 37(2), 38(6), 39(2)

Sabinea septemcarinatus (Sabine) 3(15), 9(20), 16(2), 17(22), 21(3), 22(2), 23(1), 24(1), 38(1)

Pagarus pubescens Kröyer 1(2), 2(12), 3(8), 6(1), 7(6), 8(11), 9(16), 10(1), 11(1), 12(1), 16(18), 17(18), 21(6), 22(13), 24(2), 25(5), 29(2), 30(1), 32(2), 36(3), 37(2), 38(4), 39(5), 42(4)

ECHINODERMATA

Pteraster militaris (O.F. Müller) 23(1)

Diplopteraster multipes (M. Sars) 17B(1)

Crossaster papposus (L.) 31(1)

Table 1. cont.

Stephanasterias albula (Stimpson) 22(1), 25(3), 32(1), 37(2), 39(2), 6B(2), 13B(2)

Gorgonocephalus arcticus Leach 2(B), 6(B), 24 (B)

Ophiopholis aculeata (L.) 1(25), 2(1), 3(6), 5(3), 6(55), 11(10), 17(1), 22(3), 23(1), 24(18), 25(34), 30(10), 31(2), 34(1), 35(1), 36(4), 38(5), 39(24), 42(1), 11B(1), 17B(2)

Ophiura sarsi Lütken 3(24), 6(1), 8(8), 9(29), 10(1), 16(21), 17(16), 21(24), 22(207), 23(16), 29(13), 32(6), 33(1), 34(5), 37(27), 38(9), 39(111), 42(1)

Ophiura robusta (Ayres) 17(11), 22(8), 24(2), 25(285), 30(8), 32(3), 36(1), 39(53)

Strongylocentrotus droebachiensis (O.F. Müller) 1(3), 2(5), 3(7), 6(28), 8(5), 9(9), 10(15), 12(10), 16(6), 17(20), 22(15), 23(1), 24(6), 25(28), 26(9), 29(3), 30(4), 31(6), 32(3), 33(1), 35(1), 36(3), 38(1), 39(2), 42(2), 6B(1), 11B(2), 13B(2)

Cucumaria frondosa (Gunnerus) 1(1), 3(3), 17(9), 20(1), 21(1), 22(1), 23(1), 25(1), 26(4), 36(1), 38(1), 39(2), 42(2), 11B(1)

Cucumaria lactea (Forbes) 25(1)

Psolus phantapus (Strussenfelt) 1(1), 22(10), 23(15), 24(1), 25(9)

Chirodota lævis (Fabricius) 2(29), 3(11), 8(8), 10(4), 16(3), 25(12), 30(6), 36(2), 39(4), 42(1)

Myriotrochus rinkii Steenstrup 3(17)

ASCIDIACEA

Aplidium spitzbergense Hartmeyer 22(18)

Didemnum albidum (Verrill) 31(6), 16B(1), 17B(2)

Ascidia prunum Müller 11B(3)

Dendrodoa grossularia (van Beneden) 2B(6)

Cnemidocarpa rhizopus (Redikorzev) 29(2), 38(1)

Cnemidocarpa mollispina Ärnbäck-Christie-Linde 3(2), 7(3), 12(2), 14(1), 20(20), 22(56), 23(20), 27(2), 29(6), 38(4)

Pelonaia corrugata Forbes and Goodsir 3(5), 23(34), 38(9)

Molgula griffithsii (MacLeay) 36(33)

Molgula romeri Hartmeyer 22(1), 23(2)

Eugyra glutinans (Möller) 7(6), 21(99), 22(1), 29(3), 32(2), 38(2), 2B(1), 15B(18)

PISCES

Boreogadus saida (Lepechin) 16(1)

Table 1. cont.

Ammodytes marinus Raitt 2(3), 11(1), 16(5), 17(3), 24(1), 25(1), 42(1)

Lumpenus lampretiformis (Walbaum) 22(1)

Myoxocephalus scorpius (L.) 39(1), 8B(1)

Triglops murrayi Günther 3(1), 36(1), 38(4), 39(3)

Icelus bicornis (Reinhardt) 9(3), 24(2), 36(2), 38(1), 39(1)

Liparis liparis (L.) 5(1)

Eumicrotremus spinosus (Fabricius) 11B(1)

Hippoglossoides platessoides (Fabricius) 2(1), 8(1), 11(1), 21(1), 23(1), 36(1), 39(1), 42(1)

Fauna and flora of the shores

The shores of Jan Mayen are of two main types, either beaches, consisting of sand or pebbles, or a rocky facies, with vertical cliffs of lava going down into the sea. Muddy shores, or a tidal zone with *Mytilus edulis* as found at East Greenland (Ockelmann 1958), were not observed.

