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COMMUNITIES OF BENTHIC FAUNA IN THE WESTERN BERING SEA

Z. A. Filatova, et al

Naval Oceanographic Office
Washington, D. C.

1969

TRANS 459

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(Communities of Benthic Fauna in the Western Bering Sea)

by

Z. A. FILATOVA and N. G. BARSANOVA

TRUDY INSTITUTA OKEANOLOGII
VOL. LXIX
Pp. 6-97

1964

Translator: M. Slessers
Editor : D. Marra
Typed by : C. Sims

U. S. NAVAL OCEANOGRAPHIC OFFICE
WASHINGTON, D. C. 20390
1969

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ABSTRACT

The data on the composition and distribution of the bottom fauna in the western Bering Sea were received in 1950-1952 on board of the r/v "Vityaz". During that period 256 stations were occupied; 173 quantitative samples of the bottom fauna were taken with large ($0.25m^2$) bottom-sampler "Ocean-50" and Petersen grab; 64 samples of bottom fauna were gathered with Sigsbye trawl; 46 of the stations were occupied at the depths exceeding 1000m and 38 of them--at depths exceeding 2000m.

Eighteen communities of the bottom fauna were established in western Bering Sea; 9 of them are located in shallow-water zone (less than 200m), two in bathyal zone (200-2000m) and seven in the abyssal one (more than 2000m).

True oceanic deep-sea species are dominant in the abyssal bottom-fauna communities of the western Bering Sea. Some species living presumably on the slope of the shelf are the leading forms of bathyal communities; a great many arctic-circumpolar, arctic-boreal and north-boreal Pacific species of the bottom fauna take part in the composition of the shallow-water communities of the western Bering Sea.

Author

COMMUNITIES OF BENTHIC FAUNA IN THE WESTERN BERING SEA

The Bering Sea is one of the greatest seas of the earth and the largest and deepest Far Eastern Sea. It is 1 1/2 times larger than the Sea of Okhotsk and twice as large as the Sea of Japan. The greatest depth of the Bering Sea is 4150m, that of the Sea of Japan 3669m and that of the Sea of Okhotsk 3770m.

According to the Vityaz' data (Udintsev, et al., 1959), about 56.6% of the western Bering Sea area is deeper than 2000m, 13.2% has the depth of 200-2000m, 30.2% is the shelf zone less than 200m deep. For the sea as a whole, these relationships somewhat change: the abyssal zone makes up 43.5%, continental slope 11.5%, shelf zone 45%. Thus the deep zone (bathyal and abyssal) occupies 55% of the entire sea area and about 70% of its western part. Such a depth ratio gives the benthic fauna peculiar features: the deep-sea components play a significant role.

The composition and distribution of benthic fauna exercises a great influence on the geographical position of the Bering Sea as one of the marginal seas of the Pacific Ocean. Lying between the Pacific and Arctic Oceans, the Bering Sea is subjected to their influence. It should be pointed out that the influence of these two oceans on the Bering Sea, expecially on its benthic fauna, varies from area to area. Judging from the character and intensity of water exchange, distribution of water masses, rate of sedimentation, composition and distribution of benthic fauna (expecially that of the abyssal fauna), the Bering Sea is so closely linked with the Pacific Ocean that it could even be considered as part of the ocean. This connection is determined by the considerable depth of the Bering Sea and by the width and depth of straits between the numerous islands of the Aleutian-Komandorskiye system--which form a huge sill dividing the Bering Sea from the Pacific Ocean. However, the significance of these straits in the water exchange between the sea and the ocean is far from being uniform. Straits of the western part of the island chain are much wider and deeper than those of the eastern part, and, therefore, the water exchange is more considerable in the western part. As is known (Udintsev, et al., 1959; Gershanobich, 1962a, 1962b), the greatest depth is observed in the western Kamchatskiy proliv (strait) (4420m). This depth exceeds the greatest depth of the southern Bering Sea (4150m). The width and depth of the two other large straits, Blizhniy pr. and Amchitka pr., are about the same: 196 miles and 2000m, and 74 miles and 1082m, respectively. The depth of the remaining straits varies from 200 to 760m and less. /7

Thus, the elevation of the Komandorskiy-Aleutian Islands is of twofold significance for the Bering Sea and its benthic fauna: on the west, where the depth of the straits is greater, it connects the southern depression (and its benthic fauna) with the adjacent abyssal parts of the Pacific Ocean; on the east, however, where the straits are shallow, the elevation isolates to a degree the deep part of the Bering Sea from the ocean. In addition, the shoaling places around numerous Aleutian Islands (about 150) serve as a peculiar connecting zone between the E and W parts of the sea. Evidently, the main faunal exchange takes place here.

As to the mutual contact between the Bering Sea and the Arctic Ocean, which is maintained only through the Bering Strait, it is incomparably weaker and rather one-sided due to the shallow bottom depth of the strait and the vast surrounding shelf. The 100m isobath delimits the shallow water at a distance of about 100 miles to the S and N. The exchange of deep waters, and the benthic faunas of the rather deep Chukchi-Alaska Shelf zone are obstructed by the Bering sill. This limitation is confirmed by the distribution of many abyssal forms of benthic fauna, such as bivalve mollusks, echinoderms, polychaets, etc., which do not have common abyssal species in the Bering Sea and the Arctic Ocean. Partial exchange is possible for pelagic larval forms of some bathyal species or freely swimming necton animals, such as cephalopods and some crustaceans which can master the shallow area with its low water temperature. However, the shallow water benthic fauna, which inhabits the sublitoral of the W part of the Bering Sea, has many common features with the shallow water fauna of the neighboring Chukchi Sea.

"Cold spots" in the deep waters of Anadyrskiy z. and Olyutorskiy z., formed as a result of special hydrological conditions, affect the development of "local" spots with a more cryophilic benthic fauna than in the surrounding area, which includes many arctic species. Thus, even if connections between the benthic fauna of abyssal parts of the Bering Sea and the Arctic Ocean are practically absent, the connections are quite close and constant in the shallow sublitoral zone. Due to the effect of the temperately warm Alaska Current that enters from S the E half of the Bering Sea, the temperature regimes of the W (colder) and E (milder) parts of the Bering Sea are different. In addition, substantial differences are observed in the general character of benthic fauna in the W and E parts of the sea. In addition to the common species, there are many temperately-thermophilic forms occurring only the E part, lending the fauna a thermophilic character in comparison with the W part of the sea.

The existing similarities and differencies of faunas agree with data on water exchange between the Bering Sea and the adjacent oceans and they can be defined as an "index of peculiarities". This index suggested by N. N. Zubov (1956) is determined by the ratio of sea volume to the sum of cross section areas of its straits through which the water exchange with adjacent water basins takes place.

On the basis of this index, the difference between the Bering Sea and the Arctic Ocean is almost 200 times as great as that between the sea and the Pacific Ocean. About 100,000km^3 of Pacific water flow into the Bering Sea annually through the straits of the Aleutian and Komandor islands. About 70,000km3 return back to the ocean. The Arctic water that enters the Bering Sea makes up only 30,000km^3. These data emphasize the close contact between the Bering Sea and the Pacific Ocean and the weak link between the sea and the Arctic Ocean. /8

Owing to the intense and continual water exchange with Pacific Ocean and the permanent currents (Dobrovol'skiy and Arsen'yev, 1959; Yeonov, 1947; Plakhotnik, 1912a, b; Ratmonov, 1937), the bottom water of the Bering Sea is well aerated to its greatest depths where the quantity of dissolved oxygen reaches 20% and more (Mokiyevskaya, 1956). A considerable continental runoff of large rivers (Anadyr', Yukon, and Kuskokwin) and many small rivers discharge a considerable amount of detritus, dissolved salts and suspended matter. This creates very favorable conditions for benthic life. The organic remains coming from the upper water layer and coastal populations of benthic fauna and macrophytes similarly affect favorably the development of luxurious life on the bottom of the Bering Sea, even to the greatest depths. Thus, in the W depression (Komandorskiy), not far from Kamchatskiy proliv, at the depth of 3970m the total biomass of benthic fauna reaches 30g/m^2 (Belyayev, 1960), a very high magnitude for the abyssal. According to data by Lisitsyn (1958, 1959), the mud sediments of the Bering Sea contain a considerable quantity of organic matter in the form of organic carbon, carotene, various pigments, etc. The bottom sediments of the Bering Sea contain considerably more pigments than the bottom sediments of other seas, making up at places 10% of the entire organic matter (Lisitsyn, 1959). Organic carbon usually accumulates off the lower base of the continental slope where its quantity often exceeds 2%. The effect of plants (mainly diatoms) is also manifest by considerable quantities of carotene (A vitamin) in the soft sediments of the Bering Sea, which is necessary benthic invertibrates.

Thus, in addition to hydrological conditions, the bottom relief and the composition and distribution of bottom sediments are important properties of the Bering Sea, which affect the distribution of bottom fauna and its communities. As a consequence, all the benthic communities of the Bering Sea (as in other seas) can be divided into three natural ecological groups: sublitoral, bathyal and abyssal. Life in each zone is determined by special conditions of the media. Naturally, the bottom relief reflects the entire geological history of the sea, while the composition and distribution of bottom sediments reflects, in addition, hydrochemical regime of the present and past. All these factors affect the general character of the existing benthic fauna which has been formed gradually through millennia and millions of years.

The main objective of this study is a quantitative-biocoenotic characterization of benthic fauna in the W part of the Bering Sea /9
which was investigated by the Vityaz' expedition. Inasmuch as the collection of data on benthic fauna and their quantitative processing is done by the standard method approved by the Institute of Oceanology and other Soviet Marine institutes, it is possible to compare the composition of benthic fauna of the Bering Sea with benthic communities of other seas.

Investigations of benthic communities in the W part of the Bering Sea, as was pointed out above, can be divided into three natural groups each of which has a peculiar ecological feature.

First group is constituted by communities limited to the sublitoral zone of the Bering Sea (less than 200m deep). This group consists, first of all, of communities and groups in which epifauna predominates (sedentary, sessile and freely swimming benthic animals that feed mainly by filtering seston and plankton of the surrounding water), secondly of various predators. These communities are associated basically with solid rocky and sandy bottoms of the coastal zone and the areas affected by permanent and tidal currents. Further, the communities and groups in which infaunas predominate (forms that dig into the soft surface or subsurface mud or mud-sand sediments). Sedentary forms of infauna represent mainly the animals that feed on detritus and organic matter which is obtained by them from the surface of sea bottom or by passing the muddy sediments through their stomachs. These forms are widely distributed in areas where soft mud sediments occur, in gulfs and in open parts of the Bering Sea. Lastly, the communities and groups in which onfaunas predominate, i.e., sessile forms on the bottom of the coastal belt (namely, the flat echinoderms Echinarachnius).

The second group is made up of communities that occur mainly in bathyal parts of the sea, on continental slope (at the depth of 200-300m) covered with soft muddy and muddy-sand sediments. These forms are characterized by the predominance of infauna, but of a different community than the infauna of the sublitoral zone. Many eurybathic species come here from the sublitoral, but there are also many specific bathyal benthic forms (temperate-pelagic), such as Brisaster. As to the way of feeding, mud and detritus feeders prevail. Ecologically and by their composition, this group occupies an intermediate place between shallow sublitoral and deepwater abyssal communities.

The third group consists of abyssal benthic forms characterized by the prevalence of infauna. Here one can encounter a peculiar group of animals forming the so-called "epifauna of soft bottom". The group is made up of many sessile unicellular and colonial animals adapted to life on soft bottom at great depths. These animals climb stems or stick to a hard substratum above the bottom, such as concretions, pebble or remains of other animals. Such an elevated position enables them to obtain food and protect themselves from unfavorable conditions of the lowermost water layer.

DATA AND METHODS /10

The data on which this study is based were obtained west of line o. Mednyy-mys Chukotskiy.

Regrettably, the Vityaz' expedition of 1950-1952 investigated only the westernmost part adjacent to the Soviet Union, which makes up only 1/3 of the Bering Sea area. Lately (1958-59) the VNIRO Persey and Zhemchug Expeditons obtain large quantities of data on the E part of the Bering Sea. Part of the data have already been published (Nyman, 1960a, 1960b, 1961a, 1961b, 1963). By comparing the data on W and E parts of the sea it is possible to learn about the distribution patterns of the benthic fauna on the shelf only. The central part of the sea (slope and abyssal), however, has been poorly investigated both with regard to the composition and quantitative distribution of benthic fauna. This situation obstructs and complicates the elucidation of the general distribution pattern of benthic fauna in the Bering Sea.

The benthic fauna of various areas in the W part of the Bering Sea has not been uniformly clarified. The greatest number of stations cover the central parts of the Anadyrskiy z. and Olyutorskiy z.; whereas in the northernmost part of the Anadyr',

Table 1
Distribution of Benthic Fauna by the
Depth of the Vityaz' Stations

Depth, m	No. of stations			No. of stations
	Bottom grab samples		Trawl samples	
	Quantitative	Qualitative		
0—100	99	17	26	138
101—200	32	8	15	49
201—500	7	2	3	11
501—1000	11	1	2	12
1001—2000	6	1	2	8
<2000	22	1	16	38
Totals	177	30	64	256

in z. Krest region, before and beyond it only single stations were occupied. The Koryanskiy coastal area has been very poorly covered. A very small number of bottom grab stations were occupied in the deep depressions of the Bering Sea, especially in the central (Aleutian) part. Therefore, the composition and quantitative distribtuion of benthic fauna in the abyssal part of the sea have not been sufficiently clarified (Zenkevich and Filatova, 1958).

The distribution of benthic fauna is still unknown in the Korfo-Karaginskiy region of the Bering Sea. However, the 1956 Akademik Shuleykin expedition organized by the Institute of Oceanology also collected data on the benthic fauna of this region (Lus and Kuznetsov, 1961).

In addition to data obtained during the three Vityaz' cruises (1950-52) (Fig. 1), we utilized data obtained by the Krasnoarmeyets and Dal'nevostochnik of the State Hydrological Institute in 1932-33 in areas E and NE of Lawrence Island and in the Bering Strait region (K. M. Deryugin and A. V. Ivanov, 1937; V. V. Makarov, 1937). Through slight in amount, these data constructively supplement the Vityaz' data obtained in this area.

Regrettably, the published information bears a preliminary character /12
and contains little data on species indentification. Even the most populous species have been neglected, and, therefore, the utilization of these data is limited.

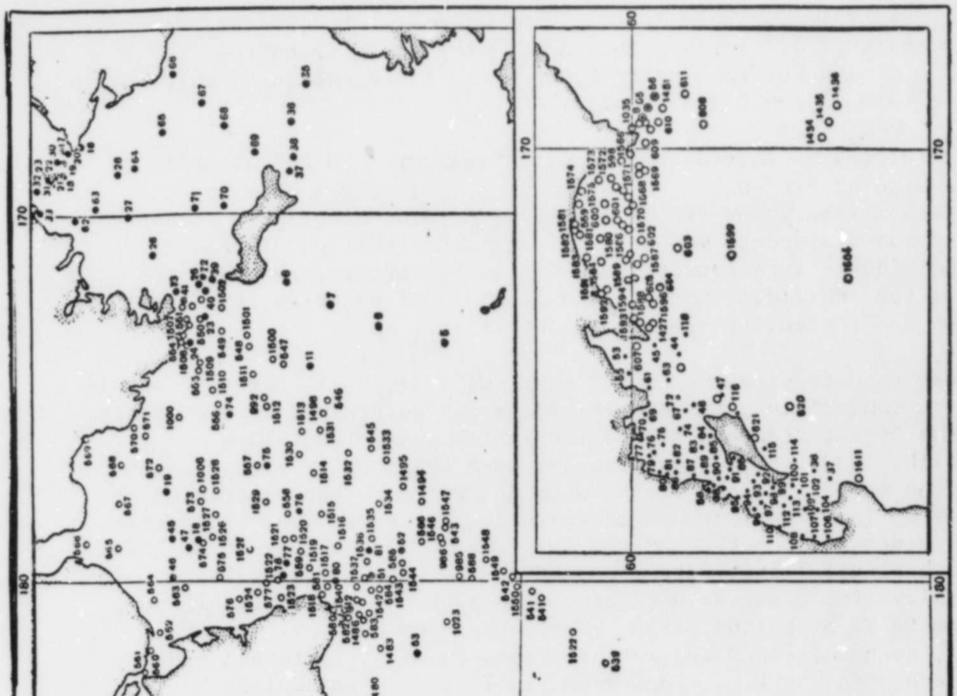

FIG. 1. Chart of Stations at Which the Benthic Fauna was Sampled.

We could utilize 64 samples obtained by the Sigsby-Gorbunov trawl; its frame was 2.5m long. In addition, we had 177 quantitative and 30 qualitative samples, obtained by the Petersen bottom grab, the area of its coverage being $0.25m^2$, and by the Okean-50 which opeaned to 0.25 and $0.3m^2$ (Table 1).

As a rule, the collected samples were fixed with 70-80° alcohol. The subsequent processing of bottom grab samples was done in the benthos laboratory of the Institute of Oceanology in accordance with approved standard methods: after identification of species, the individuals were counted and weighed by species. Biomass was counted for individual species and groups. In addition, the total biomass for the entire sample was determined.

In order to determine the significance of individual forms of benthic fauna in communities, the density index was determined in accordance with the Soviet standard method (Zenkevich, 1947; Brotskaya and Zenkevich, 1939). The trawl samples were examined by groups, after which the members of the groups were determined. The processing of samples by individual groups of benthic animals was done by experts of the benthos laboratory of the Institute of Oceanology of AS USSR, of the Zoological Institute of AS USSR, and of the Moscow State University; foraminifera were processed by Z. G. Shchedrina (1956), sponges by V. M. Koltun (1955, 1959), hydroids by D. V. Naumov (1960), pennatularians and antipatarians by F. A. Pasternak (1960, 1961) echiarids by L. A. Zenkevich (1957, 1958), priapulids by V. V. Murina and Ya. I. Starobagatov (1961), simpculids by V. V. Murina (1957a, 1957b, 1958, 1961); polychaets by R. Ya. Yevenshteyn (1957, 1960, 1961); bivalve mollusks by Z. A. Filatova (1957) and O. A. Skarlato (1956, 1960); gastropods by Yu. A. Galkin (1955), N. G. Bassanova and V. Ya. Lus; loricate mollusks by A. M. Yakovleva (1952); amphipods and isopods by Ye. F. Gur'yanova and Ya. A. Birshteyn; decapods by Ya. A. Birshteyn and L. G. Vinogradov (1953) and N. A. Zarenkov (1960); cumaceans by N. B. Lomakina (1955, 1956, 1958); barnacles by N. I. Tarasov and G. B. Zevina (1957); echinoderms by Z. I. Baranova (1955, 1957) and G. M. Belyayev; pogonophores by A. V. Ivanov (1952, 1960). Let us give thanks to all of the experts that participated in the data processing.