Besides birds, the only animal life seen in the supralittoral zone on the sand and pebble beaches were small red mites. Some driftwood with occasional animal life may occur (e.g. a log with *Lepas anatifera* L. was found by the geologist Paul Imsland in Maria Musch Bay.) The shoreline of these beaches could change rapidly. For instance, we observed that the shoreline of the beach on the "new" land changed several metres during the course of only a few days. Together with ice scouring, winter freezing, and the narrow tidal range, this was probably the main reason for the lack of animals.

The rocky facies of Jan Mayen were also very poor in life. Lichens were observed in the supralittoral zone and green algae covered some rocks in the tidal region. The volcanic rock is soft, deteriorates fast, and is very unsuitable for settlement by both plants and sedentary animals, expecially in the tidal zone where ice, freezing, wave action, and other factors accelerate this deterioration.

In comparison, the only life found in the supralittoral zone on the rocky facies of East Greenland was *Verrucaria*-like lichens and the mite *Molgus littoralis* (L.) (Madsen 1936).

The absence of algae and sessile animals in the tidal zone of cold regions, caused by ice action, is well-known (Stephenson & Stephenson 1954, Ellis 1955, Ellis 1960, Ellis & Wilce 1961) and in the Arctic Ocean this absence is reported down to 6 m depth (Allee & Schmidt 1951), to 3 m at East Greenland (Thorson 1933, Madsen 1936).

The rocky bottom from the tidal zone down to about 6 m depth was not completely barren at Jan Mayen, cfr. diving station 5B, but algal growth was sparse and hydrozoans were the only sedentary group observed.

Fauna associated with the vegetation

Ockelmann (1958) has divided the epifauna from East Greenland into three main categories: 1) the epifauna of the tidal zone, 2) the epifauna of the vegetation, 3) the epifauna on rocks, stones, pebbles etc. of the sea bottom.

The animals belonging to the second group, the epifauna of the vegetation, is not easily singled out. It is very difficult to distinguish between animals normally associated with plants and animals associated with the bottom substrate or with other animals. Thorson (1933) writes that dredge samples of the *Desmarestia*-epifauna will also contain "actual bottom animals." Later on, in the chapter on the red algae epifauna, he writes: ".... it is, of course, not always easy to decide how much of the epifauna is attached to the stones and how much to the algae." Many of the species described by Thorson (1933) as belonging to the epifauna of the vegetation are more probably associated with the bottom. This is, for instance the case for *Hiatella arctica*, *Strongylocentrotus droebachiensis*, and *Stephanasterias albula*. An observation supporting this idea is also provided by Thorson (1933), who observed mostly juvenile *H. arctica* and *Mya truncata* among the algae, the adult individuals probably not finding enough support on the algae. The adult individuals are strongly attached to their normal substrate, the bottom, and the dredge probably catches only those animals which have not yet found a suitable substrate.

Many of the species associated with the vegetation by Thorson are, therefore, in this connection treated as belonging to the rocky bottom. However, some organisms are undoubtedly very closely associated with the vegetation. Among these are some hydrozoans, the fish *Myoxocephalus scorpius* and the scyphozoan *Haliclystus* sp. *Haliclystus* sp. has an adhesive stalk on its aboral surface by means of which it attaches to algae. It probably feeds on amphipods or other small crustaceans. The snails *Acmaea rubella* and *Margarites helicinus* were often observed on red crustose corallines, probably feeding. These snails are very similar in colour to these algae, and the crustose corallines may also camouflage the snails.

Flora and fauna on level bottom areas

Most workers who have described Arctic marine life have accepted the community concept. Level bottom communities previously described from shallow waters in arctic regions include *Gomphina fluctuosa, Portlandia arctica,* and *Macoma*-communities (Thorson 1957, Ockelmann 1958, Ellis 1960). Parat & Devillers (1936) recognized a community of *Astarte borealis - Macoma calcarea* in shallow waters at Jan Mayen (called the *Macoma calcarea*-community by Thorson 1957). This community, of *Astarte - Macoma* with a few echinoderms, was said to be very distinct from 25-30 m, while from 30-90 m *Astarte - Macoma* were rare and *Pecten groenlandicus, Ophiocten sericeum, Ophiura robusta* were more abundant.

No quantitative sampling of level bottom areas in the waters around Jan Mayen was carried out during 1972, but the numbers of animals in the dredge samples were recorded (Table 1). These numbers should provide some information about the abundance of the benthic animals. Since some of the samples contained extremely high numbers of certain animals, among them *Ophiura robusta, O. sarsi,* and *Astarte borealis,* it was impossible to preserve all the specimens and the recorded numbers for some of the most numerous animals are therefore probably too low. None of the samples obtained indicated the presence of an *Astarte borealis - Macoma calcarea* community at Jan Mayen, because no specimens of *Macoma* were found. Furthermore, according to Ockelmann (1958), no *Macoma* species has ever been taken alive at Jan Mayen.

However, high numbers of *Astarte borealis* were recorded on two bottom areas; viz. the areas where dredge samples 7, 8, 10, and 11 were taken and the area within which dredge samples 20, 21, 23, and 24 were taken. But the accompanying species in the same samples do not give evidence to conclude that a *Macoma calcarea*-community is present in these areas.

I did not record any *A. borealis* in dredge samples 9 and 22, each of them near to one of the areas within which *A. borealis* was abundant. Both sample 9 and 22 were deep, horizontal samples, which indicates that the high densities of *A. borealis* were only to be found at depths shallower than 90-100 m.

The sampled material does not provide any evidence for the existence of distinctive animal communities on level bottom areas in the waters around Jan Mayen. There may be many reasons for this; lack of sufficient quantitative sampling material; such bottom communities perhaps simply do not exist at Jan Mayen; or there is an absence of large areas over which similar environmental conditions exist. If distinctive animal communities do exist at Jan Mayen, this is a problem which cannot be solved before more quantitative material is at hand.

The main trend in the distribution of animals at Jan Mayen seem to be towards heterogeneity, the environmental conditions varying very much from locality to locality. However, the results do indicate the existence of zones with similar substrates. The substrate is a complex environmental parameter, which may provide information about water movements, food supplies, and other features of the environment. I have therefore made a sketch map showing the main substrate types (Fig. 2). This map is based on the observations made during diving, dredge hauls and map no. 512 from the Norwegian Institute of Polar Research (1955).

Only two small underwater areas contained typical soft bottom organisms, those comprising stations 22-25 and 37-39. The absence of bottom with fine sediments above about 100 m depth may be due to several factors. Among them are the topography (no well-developed shelf around the island), the strong water movements and the relatively small supply of terrigenous material from the 380 km^2 large island. Most of the sediment supply to the sea bottom around Jan Mayen probably originates from shoreline erosion by waves and ice, and from sea ice carrying rock fragments.

Four of the diving stations, 4B, 12B, 14B, and 15B, had a level bottom with black volcanic sand and well developed ripple marks. This sandy bottom was very poor in life, as the quantitative samples from station 15B show. Scattered clumps of driftweed and amphipods were the most conspicuous. A strange observation at station 15B was the abundance of the ascidian *Eugyra glutinosa* at 7 m depth, probably due to an accumulation of detritus at just this depth.

Areas with a fauna most resembling the fauna on level bottom areas at Jan Mayen are probably to be found at East Greenland. Ockelmann (1958) concluded that the bivalve fauna of Jan Mayen shows distinctly Arctic features, with a close resemblance to the bivalve fauna of the southern coast of Greenland.

Benthos on rocky bottom areas

The rocky bottom at Jan Mayen may conveniently be divided into two types:

1. Aggregations of boulders and rocks on predominantly sand and gravel bottom areas.
2. Exposed bedrock areas, with scattered rocks and boulders.

Stations 2B, 11B, 16B, and 17B on the "old" grounds can be classified under the first type of rocky bottom, while stations 1B, 3B, 5B, 6B, and 10B could be classified under the second type. I did not investigate the differences in flora and fauna between the two types thoroughly, but some main trends seem to be present. The flora and fauna on the first type of rocky bottom was more varied mainly because it provides a greater diversity of ecological niches, or "microlandscapes" as Thorson (1957) denotes them. In between the rocks, tubes of polychaetes, lophophores of brachiopods and siphons of molluscs were observed (Fig. 5). Algal growth also seemed to be heavier on the first type of rocky bottom. This may not always be true, however, because a very heavy growth of *Alaria pylaii* was in fact observed from 10-12 m depth at Stn. 3B. A similar growth of *A. pylaii* was also observed at "Bouwensonbåen" south