Regrettably, part of the benthic groups remain partly or wholly unprocessed; namely, actinians, bryozoans, part of sponges, hydroids, gastropod mollusks, holoturians and some others.

SUBLITORAL COMMUNITIES

Communities in Which Epifauna Prevails

The communities of benthic fauna in which epifauna prevails (Table 2), which inhabit the W part of the Bering Sea, have been much less studied than the communities of infauna. The reason for this is that the Vityaz' expedition, as a rule, neglected the shallow coastal areas because the sampling of benthic fauna on boulders and in areas with strong currents is very difficult.

Judging from the existing samples, the communities in which epifauna prevails, in contrast to other communities, that inhabit the coastal zone (onfauna and infauna), have a spotty /13
distribution pattern. They are usually limited to capes, straits, island coasts, etc. Such epifaunal sectors are observed off m. Chukotskiy and Navarina, off m. Olyutorskiy and Goven, off o. Karaginskiy, Komandorskiye ostrova and in Aleutian Islands (Fig. 2).

This community occurs also in the Koryakskiy coastal region and in the Bering Strait, but it has been little investigated. The greatest depth inhabited by epifaunal communities is observed in Kamchatka Strait (Kamchatskiy proliv). Here the epifauna is encountered at depths exceeding 2000m; this abyssal is crossed by strong currents reminiscent of those in shallow places.

The existence of epifaunal communities at m. Navarin and m. Chukotskiy in Anadyrskiy zaliv is pointed out by Deryugin and Ivanov (1937), Makarov (1937) and Vinogradova (1954). Due to the thriving of barnacles in these regions, the density and biomass of benthic populations increase noticeably, to 2500ind/m^2 and 800g/m^2 or more. The leading forms are Balanus balanus, B. crenatus and R. rostratus dalli; then follow sponges, hydroids, bryozoans, actinians and ascidians. The epifaunal communities of the Korfo-Karaginskiy region are described in the most general way by Lus and Kuznetsov (1961).

Data on the propagation of epifaunal communities in the eastern /17
part of the Bering Sea are still scarce. Neyman (1960a, 1963) observed them only in the coastal zone of St. Matthew and St. Lawrence Islands. There is no doubt that these communities are widely distributed, even in the eastern coastal part of the sea which was not investigated by the VNIRO Expedition.

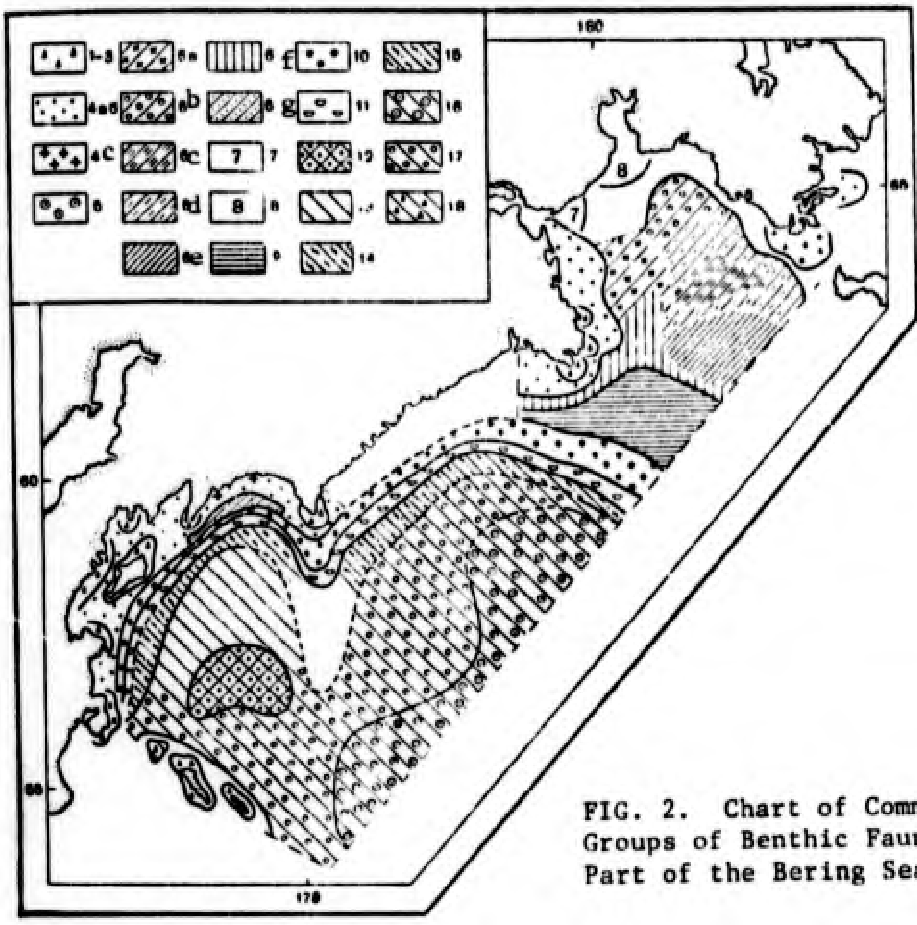

FIG. 2. Chart of Communities and Groups of Benthic Fauna in the W Part of the Bering Sea.

1-3--epifauna; 4a,b--Echinarachnius parma-Macoma calcarea; Ech. parma-Venericardia borealis-Tellina lutea; 4c--Echinarachnius parma-Macoma baltica; 5--Astarte rollandi; 6a--Macoma calcarea; 6b--Macoma calcarea-Ophiura sarsi-Yoldia hyperborea; 6c--Macoma calcarea-Ophiura sarsi-Golfingia margaritaceum-Nucula tenuis-Maldane sarsi; 6d--Ophiura sarsi-Macoma calcarea-Nucula tenuis-Onuphis parva-striata; 6e--Maldane sarsi-Ophiura sarsi-Macoma calcarea-Nucula tenuis; 6f--Macoma calcarea-Nicomache lumbricalis; 6g--Macoma calcarea-Amphiodia craterodmeta; 7--population of limans and estuary areas of Anadyr'; 8--Ophiura sarsi-Myriotrochus (zal. Kresta); 9--Ophiura sarsi-Yoldia thraciaeformis-Ctenodiscus crispatus; 10--Brisaster (B. Townsendi and B. latifrons); 11--Yoldia beringiana-Travisia forbesii; 12--Spongia-Phascolion lutense, etc.; 13--Bathysiphon zenkewitschi-Eremicaster-Psychropotes-Pogonophora-Amphipoda; 14--Bathysiphon zenkewitschi-Maldane sarsi-Ophiura leptoctenia, etc.; 15--population of W periphery of the C depression; 16--Polybrachia annulata-Heptabrachia gracilis-Eremicastet-Spongia; 17--Spongia-Polybrachia annulata-Heptabrachia gracilis--Travisia profundi; 18--community of pelagic epifauna.

Table 2

Communities and Groups of Benthic Fauna in the W Part of the Bering Sea

Communities and Groups	No. of Stations	Depth, m	Bottom	Bottom temperature °C	Month	Mean biomass g/m²	Region
			Sublitoral Communities				
1. Comm. «*Balanus crenatus — Strongylocentrotus sachalinicus*»	550,551,554 1504,1506,1507, 1508, 582,1518, 1539,596	24—27 (средняя 46)	Mixed boulder, coarse sand, broken shells	From 1,5 To 2.75	VI, VIII IX	995	m. Chukotskiy, m. Navarina, m. Olyutorskiy
2. Comm. «*Balanus crenatus* — Ascidia — *Chlamys beringianus* — Spongia — *Venericardia*»	523,1427,1568, 1594	87—115 (100)	Coarse sand with boulder, pebble & broken shells	1,38	VI—VIII	663	m. Afrika, m. Goven, m. Olyutorskiy
3. Comm. «*Balanus evermanni — Chlamys albidus — Saxicava* — Spongia — Hydroidea»	958	110	Sand with boulders and pebble				S of o-va Beringa
4. Comm. «*Echinarachnius parma*»							
4a. Groups «*Echinarachnius parma-Macoma calcarea*»	559,562,563 575,576,577 580,581,1517 1519,1522,1524 1541	22—118 (50)	Fine sand with pebbles & gravel	0,14 3,0	V —IX	554	Anadyrskiy zal.
4б. Groups «*Echinarachnius — Venericardia borealis — Tellina lutea*»	593,594,597, 599,600,1567, 1571,1572,1574, 1575,1580,1581, 1584,1590, 1593.	8—80 (46)	same	2—3.5	VI—IX	542	Olyutorskiy zal.
4в. Groups «*Echinarachnius — Macoma baltica*»	1582,1582—a, 1592	8—11	Gray fine sand	3,78	VI	304	same
5. Comm. «*Astarte (Tridonta) rollandi*»	606,1458,1566 1573	25—68	Coarse sand with pebbles	4,14	VI—IX	200	same