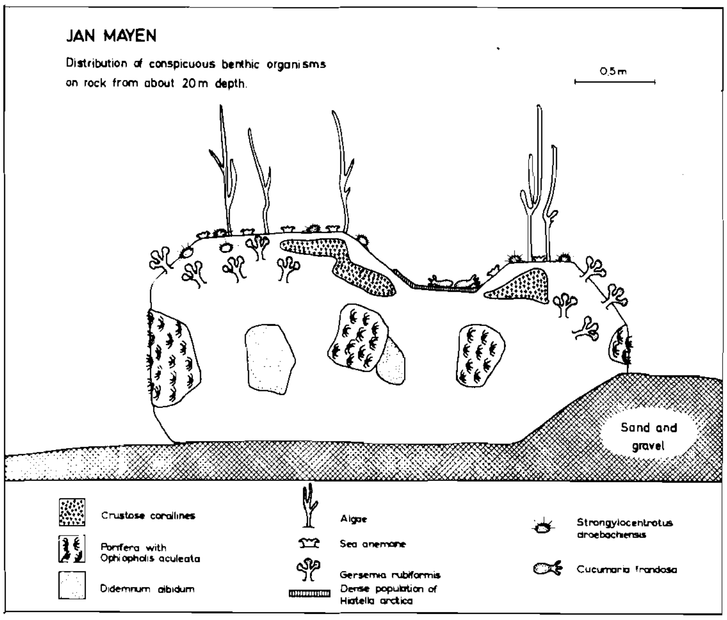

Fig. 4. Sketch of a boulder, showing the main distribution of plants and animals. Ca. 20 m depth.

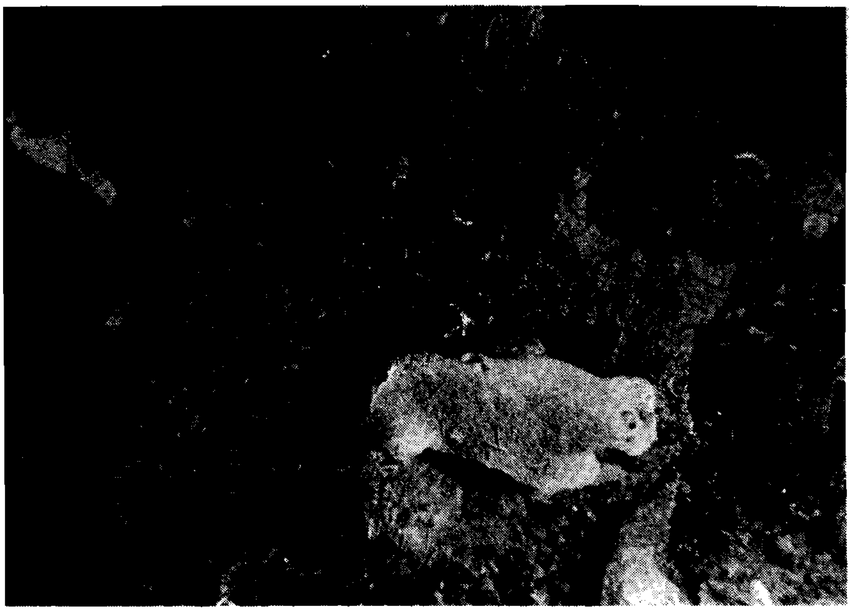

Fig. 5. Gravel with lophophores of the brachiopod *Hemithyris psittacea*. The picture covers 109 x 164 mm. Stn. 13B. 25 m depth.

of Jan Mayen at 13-15 m depth (Gulliksen in press).

In the following discussion both types of rocky bottom are treated together, except where specified, because the rocky facies of "aggregations of boulders and rocks among sand and gravel" show similarities with those of "bedrock with scattered rocks and boulders." The flora and fauna on and in the sand and gravel deposits between the rocks and boulders are only treated superficially.

The light gradient and the competition for substrates between the algae and sessile animals in the phytal zone, results in a vertical zonation of the organisms, characterized by an increase in the animal components and a corresponding decrease in the plants. The main groups participating in this relationship at Jan Mayen were algae, Porifera, hydrozoans, actinians, bivalves, and ascidians. Reduced water currents in the algal stands, reducing the amount of food available to filter feeders, may also help to explain the increase of animals with depth.