6. Comm. «*Macoma calcarea — Ophiura sarsi—Maldane sarsi—Nucula tenuis*»		50—100					
6a. Groups «*Macoma calcarea*»	1525,1526,1527, 1528,1006; 18 («Красноармеец»)	66—88 (80)	Aleurite mud	From 1,6 to 0,88	VI—X	170	Anadyrskiy zal., W part
6б. Groups «*Macoma calcarea—Ophiura sarsi—Yoldia hyperborea*»	568,571,572, 573; 19 («Красноармеец»)	55—80 (70)	Coarse aleurite mud	" 1,28" 2,33	IX	217	Anadyrskiy zal., N part
6в. Groups «*Macoma calcarea—Ophiura sarsi—Gelfingia margaritaceum—Nuciula tenuis—Maldane sarsi*»	556a,5566,557, 1511; 74,75 («Красноармеец»)	77—82 (80)	Coarse aleurite mud	" 1,72" 1 2	VI, IX	473	Anadyrskiy zal., C part
6г. Groups «*Ophiura sarsi—Macoma calcarea—Nucula tenuis—Onuphis parva—striata*»	548,549,992, 1501,1510,1512	69—83 (74)	Fine aleurite mud	" 1,26" 0,50	IX, VI	503	Anadyrskiy zal., in exit
6д. Groups «*Maldane sarsi—Ophiura sarsi—Macoma calcarea—Nucula tenuis*»	546,547,1513, 1514,1530,1531 1532; 7,8,11 («Красноармеец»)	49—100 (77)	Fine aleurite and clayey mud	" 0,69" 0,48	VIII, IX	267	same
6e. Groups «*Macoma calcarea—Nicomache lumbricalis*»	558,584,1515, 1516,1520,1521, 1529,1537,1538, 1542	84—143 (106)	Coarse aleurite mud	1,49	VI—IX	57	same
6ж. Groups «*Macoma calcarea—Amphiodia craterodmete*»	605,1576,1585, 1587a,1588,1589 1595	117—227 (174)	Fine aleurite mud	1,47	VI	209	Olyutorskiy zal.
7. Popul. of the Liman & the estuary area of r. Anadyr	560,561,564	17—38 (25)	Sand, gravel, pebble	" 0,56 " 8,6	IX	230	Anadyrskiy zal.
8. Comm. «*Ophiura sarsi—Myriotrochus*»	565,566	64—67 (65)	Black mud with H_2S smell	" 1,39 " 1,08	IX	90	zal. Kresta
9. Comm. «*Ophiura sarsi—Yoldia thraciaeformis—Ctenodiscus crispatus*»	543,545,585, 586,1494,1495, 1533,1534,1535, 1536,1543,1544. 1546,1547	96—200 (142)	Fine aleurite mud	1,2—3,0	VI, IX	88	Anadyrskiy zal., in exit

Bathyal Communities (Slope)

10. Comm. «*Brisaster*» (*townsendi, latifrons*)»							
10a Groups «*Brisaster townsendi*»	608,1577,157[illegible] 1586.	317—710 (514)	Coarse & fine aleurite mud	2,8	VI	93	W depression (slope)
106. Groups «*Brisaster latifrons*»	1023,1461,1549; Zhemchur 179, 207, Pervents 161	117—1805 (850)	same	2,87	VI	87	C depression (slope)
11. Comm. «*Yoldia beringiana—Travisia forbesii*»	542,602,604, 611,1030,1597	533—1928 (14[illegible])	Coarse and fine aleurite mud	2,72	IX	26	same
Abyssal Communities							
12. Comm. «Spongia-*Phascolion lutense—Eremicaster tenebrarius—Heptabrachia gracilis*—[illegible] *pictobranchiata*»	618	3875	Clayey mud	1,56	IX	3.8	W depression (C. part)
13. Comm. «*Bathysiphon—Eremicaster — Psychropotes*-Pogonophora—(*Heptabrachia gracilis — Siboglinum fedotovi*)—Amphipoda»	1604,1599	3680,2997	Clayey mud	1,56	VI	15,6	W depression (N. part)
14. Comm. «*Bathysiphon—Maldane sarsi — Ophiura leptoctenia—Golfingia improvisa — Melinnampharete eoa*»	603,620	2620-3486	Clayey mud	1,6	IX	30,0—4,1	W depression (N and W peripheries)
15 Popul. of N periphery of C Depression	612,591,1550	2160-2597	Clayey mud	1,75	VI—IX	5,7—0,05	C depression
16. Comm. «*Polybrachia annulata—Heptabrachia gracilis—Eremicaster*—Spongia»	535,539,541 970,1410,1552	2796-3980	Clayey and clayey diatom mud	1,6	VI—IX	5,4	same
17. Comm. «Spongia—*Polybrachia annulata —Heptabrachia gracilis—Travisia profundi*»	530,531,537 614,617,965, 966,972,1557	1690-3936	Clayey mud	1,7	IX, VI	3,1	same
18. Comm. of pelagic epifauna—«Spongia—Stylasteridae—Bryozoa—Brachiopoda»	626	2393	Cliffs, pebble, gravel	1,56	IX	—	Kamchatskiy proliv

In order to characterize the epifaunal communities 16 Vityaz' stations were used.

1. Community *Balanus crenatus--Strongylocentrotus sachalinicus*

This community inhabits the N half of the W coast of the Bering Sea, namely in cape areas (Fig. 3). We used data from 11 stations: 550, 551, 554, 1504, 1506, 1507, and 1508 off m. Chukotskiy; 582, 1518 and 1539 off m. Navarina and 596 off m. Olyutorskiy. These stations were represented by 15 bottom grab stations (9 quantitative and 6 qualitative samples), and 3 trawling stations (from 24 to 75m deep, average being 46m) occupied on solid and mixed bottoms with boulders, coarse sand and broken shells. The total biomass of benthic fauna varies from 42 to 2932g/m^2 (average being 995g/m^2). At station 1507, 24m deep, on boulders, the biomass reaches a maximum value and was represented mainly by B. crenatus (1920ind/m^2, biomass 2604g/m^2); Saxicava arctica, 149, Eunephthya, 103g/m^2, etc.

By counting the number of animals by species, it appeared that the leading forms were B. crenatus, followed by Strongylocentrotus sachalinicus. The occurrence of B. crenatus was 100%, that of echinoderms 70%. Considering their high biomass (605 and 160g/m^2, respectively), they predominate over the other forms.

The typical sponge is Saxicava arctica, and the soft corals Eunephthya. Pecten (Chlamys) beringianus occurs often (82%). However, it is difficult ot obtain them by bottom grabs, and, therefore, data on their biomass are rather low (5.6g/m^2). In addition to ascidians and bryozoans, the crab Hyas coarctatus alutaceus occurs quite often; their young are mostly caught by bottom grabs, mature individuals by trawls. Often observed are these errant polychaets: Nephthys ciliata, N. pelagica and N. paradoxa, Ophiopholis aculeata and such species as Crepidula, /18 Psolus, Lophyrochiton albus, as well as Harmothoe rarispina and H. imbricata. Hydroids are observed everywhere. Here we encountered the following species: Abietinaria abietina, A. gigantea, Sertularella tricuspidata, Lafoea dumosa, Thuiari cornigera, Th. breitfussi, Th. kudelini, Halecium beani, etc. Bryozoans are less frequent, mainly as cork forms growing on boulders.

According to the incomplete data, the benthic community consists of 200 species of invertebrates (Polychaeta 65, Mollusca 60, Crustacea 20, Echinodermata, 12). Had the processing been completed, the number of species might be as high as 250.

The given community is not uniform at all. Its western representatives can be divided into a number of groups depending upon living

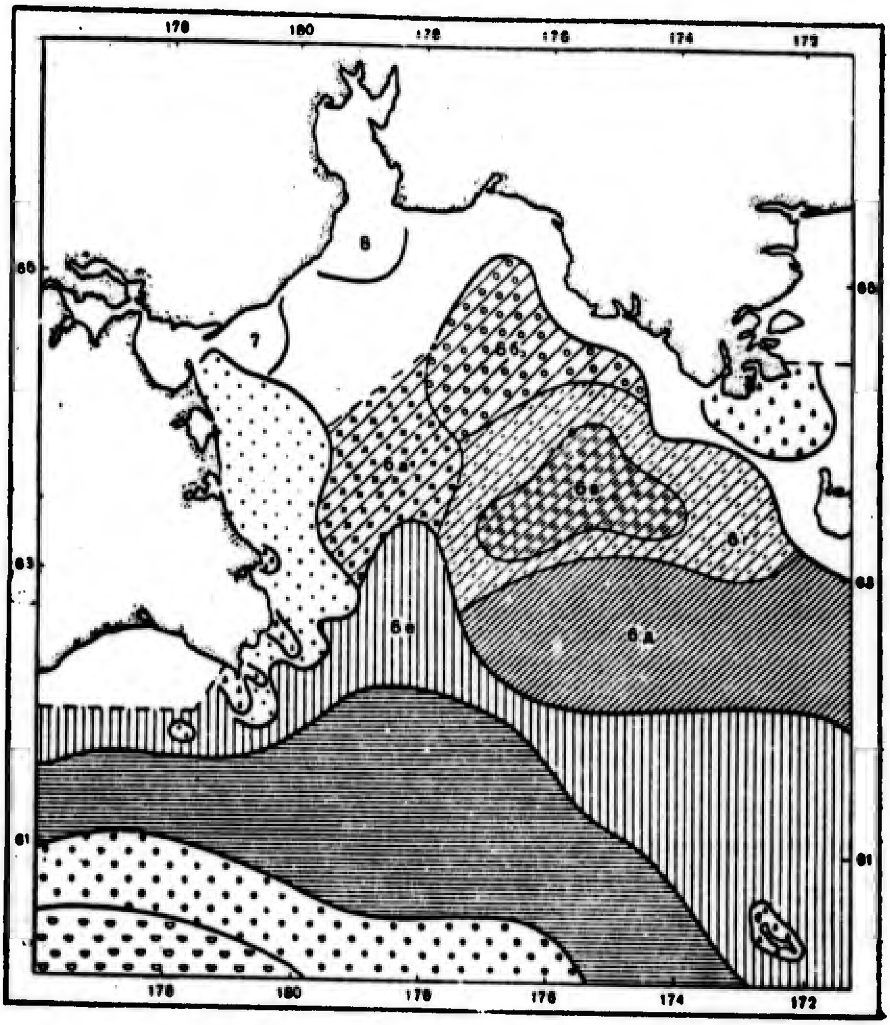

FIG. 3. Benthic Fauna in Anadyrskiy zaliv

Designations the same as in Fig. 2.

conditions. Regrettably, data on their parameter are very limited. /19

In a "clear" form this baric epifaunal community of the western part of the Bering Sea occurs off the following capes: m. Chukotskiy, m. Navarina and m. Olyutorskiy.