Algae were distributed all over the rocks and stones in shallow water. The vegetation showed patchiness, even in the upper water layers. The second type of rocky bottom, "bedrock with scattered rocks and boulders" had less algal growth than the first type. As light intensity became reduced with depth, so the algal covering became more and more concentrated to the tops of the boulders and rocks (Fig. 4), and the lower limit for Thallophyta at Jan Mayen was found at about 30 m depth.

Porifera colonies were poorly developed above 5-10 m depth, as were many of the other sedentary groups. The sponges did seem to have a preference for vertical surfaces and the largest colonies were to be found on the sides of rocks and boulders. A correspondingly sparse settlement of sponges in the upper water layers has also been recorded from rocky bottom in the Mediterranean (Bayry-Esnault 1971) where the angle of the substrate was also found to be of great importance.

Hydrozoans were to be found everywhere where they could find attachment. No typical distributional trend was observed, but they seemed to occur in highest densities in protected "microlandscapes." This sedentary group was the most conspicuous one found on the rocky substrates at station 5B and on the "new" grounds. Hydrozoans did not form one of the most conspicuous groups at any

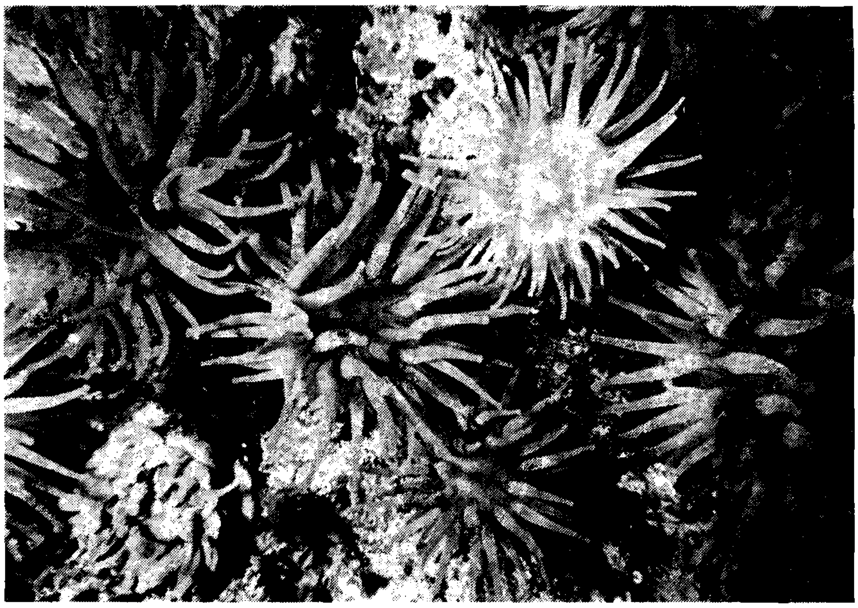

Fig. 6. Rock with the actinian *Tealia felina* var. *crassicornis*. The picture covers 109 x 164 mm. Stn. 11B. 25 m depth.

Fig. 7. Population of the bivalve *Hiatella arctica*. The picture covers 109 x 164 mm. Stn. 2B. 10-12 m depth.

Table 2. Number of individuals pr. m^2 of some conspicuous species. Nos calculated from the underwater photos, photographed areas 109 x 164 mm

	Stn. 2B	Stn. 3B	Stn. 6B	Stn. 1B	Stn. 11B	Stn. 11B	Stn. 13B	Stn. 16B	Stn. 17B
No, of samples	7	14	31	16	20	14	18	11	15
Depth in metres	10-12	10-17	15-18	18-20	18-20	25	25	25	30
Species									
Tealia felina		240	144	38	14	192	106	183	101
Hiatella arctica	1502	168	101	3	56	32	3		
Acmaea rubella			45	17					
Margarites helicinus	104	4	11	10	20	12	6		
Buccinum spp.		12	5						
Ophiopholis aculeata		96	63	108	3	40	50	25	183
Strongylocentrotus droebachiensis		64	81	87	6	36	16	46	52
Cucumaria frondosa		24	13	3	3	28	9	71	26

of the other rocky bottom, diving stations.

Actinians (Fig. 6) became the most prominent sedentary animal group on horizontal surfaces on rocky bottom areas at Jan Mayen where the algal growth diminished. The only species observed on the underwater photos was *Tealia felina* var. *crassicornis*.