Below are listed the main community and its composition for St. 1507.

Table 3

Composition of *Balanus crenatus--Strongylocentrotus sachalinicus**

Forms	A	B	occurrence %	density index
Leading Forms				
Balanus crenatus	43	605	100	245
Strongylocentrotus sachalinicus	11	161	64	102
Main Typical Forms				
Spongia	—	42,5	82	59
Eunephtya	—	64	45	53
Saxicava arctica	96	28	91	50
Secondary Typical Forms				
Ascidia	—	42,0	82	42
Bryozoa	—	16,0	91	38
Hyas coarctatus alutaceus	4	11,4	73	29
Psolus	2	18,1	45	28
Pecten (Chlamys) beringianus	1,2	5,6	82	21
Brachiopoda	4	4,0	64	16
Hydroidea	—	3,6	64	15
Nephthys ciliata	4	1,3	64	9,1
» *paradoxa*	5	1,5	54	9,0

*Here, as elsewhere, the mean data are given. A denotes mean number (ind/m^2), B mean diomass (g/m^2).

The density index of other forms is less than 9. They are as follows:

Coelenterata: Bonneviella grandis, Sertularella tricuspidata, Sertularella polyzonias, Campanularia verticillata, Thuiaria thuja, T. cornigera, T. kudelini, Lafoea dumosa, Eunephthya rubriformis, Abietinaria abietina.

Polychaeta: Lumbriconereis fragilis, L. minuta, Pectinaria granulata, Ampharete goësi, A. arctica, Terebellides stroemi, Trichobranchus glacialis, Praxullella praetermissa, Scalibregma inflatum, Scoloplos armiger, Phyllodoce maculata, Ph. groenlandica, Syllis fasciata, Brada granulata, Nereis pelagica, Polycirrus medusa, Amphitrite cirrata, Thelepus cincinnatus, Eteone longa,

E. flava, Eunoe nodosa, Cirratulus cirratus, Proclea graffi, Ophelia limacina, Glycera capitata, Myxicola infundibulum Gathyana cirrosa, Nicolea zostericola, Harmothoe imbricata, H. rarispina, Capitella capitata.

Mollusca: Liocyma fluctuosa, Musculus corrugatus, Yoldia myalis, Macoma moesta, Astarte montagui, Lophyrochiton albus, Lepeta caeca.

Crustacea: Balanus balanus, Spirontocaris phippsi, Pagurus pubescens, Pantopoda Pseudopallene circularis.

Echinodermata: Ophiopholis aculeata, Ophiura maculata, Amphiodia craterodmeta, Amphiura psilopora, A. sundevalli, Gorgonocephalus caryi, f. stimpsoni.

In addition, the community includes a number of unidentified species, such as Actiniaria, Nemertini, Turbellaria, Brachiopoda, Polychaeta, Mollusca.

2. Community *Balanus crenatus*--Ascidia--*Chlamys beringianus*--Spongia--*Venericardia borealis* /21

Four stations (523, 1427, 1568 and 1594) characterize this community (Fig. 3) inhabiting the areas of capes Olyutorskiy, Goven and Kamchatskiy, i.e., the S part of the Bering Sea. The number is too small for quantitative characterization of such a complex community, especially with regard to the diverse groups. The community occurs at depths from 87 to 115m (mean d. 100m) on coarse sand with boulders, pebble, gravel and broken shells. Four quantitative bottom grab samples were obtained here, one qualitative sample and two trawl samples.

The total biomass of benthic fauna varied from 242 to 1118g/m^2 (mean value 663g/m^2). The greatest biomass values are made up by the large Chlamus beringianus, 484g/m^2. This community is different from Balanus-Strongylocentrotus, as can be seen from the list of leading forms in Table 5, by the absence of Strongylocentrotus, by the increase of mollusks, namely Chalmys beringianus, the appearance of Venericardia borealis, decrease of Saxicava arctica, increase of ascidians and increase of the general biomass of this community. In addition, the given community occurs deeper, reaching almost 100m depth, preferring less rugged bottom, namely coarse sand with boulders and pebbles. This, evidently, accounts for the increase of the forms inhabiting sandy bottom, such as bivalve mollusks. Very large Chlamys beringianus occur less often here than in the north, but their biomass is quite large (as much

Table 4

Faunal Composition at a Station Typical of the Community
Balanus crenatus--Strongylocentrotus sachalinicus
St. 1507, Anadyrskiy zaliv at bukhta Provideniya, depth 24m,
bottom: cliff, two bottom grab* samples, 0.25m^2

Forms	A	B	Biomass by groups, g/m^2
Balanus crenatus	1920	2604,0	
Hyas coarctatus	6	11,5	
Eualus fabricii	1	0,6	
Pagurus	1	0,2	
Cumacea	2	0,02	
Amphipoda	78	0,9	Crustacea 2617,2
Spongia	—	3,7	Spongia 3,7
Hydroidea	—	6,6	
Actiniaria	16	5,6	
Eunephthya	4	103,1	
Eunephthya glomerata	2	0,3	Coelenterata 115,6
Saxicava arctica	476	149,2	
Pecten beringianus	4	1,8	
Musculus corrugatus	4	0,3	
Margarites	2	1,1	
Trichotropis	6	0,4	
Trophon	6	1,4	
Algorada	2	0,1	
Velutina	2	0,2	Mollusca 154,5
Bryozoa	—	15,2	Bryozoa 15,2
Turbellaria	18	1,00	Turbellaria 1,0
Nemertini	8	2,1	Nemertini 2,1
Golfingia	4	0,5	Sipunculoidea 0,5
Ammothea	8	0,5	Pantopoda 0,5
Asteroidea	2	1,0	
Psolus	4	0,1	Echinodermata 1,1
Ascidia	14	1,8	Tunicata 1,8
Phyllodoce maculata	40	4,7	
Ph. groenlandica	2	0,1	
Eteone longa	20	0,5	
Nereis pelagica	18	8,4	
Harmothoe imbricata	40	1,8	
H. rarispina	30	0,9	
Eunice	2	0,04	
Cirratulus cirratus	10	0,6	
Amphitrite cirrata	6	0,3	
Proclea graffi	2	0,02	
Capitella capitata	8	0,04	
Brada granulata	2	0,1	
Capitella	4	0,02	
Sabellidae	6	0,2	
Polychaeta varia	2	1,4	Polychaeta 19,1

Total biomass-- 2932,3 г/м^2;
Food biomass-- 195 г/м^2.

*Petersen grab in this and other tables.

as 500g/m^2), so is their size. In addition, the foloowing forms are observed: Hyas coarctatus alutaceus (mean biomass 13g/m^2), Nephthyla ciliata (6.42g/m^2), Lophyrochiton albus (1.8g/m^2), Eunoe nodosa and many others. Especially significant such epifaunal forms as ascidians (mean biomass almost 100g/m^2) and various sponges (58g/m^2). There are new species of sponges, such as Myxichella ochotensis and Phorbas salehrosus (Koltun, 1955); of ascidians, such as Boltenia echinata, B. ovifera, Phallusia, Tethyum, various Synascidia etc., which constitute here the mean biomass of the community. Here, also occur large quantities of various hydroids (Lafoea fruticosa, L. grandis, Sertularella, gigantea, S. tricuspidata, Grammaria abietina, Gr. stentor, etc.).

The community is characterized by a great variety of errant polychaets, notably Eunoe nodosa, Gattyana ciliata, G. cirrosa, Harmothoe rarispina, H. imbricata, Nephthys ciliata, N. paradoxa, Glycera capitata, various sessile Serpulidae (e.g. Serpula zygophora), etc.

There are numerous gastropods, such as Plycifusus kroyeri, Sipho, Neptunea, Margarites striata cinerea, M. ochotensis avachensis, Solariella varicosa of bivalve mollusks (in addition to Chlamys and Venericardia) there are Musculus nigra, M. discora, Liocyma fluctuosa, etc. Of amphipods there are numerous Rhachotropis aculeata pacifica, Ampelisca derjugini, A. eschrichti pacifica, of decapods numerous Pandalus goniurus, P. montagui, Sclerocrangon communis, Spirontocaris spina intermedia etc. Fauny Chionoecetes opilio represent crabs.