Bivalves. The most prominent bivalve on rocky bottom was *Hiatella* (= *Saxicava*) *arctica*. The highest densitites were recorded at 10-12 m depth (Table 2), especially in substrate crevices and grooves. Fig. 7 shows a population of *H. arctica*, with 56 individuals in an area measuring only 109 x 164 mm, from Stn. 2B.

Thorson (1933, 1934) has described the *Hiatella*-epifauna from East Greenland. It occurs whereever the bottom exhibits small irregularities and is found down to 50-60 m depth. The *Hiatella*-epifauna described by Thorson does not seem to differ much from the fauna on rocky bottom areas at Jan Mayen. However, he based his conclusions primarily on dredge samples, whereas I have based mine on observations obtained during diving. The differences between Thorson's description of the whole *Hiatella*-epifauna from East Greenland and my own from Jan Mayen is probably due to the different sampling methods employed.

Ascidians. Two ascidian species were recorded from rocky bottom areas. *Dendrodoa grossularia* was found on rocks at the shallow station 2B, while *Didemnum albidum* formed encrusting surfaces on the vertical sides of the rocks at the deepest diving stations. *D. albidum* seemed to prefer the same biotope as the Porifera. It was also found occupying the same biotope at Eggvingrunnen, about 100 miles west of Jan Mayen (Gulliksen in press).

Motile and swimming animals

Amphipods (*Caprella* sp., *Gammarellus homari*, *Ischyroceros* sp.), nudibranchs (*Coryphella stimpsoni*, *Trinchesja viridis*, *Dendronotus* sp.), gastropods (*Acmaea rubella*, *Margarites helicinus*, *Buccinum* spp.), echinoderms (*Ophiopholis aculeata*, *Strongylocentrotus droebachiensis*, *Cucumaria frondosa*, *Stephanasterias albula*, *Diploteraster multipes*), and the fish *Myoxocephalus scorpius* (Fig. 8) were the most conspicuous motile and swimming animals found on the

Fig. 8. The fish *Myoxocephalus scorpius*, among Porifera inhabited by the brittle star *Ophiopholis aculeata*. The picture covers 109 x 164 mm. Stn. 1B. 18-20 m depth.

Fig. 9. *Strongylocentrotus droebachiensis* on rock covered with crustose corallines. The picture covers 109 x 164 mm. Stn. 6B. 15-18 m depth.

rocky bottom areas.

The amphipods were common on all types of substrate. They became very active if the water above the substrate was stirred heavily by the diver and their density seemed to increase within the stirred area. The nudibranchs were often found among hydrozoans. The gastropods seemed to have higher densities in the upper phytal zone (Table 2).

O. aculeata is one of the most common arctic ophiuroids (Hofsten 1915, Taylor 1958). At Jan Mayen, the majority of the observed individuals were associated with Porifera and sat inside the colonies, with outstretched arms for food collection.

S. droebachiensis (Fig. 9) seemed to be quite evenly distributed, with an average density of nearly 50 individuals/m^2 and a maximum of 87 individuals/m^2, while *C. frondosa* occurred in small clumps, with 2-5 individuals in each clump, and an average density of 10-15 individuals/m^2. A prey-predator relationship may exist between *S. droebachiensis* and the actinians, since sea-urchins were observed being eaten by actinians.

The fish *Myoxocephalus scorpius* occurs in great numbers among the algae. As an example, 56 specimens were caught in a net during a single night at Kapp Wien.

Arctic waters are known to be inhabited by slowly growing, long-lived species. Thorson (1936) found that high-arctic East Greenland fjords seemed to be inhabited by roughly 6 to 8 (for some species even 12 to 14) year classes of bivalves at one and the same time. He reported a life expectancy of 6 to 10 years for *Hiatella arctica*. Actinians are known to have life spans in excess of 50 years (Parker 1899, Ashworth & Annandale 1904, Hausding 1913, Thorson 1957). Some sponges may live from 25 to 50 years (MacGinitie 1949). Hydrozoans are the only dominant group with a relatively short life span among the sedentary organisms and the long life spans of most other sedentary organisms suggests that the sessile fauna on rocky bottom areas at Jan Mayen is very stable, showing very little annual variation.

Colonization of "new" volcanic grounds

The three transects on the "new" grounds (Fig. 3) were all made on rocky bottom areas and they can all be classified under "aggregations of boulders and rocks on predominantly sand and gravel bottom areas." Sand and gravel had not accumulated in large amounts along any of the transects, but this is probably due to the short lapse time since the volcanic eruption took place.