Judging from data by Lus and Kuznetsov (1961), the community Balanus--Ascidia--Chlamys--Spongia--Venericardia (or its modification) also inhabits the Korfo-Karaginskiy zaliv, where the biomass is high in the N part of the gulf; namely, more than 3kg/m^2. It /22 is formed mainly by Venericardia (1145 and 1083g/m^2). In addition, there are hydroids, bryozoans, errant polychaets, including Nephthys ciliata, as well as sea urchins, such as Strongylocentrotus, ascidians Psolus, etc. Even these brief data indicate that there is a similarity between the epifauna of the Korfo-Karaginskiy zaliv and the above community. It should, however, be pointed out that Venericardia are widely distributed in the gulf, forming an independent community (Lus and Kuznetsov, 1961).

The composition of this community and one of its typical area represented by St. 1427 are presented in Tables 5 and 6.

Table 5

Composition of Community Balanus crenatus--Ascidia--Chlamys beringianus--Spongia--Venericardia borealis

Forms	A	B	Occurrence, %	Density index
Leading Forms				
Balanus crenatus	265	129,5	75	100
Ascidia	—	99,7	75	99
Pecten (Chlamys) beringianus	1	125,3	50	79
Spongia	—	58,1	100	7C
Venericardia borealis	31	51,6	100	72
Typical forms				
Bryozoa	—	23,5	100	48
Hyas coarctatus alutaceus	8	12,8	100	36
Hydroidea	—	8,7	100	29
Nephthys ciliata	22	6,4	100	25
Secondary forms				
Brachiopoda	—	3,4	75	18
Lophyrochiton albus	12	1,8	75	12
Saxicava arctica	3	0,2	75	4

The density index of other forms is less than 4. They consist of the following:

Coelenterata: Grammaria abietina, G. stentor, Lafoea fructicosa, L. grandis, Abietinaria abietina, Sertularella gigantea, S. tricuspidata.

Polychaeta: Nicomache lumbricalis, Notoproctus pacificus, Lysippe labiata, Ampharete goesi, Melinna elisabethae, Pectinaria granulata, Nephthys caeca, N. paradoxa, N. longosetosa, Polynoe tarasovi, Gattyana cirrosa, Owenia fusiformis, Lumbriconereis minuta, L. fragilis, Glycera capitata, Eteone longa, Onuphis geophiliformis, O. parva-striata, Pista cristata, Nicolea zostericola, Serpula zygophora, Idanthyrsus armatus, Terebellides stroemi, Scoloplos armiger, Pholoe minuta, Praxillella praetermissa, Phyllodoce groenlandica, Chaetozone setosa, Axiothella catenata, Leaena abranchiata, Proclea graffi, Arcteobea anticostiensis, Maldane sarsi.

Sipunculoidea: Phascolion strombi, Golfngia eremita.

Mollusca: Serripes groenladicus, S. laperousi, Thyasira gouldii, Trophon pacificus, Columbella rosacea, Plicifusus kroyeri, Turritella erosa, Astarte rollandi, Macoma calcarea, Nucula tenuis, Rictocyma zenkewitchi.

Crustacea: Spirontocaris phippsii, Eualus pusiola, Pagurus pubescens, P. splendescens, Pandalus goniurus, Sclerocrangon intermedia.

Pantopoda: Pseudopallene circularis.

Echinodermata: Asteronyx loveni, Amphiodia craterodmeta, Amphiura psilopora.

In addition, there are forms which have not been identified to the species, namely, Actiniaria, Nemertini, Crepidula, Sipho, Amphipoda, Isopoda.

Table 6 /23

Composition of Fauna at a Station Typical of the Community" Balanus crenatus--Ascidia--Chlamys beringianus--Spongia--Venericardia borealis

St. 1427, m. Goven, d. 87m, bottom: pebble, boulders, sand. Bottom grab Okean. $0.3m^2$, 2 samples

Forms	A	B	Biomass by groups, g/m^2
Spongia	Fr.	0,02	Spongia 0,02
Hydroidea	Fr.	7,7	Hydroidea 7,7
Nemertini	Fr.	0,02	Nemertini 0,02
Nephthys ciliata	30	15,1	
Pectinaria granulata	11	1,3	
Lysippe labiata	3	0,4	
Amphareté	5		
Nicolea zostericola	2	0,2	
Scoloplos armiger	10	0,2	
Gattyana cirrosa	2	0,05	
Pholoe minuta	2	0,03	
Eteone longa и др.	Fr.	0,02	Polychaeta 17,3
Bryozoa	Fr.	4,3	Bryozoa 4,3
Brachiopoda	2	0,2	Brachiopoda 0,2
Amphipoda	36	1,2	
Cumacea	3	0,02	
Balanus crenatus	750	427,4	
Pagurus pubescens	1	0,8	
Hyas coarctatus alutaceus	Fr.	4,8	
Pandalus goniurus	8	18,30	Crustacea 452,5
Venericardia borealis	35	132,6	
Saxicava arctica	5	0,3	
Varia	80	0,8	Bivalvia 133,7
Margarties, Solariella, Lora	4	1,04	
Plicifusus kroyeri	2	0,3	Gastropoda 1,40
			Mollusca 135,1
Amphiodia craterodmeta	36	1,3	Echinodermata 1,3

Total biomass—618,3 г/м²

3. Community *Balanus evermanni--Chlamys albidus--Saxicava arctica*--Spongia--Hydroidea

S of the Bering Sea (Fig. 2), i.e., outside the confines of the sea, the epifaunal communities are subjected to considerable variations in their composition. A number of leading forms typical of the epifaunal community of the Bering Sea are not observed here. This community includes a large number of forms, some of which are rare in the Bering Sea or occur only in its southern periphery and in the Sea of Okhotsk. Only one station characterizes this community; namely, St. 958, depth 109m, bottom covered with sand, boulders and pebble. At this station we observed the following forms. Spongia, more than 10 ind., and /24
spicules. There were several colonies of hydroids (Lafoea fruticusa, Grammaria stentor, Sertularella tricuspidata, Tubularia indivisa). Eunephthya, several small dark-red colonies. Fragments of Paragorgia arborea. Polychaeta: Harmothoe impar, Eunoe nodosa, Nereis zonata, Onuphis cenchylega, Sabellidae (1-2 ind.). Bryozoa, fragments. Crustacea: Isopoda, Amphipoda (1-2 ind.). Decapoda (1-5 ind.): Pandalus goniurus, P. montagui tridens, P. borealis eous, P. hipsonotus, Eualus townsendt, E. suckleyi, E. pusiola, Nectocrangon ovifer, N. dentata, N. crassa, Sclerocrangon communis, S. volki, S. arcuata, Chionoecetes opilio, Ch. bairdi, Hyas lyratus, Oregonia gracilis, Pagurus splendescens. Balanus evermanni. Pantopoda: Nymphon grossipes, Colossendeis.

Mollusca: Chlamys albidus (4 ind.); Anomia (Pododesmus) macroshisma (1); Saxicava arctica (1); Nudibranchia (2); Fissurella (1); Echinodermata: Ophiopholis (38); Solaster (3); Crossaster (1): Henricia (22); Strongylocentrotus (5); Psolus (19); Cucumaria (16); Gorgonocephalus (1).

Of interest are the following forms: Balanus evermanni, which occurs seldom in the Bering Sea, but is widely distributed in the Sea of Okhotsk. Here it is replaced by B. crenatus; Chlamys albidus replacing Chl. beringianus; thermophilic Pododesmus macroshisma, typical of more southern areas; and lastly Hyas lyratus absent in the Bering Sea and replacing here H. Coarctatus. Thus, in the southern periphery of this sea the given epifaunal community does not yet have the typical status held by it in the W part of the Bering Sea.

The mean total biomass for all of the three epifaunal communities is 755g/m^2. The main contributor is Cirripedia (various Balanus species) constituting here 100% of occurrence and making up almost half (47%) of the mean faunal biomass of these communities (Table 7, Fig. 4).

Table 7
Relationship Among Epifaunal Benthic Animals in the W Part of the Bering Sea

Groups	Mean number, ind/m^2	Mean biomass, g/m^2	Occurrence %	% of total biomass
Spongia	—	68,75	53	9,1
Actiniaria	13	54,58	41	8,4
Hydroidea	—	8,79	53	
Nemertini	6	0,53	41	0,1
Polychaeta	97	26,49	100	3,5
Sipunculoidea	6	0,98	35	0,1
Brachiopoda	6	5,0	29	0,6
Bryozoa	—	32,08	76	4,4
Crustacea	540	360,24	100	7,64
Mollusca	98	57,69	100	7,6
Echinodermata	59	96,57	70	12,8
Tunicata	19	43,3	70	5,7
Total	—	755,0	—	100,0

/25

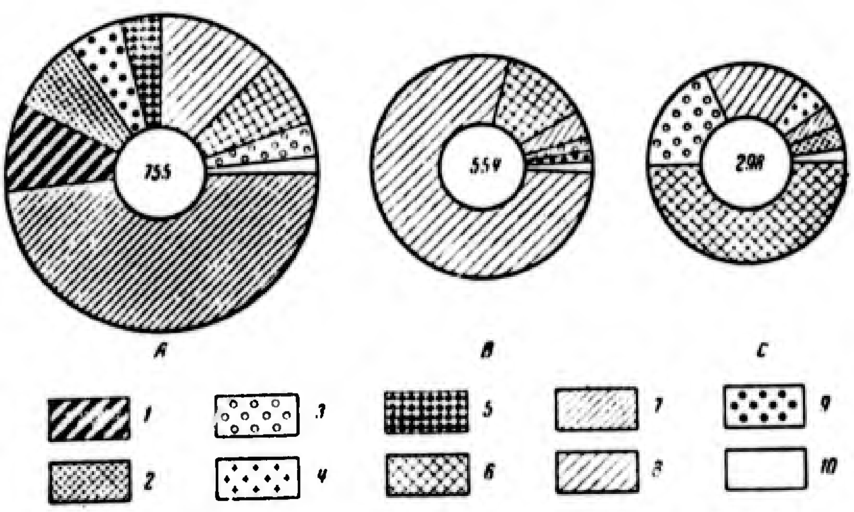

FIG. 4. Relationships Among the Groups of Several Communities of Benthic Fauna Inhabiting the Bering Sea

A--epifauna; B--Echinarachnius parma-Macoma calcarea; C--Maldane sarsi-Macoma calcarea-Ophiura sarsi-Nucula tenuis; 1--Spongia; 2--Coelenterata; 3--Polychaeta; 4--Sipunculoidea; 5--Bryozoa; 6--Mollusca; 7--Crustacea; 8--Echinodermata; 9--Tunicata; 10--Varia; numbers in the center denote the mean biomass of the community (in g/m^2).

Communities in Which Onfauna Predominates

4. Community *Echinarachnius parma*

The community represented by the echinoderm Echinarachnius parma is widely distributed throughout all marginal seas of the N Pacific Ocean. This is one of the typical biocoenosis of benthic fauna thriving on shallow sand coasts; less often it is observed in shallow places of the open sea (Neyman, 1960a). Dryugin and Ivanov (1937) were the first ones to observe it in the Bering Sea. Makarov (1937) and Vinogradova (1954) list quantitative data for this community.

In addition to the Bering Sea, E. parma inhabits E coast of Kamchatka, belt of N Kurile Islands (Kuznetsov, 1959, 1961a, 1961b, 1963), Sea of Okhotsk (Savilov, 1961; Pastunak, 1957; Ushakov, 1953), off S Sakhaline (D'yakonov, 1958; Kobyakova, 1949). In the Sea of Japan it occurs in zal. Petra Velikogo and zal. Syaukhu (Dryugin, 1939, Deryugin and Somova, 1941, D'yakonov, 1938). According to Deryugin, this biocoenosis is widely distributed throughout the Sea of Japan, occurring in patches on sandy bottoms of the coastal belt at depths ranging from 3 to 60m. In zal. Syaukhu, i.e., in the southernmost habitat of this biocoenosis, the community consists of a number of thermophilic forms, such as Echinarachniusi griseus, Dosinia japonica, Tellina lutea venulosa, etc. Evidently, the southern Sea of Japan is crossed by the boundary line of this community. In more southern areas of the Sea of Japan the species Echinarachnius parma is replaced by the more thermophilic E. griseus but data on the distribution of the species are almost nonexistent. As to the /26
Pacific coast of America, it is known that only the Pudget Sound (48°N) lies on the S boundary of the territory inhabited by E. parma (D'yakonov, 1958). It is, however, not known whether or not it forms a community here as in the case of the Bering and other Far Eastern Seas (Shelford, 1935). One can only think that there is such a community with amphi-Pacific distribution of E. parma.

In addition to the N Pacific Ocean and its marginal seas, E. parma occurs on the Atlantic coast of N. America, from New Jersey to W. Labrador. But, it is absent along the European coast of the Atlantic. Thus, its general distribution in the N hemisphere is an illustrative example of amphi-boreal (amphi-American) type of distribution. Whether or not it forms an Atlantic community, similar to the Pacific community, is not yet known, but there is reason to assume that such a community does exist.

E. parma inhabits the entire shallow belt of the Bering Sea from the Bering Strait in the North to Kamchatskiy proliv and Aleutian Islands in the south (Fig. 2). However, E. parma occurs considerably farther north than the boundary of its community. Single individuals were observed as far north as the Gulf of St. Lawrence and even the open part of the Chukchi Sea (Krasnoarmeyets, St. 52, 70°25'N, 172°E, depth 30m, bottom consisting of gravel, temp. 1.17°C, salinity 33.08°/oo; D'yakonov, 1952). The existence of E. parma in the Chukchi Sea has not yet been established (Ushakov, 1952). Evidently, this species does not inhabit this northern sea.

The northernmost boundary of E. parma is the W part of the Bering Strait (Deryugin and Ivanov, 1937). Here the quantity of the species reached 405ind/m^2, the biomass being 3kg/m^2, which appears to be one of the richest habitats of the animal (Krusnoarmeyets, St. 26, depth 43m, bottom consisting of slightly muddy sand; Makarov, 1937). In addition to Echinarachius, we encountered Yoldia, 5, Trophon, 10, Gastropoda, 60, whose biomass amounted to 162g/m^2; Amphipoda (represented mainly by Erichtonius tolli) made up 127g/m^2. The total biomass of benthic organisms at this station reached 4237g/m^2, i.e., it was the highest in the entire habitat of this community. Such a mass development of E. parma in the Bering Strait region leads us to assume that the biocoenosis of this species may be extended farther northeastward in the Beaufort Sea. As is known, the cape Lisburn--cape Barrow sector is considerably heated by the water that passes through the Bering Strait and deflects eastward. Therefore, the existence of a temperature thermophilic community of Echinarachnius is possible there.

Little was known about the distribution of Echinarachnius over the open E part of the Bering Sea. Only data of two stations SE of the Bering Strait were available to us (Krasnoarmeyets, 1933; St. 65 and 67, depth 33m). The total biomass of the benthic fauna at these stations was 597 and 160g/m^2, respectively. Echinarachnius constituted 585 and 90g/m^2, respectively.

However, judging from data obtained later by the VNIRO Expedition (1958-1959, Neyman, 1960b, 1963), the biocoenosis of Echinarachnius is large, covering the entire E part of the Bering Sea. This wide distribution of the community is evidently furthered by large shallow shelf areas. /27

As a result, this community inhabits the entire west coast of Alaska and, evidently, also the coast of the Gulf of Norton. It is probable that this community is also found off the S coast of Alaska and along the Aleutian Islands. A separate group of Echinarachnius inahbits the shallow central part of the Bering Sea, W of Island Matwey (Zhemzhug, 1958, St. 158, d. 97m; muddy sand bottom, bottom grab Okean, $0.25m^2$). The total number of the echinoderms reached $492g/m^2$. Such a rich but isolated habitat of E. parma was evidently established by the larvae that were brought in from the coastal communities of the eastern Bering Sea.

According to D'yakonov (1958), off the W coast of America, the S boundary of E. parma lies somewhere around the Pudget Sound (47-48°N). There is nothing known about the biocoenosis of the species in this region.

Because the shelf of the Pacific coast of America is narrow and its slope is steep, from the Gulf of Alaska southward, the conditions for the development of E. parma are less favorable than within the same latitudes of the Asian coast where the shelf zone has dense benthic populations. Off the Queen Charlotte Island and Washington and Oregon states, for example, the 200m isobath runs so close to the coastline that the zone of sandy shoals, which is preferred by the Echinarachnius community, is very narrow indeed. These conditions evidently limit the propagation of this community along the Pacific coast of America.

Some of the ecological characteristics of E. parma, notably foraging (Sokolova and Kuznetsov, 1960) evidently determine its distribution. E. parma thrives in the relatively short coastal belt where the type of bottom is suited for the settlement of larval forms. One catch made by the Sigsby trawl in the Olyutorskiy zaliv of the Bering Sea at the depth of 60m on even sandy ground amounted to 500kg (Vityaz', St. 1590). The trawling lasted only 20 minutes. Judging from bottom grab samples collected in Anadyrskiy zaliv (St. 575, d. 43m, sand), the quantity of the echinoderms reaches $327ind/m^2$, the corresponding biomass being $1571g/m^2$, and $288ind/m^2$ weighing $1990g/m^2$ (St. 576, d. 32m, sand).

E. parma is noted for its selectivity: it prefers pure or slightly silty sand of varying density and graininess, which is deposited in areas where the water circulation is pronounced. Such conditions transport detritus which is used as food for the echinoderms, and aerates the bottom water inhabited by the species (Sokolova, Kuznetsev, 1960).

Judging from the general living conditions for this community, /28
it appears to be thermophilic, though some species are eurythermal, arctic-boreal (amphiboreal), stenobathic inhabiting the upper sublitoral belt, as well as stenoedaphic seston feeders. The echinoderms develop rich and variegated communities in the Pacific Ocean; i.e., not an oligomixed unit, but a unit consisting of various benthic species.

In order to determine the composition and distribution of E. parma in the NW part of the Bering Sea, we utilized data on benthic fauna based on 32 bottom grab samples and 12 trawl samples obtained by the Vityaz' as well as older data collected by the Krasnoarmeyts Expedition (1933, 3 bottom grab stations). /29

In addition, 8 bottom grab samples and 6 dredge samples of the Korfo-Karaginskiy region were used (CPT Shuleykin, 1956). Altogether we utilized 43 bottom grab and 18 trawl and dredge samples of test stations, obtained at various times in the W part of the Bering Sea (Table 8).