Two tendencies are significant in the colonization of the "new" grounds by animals: The number of species increased from the centre of the "new" grounds towards the margins and also increased with depth (Table 3). Most of the animals were also recorded elsewhere at Jan Mayen. This suggests that the colonization takes place from deeper waters and from the margins, either by migrating adults or by the pelagic larval stages of sessile animals.

The origin of the algae of the "new" grounds is more complicated, since three of the five species, *Monostroma* sp., *Porphyra miniata*, and *Halosiphon tomentosus* were recorded exclusively from the "new" grounds.

Two sedentary animal groups were recorded on the "new" grounds, hydrozoans and bryozoans. None of these were to be found among the dominant groups on rocky bottom areas of the "old" grounds, with exception of the hydrozoans at station 5B.

Colonization of the "new" grounds may be compared with marine fouling of man-made structures. Hydrozoans and bryozoans are likewise to be found among the dominant fouling groups in boreal areas (Woods Hole Oceanographic Institution 1952).

Motile animals present on the "new" grounds were primarily amphipods (*Gammarellus homari*, *Gammarus setosus*, *Ischyrocerus* sp.) and nudibranchs (*Dendronotus* sp.) (Fig. 10, 11). *Gammarus setosus* was not recorded elsewhere at Jan Mayen, while the rest of the aforementioned species were found in other rocky bottom biotopes. An increasing number of motile animals were recorded towards the margins of the "new" grounds.

Comparing the present colonization with that of the volcanic bottom off Surtsey, the "new" Icelandic island, we find many similarities. Hydrozoans and bryozoans were among the pioneer groups there, too. In addition, barnacles and bivalves were found to be pioneering groups

Table 3. The distribution of plants and animals along the transects over the "new" lava grounds

Depth	Transect 1	Transect 2	Transect 3
0-5 m	Amphipods	Amphipods	Amphipods
5-10 m	Amphipods	*Monostroma* sp. *Acrosiphonia sonderi* Amphipods Nudibranchs (*Dendronotus* sp.)	*Monostroma* sp. *Acrosiphonia sonderi* Hydrozoans Amphipods Nudibranchs (*Dendronotus* sp.) Echinoderms (*Strongylocentrotus droebachiensis*)
10-15 m	Amphipods Nudibranchs (*Dendronotus* sp.)	*Monostroma* sp. *Acrosiphonia sonderi* *Porphyra miniata* *Halosiphon tomentosus* Scyphozoans (*Haliclystus* sp.) Amphipods Nudibranchs (*Dendronotus* sp.)	*Acrosiphonia sonderi* *Porphyra miniata* *Halosiphon tomentosus* Hydrozoans Scyphozoans (*Haliclystus* sp.) Amphipods Bryozoans Nudibranchs (*Dendronotus* sp.) Bivalves (*Hiatella arctica*, dead) Pisces (*Myoxocephalus scorpius*)
15-20 m	Hydrozoans Bryozoans Amphipods Nudibranchs (*Dendronotus* sp.)	*Monostroma* sp. *Acrosiphonia sonderi* *Porphyra miniata* *Halosiphon tomentosus* Hydrozoans Scyphozoans (*Haliclystus* sp.) Bryozoans Amphipods Nudibranchs (*Dendronotus* sp.)	*Acrosiphonia sonderi* *Porphyra miniata* *Halosiphon tomentosus* *Alaria pylaii* Hydrozoans Scyphozoans (*Haliclystus* sp.) Bryozoans Amphipods Nudibranchs (*Dendronotus* sp.)
20-30 m	*Alaria pylaii* Hydrozoans Bryozoans Amphipods Nudibranchs (*Dendronotus* sp.)	*Porphyra miniata* *Halosiphon tomentosus* Hydrozoans Bryozoans Amphipods Nudibranchs (*Dendronotus* sp.)	*Porphyra miniata* *Halosiphon tomentosus* *Alaria pylaii* Hydrozoans Scyphozoans (*Haliclystus* sp.) Bryozoans Amphipods Prosobranchs (*Buccinum* sp.) Nudibranchs (*Dendronotus* sp.) (*Coryphylla stimpsoni*)

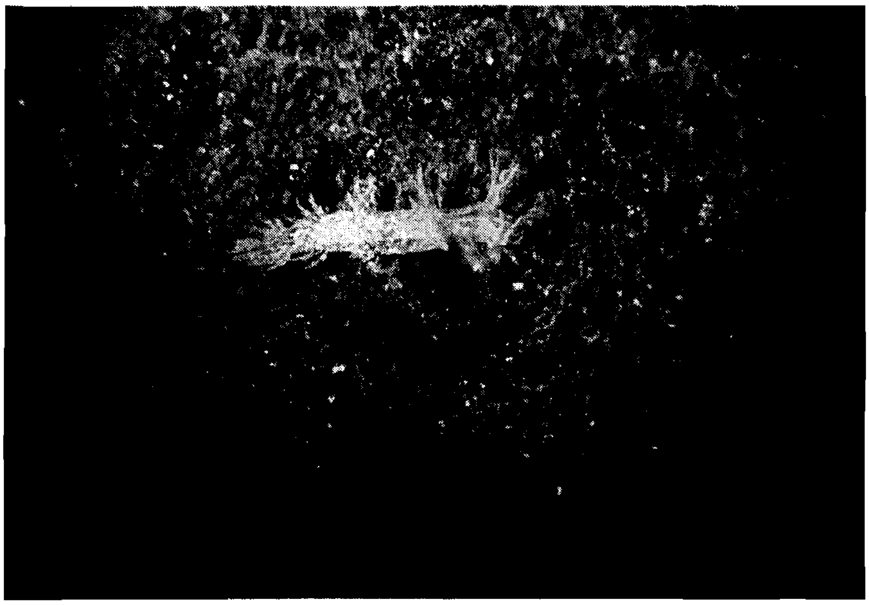

Fig. 10. Lava rock from the "new" grounds with a nudibranch of the genus *Dendronotus*. The picture covers 109 x 164 mm. Stn. 7B. 15-20 m depth.

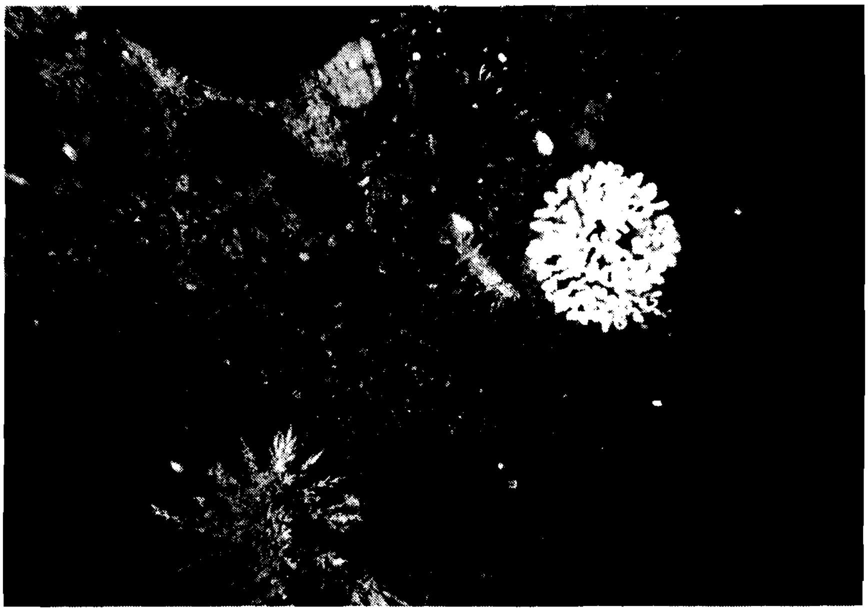

Fig. 11. The "new" grounds with hydrozoans, bryozoans, a nudibranch, and eggs from a nudibranch. The picture covers 109 x 164 mm. Stn. 7B. 15-20 m depth.

(Sigursson 1968, 1970). Barnacles were not recorded at Jan Mayen, even on the "old" grounds. One dead specimen of the bivalve *H. arctica* was recorded, but it may have been brought to the "new" grounds, for instance by birds. The lack of bivalves at Jan Mayen may be explained by the more southerly location of Surtsey, or by the fact that the colonization had advanced further at Surtsey when investigations took place there.

Comparing the algal colonization at Jan Mayen and Surtsey, four of the five genera (but not the same species), were also found at Surtsey (Jónsson 1970). The four genera were *Monostroma, Acrosiphonia, Alaria,* and *Porphyra.*

Large differences exist in the composition of the flora and fauna of the "old" established areas and the "new" lava grounds. These differences suggest that it may take many years before a fully-developed rocky bottom community becomes established on the "new" grounds.

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