The Echinarachnius community occurs along the entire NW coast of the Bering Sea with sandy bottom at depths ranging from 8 to 118m (average value 46m). This community is evidently absent from areas with rocky bottom at capes where the bottom water moves at a rapid rate and favors development of the epifauna. The echinoderms also avoid brackish regions and areas with low water temperature, below 0°C. Lastly, very muddy sand and aleurite silt of the central part of Anadyrskiy zaliv is avoided by echinoderms.

The fact that the optimum region for echinoderms is considerably smaller than the region inhabited by them is indicated by numerous observations of echinoderms on types of bottom that are not preferred by the community, at low temperature and in isolated areas. These groups represent pioneers occurring beyond the boundaries of regular habitats. Their larvae evidently have been transported by currents and have managed to survive. But the living conditions in such marginal areas are often far from optimal and the small groups perish after a while. The single echinoderm found in the S part of the Chukchi Sea, (Krasnoarmeyets) St. 52 with a water temp. of -1.17C, is one of such random cases.

The E. parma community that lives in the W part of the Bering Sea consists of many groups.

4a. Group *Echinarachnius parma--Macoma calcarea*

In Andyrskiy zaliv this northern group occurs in the W part, from mys Navarina to the Anadyr estuary (Fig. 2 and 3). This group is represented by 13 bottom grab samples (2 of which are qualitative s.) and 7 trawl samples. Here the group was observed at depths ranging from 21 to 118m (the mean depth being 50m). It occurred almost exclusively on fine sand with admixture of scattered gravel and pebble. In m. Navari region, where rock and mixed bottoms prevail, while sand occurs only in some places, the distribution of Echinarachnius is patchy. The eastern boundary of echinoderms

Table 8

Vityaz' Stations in the Area Inhabited by the <u>Echinarachnius parma</u> community

Region	St.	Equipment	Depth m	Bottom	Biomass g/m²	Food biomass g/m²
Anadyrskiy zaliv	559	д. П.	68	Sand with fine gravel	216	9,7
	562	д. П., т. С.	21	Sand	336,2	31,8
	563	д. П., т. С.	37	Fine sand	427,0	56,2
	575	д. П.	43	Sand	1602,0	31,6
	576	д. П.	32	Fine sand	1994,0	7,3
	577	д. П. (к.) т. С.	35	Sand, pebble	—	—
	580	д. П., т. С.	25	Sand	19,2	14,4
	581	д. П. (к.)	47	Sand	—	—
	1517	д. П., т. С.	118	Sand, pebble	70,9	30,9
	1519	д. П.	85	Pebble, mud, sand	87,2	20,6
	1522	д. П.	65	Fine sand	648,6	67,2
	1524	д. П., т. С.	49	Medium coarse sand	331,0	43,0
	1541	д. П.	110	Sand with pebble & gravel	363,0	122,8
Olyutorskiy zaliv	597	д. П.	54	Coarse sand	145,8	7,6
	599	д. П.	22	Fine sand	514,5	20,1
	600	д. П.	77	Coarse sand	872,6	288,6
	1567	д. П.	74	Fine sand	606,4	38,6
	1574	д. О.	72	Sand	400,5	87,8
	1573	д. П.	55	Sand	213,4	82,8
	1574	д. П.	27	Coarse & medium coarse sand	945,0	18,0
	1575	д. П.	62	Fine sand	1584,4	295,0
	1580	д. П.	70	Fine sand	41,0	35,4
	1581	д. П., т. С.	29	Fine sand	453,3	3,5
	1581a	д. П.	20	same	438,4	14,7
	1582	д. П., т. С.	11	"	442,2	20,8
	1582a	д. П.	8	"	165,7	12,2
	1584	д. П., т. С.	81	"	397,9	46,9
	1590	д. П., т. С.	66	sand	667,0	14,2
	1592	д. П.	11	"	183,9	48,5
	1593	д. П.	47	Pebble, gravel	63,3	57,7
Koryakskiy zaliv	593	д. П., т. С.	55	Coarse sand	313,5	—
	594	д. П., т. С.	48	same	35,5	—

NOTE: ДП = Petersen bottom grab
(k) = qualitative sample;
TC = Sigsby trawl

is located in the open part of the gulf, where pure sand is gradually replaced with coarse aleu.ite.

The bottom temperature in the W part of Anadyrskiy zaliv (where the groups occur) varies from 1° to 3°, decreasing in winter to -1.5° and rising to 8° in summer (Aug.-Sept.). Salinity of the bottom water ranges from 28 to 35o/oo, the greatest decrease of salinity occurring at the entrance to the liman of Anadyr' River.

The greatest quantity and biomass of echinoderms is observed at depths less than 50m. Thus at the depth of 33m we observed 268ind/m^2 /30
and 1990g/m^2 (the mean weight of 1 ind. is 749). At the depth of 43m, 410ind/m^2, weighing 3921g/m^2 (mean w. of 1 ind. 959). The mean quantity of echinoderms in the W part of the gulf is 74ind/m^2, the mean biomass 475g/m^2, (the mean weight of 1 ind. being 64g).

Judging from the ratio of ind. groups of benthic animals, the main group consists of echinoderms, mollusks, crustaceans and partly of tunicates (Table 9, Fig. 4). The mean total biomass of the groups is 554g/m^2, the quantity 280ind/m^2. The number of species about 100. But there are a number of species that have not yet been identified (Table 10). Considering this fact, it seems that the total number of the species is as high as 250.

Table 9

Relationship between the Groups Constituting the Benthic Animals _Echinarachnius parma_--_Macoma calcarea_

Groups	Mean number, ind/m^2	Mean biomass, g/m^2	Occurrence %	% of total biomass
Coelenterata	1	3,66	63	0,6
Nemertini	1	0,05	50	0,01
Polychaeta	72	9,69	100	1,80
Sipunculoidea	3	0,05	9	0,01
Bryozoa	—	2,7	36	0,48
Crustacea	106	21,19	82	3,9
Mollusca	37	71,41	100	12,7
Echinodermata	69	435,6	100	78,7
Tunicata	7	10,0	36	1,8
Totals		554,35		100,0

Here, as elsewhere, E. parmais the leading form. Then follow bivalve mollusks and polychaets (Table 10). According to the samples obtained with trawls, the Echinarachnius--Macoma group of Anadyrskiy zaliv includes also such forms as Hyas coarctatus alutaceus and young Chionoecetes opilio, Pandalus goniurus, Pagurus pubescens and especially P. splendescens. Acanthostepheia beringiensis and Anonyx nugax pacificus represent amphipods. Near m. Navarina (St. 1517, d. 115m) the Kamchatka crab has been observed. This group has evidently left its regular boundaries. Evidently, the temp. of 5-8° in summer favors the survival of larvae. The gastropods of the group are represented by Neptunea beringiana, N. vinosa, Plicifusus kroyeri, Argobuccinum oregonensis, Solariella obscura and S. varicosa, bivalve mollusks by Serripes groenlandicus and S. laperousii, echinoderms by Stegophiura nodosa, Ophiopholis aculeata japonica, Gorgonocephalus caryi f. stimpsoni.

Table 10 /31

Composition of Echinarachnius parma--Macoma calcarea Group That Inhabits Anadyrskiy zaliv

Forms	A	B	Occurrence, %	Density index
Leading Forms				
Echinarachnius parma	74	475,4	100	218
Typical forms				
Macoma calcarea	10	10,0	54	24,2
Nephthys longosetosa	12	3,76	81	17,4
Liocyma fluctuosa	4	5,2	50	16,1
Yoldia ensifera	1	3,6	50	13,4
Secondary				
Praxillella praetermissa	10	1,4	50	8,3
Owenia fusiformis	4	0,66	50	5,7
Scoloplos armiger	19	0,22	50	3,3
Onuphis geophiliformis	4	0,2	50	3,3
Glycinde ermigera	7	0,12	81	3,1
Rhodine gracilior	4	0,12	50	2,4

The remaining 82 species have a density index of 2.4. They make up the following groups:

Polychaeta: Travisia kerguelensis, T. forbesii, Ophelia limacina, Pholoe minuta, Magelona pacifica, Ampharete acutiforns, Phyllodoce groenlandica, Nephthys caeca, N. ciliata, Arcteobea anticostiensis, Nicolea zostericola, Eteone flava, Ampharete arctica, Gattyana amondseni, Polycirrus medusa, Eteone longa, Nicomache lumbricalis, Proclea graffi, Onuphis conchylega, Chaetozone setosa, Eulalia bilineata, Terebellides stroemi, Lysippe labiata, Maldane sarsi, Ammotrypane aulogaster, Harmothoe imbricata, Heteromastus filiformis, Idanthyrsus armatus, Magelona longicornis, Polynoe tarascovi, P. pavlovski, Eteone barbata, Lumbriconereis minuta, Glycera capitata, Nereis zonata, Pectinaria granulata.

Sipunculoidea: Golfingia eremita, G. margaritacea, Phascolion strombi.

Mollusca: Lepidopleurus assimilis, Margarites rossica, Solariella varicosa, S. obscura, Cylichna scalpta, Plicifusus kroyeri, Macoma middendorffi, M. moesta, M. loveni, Astarte montagui, A. borealis, Serripes groenlondicus, Musculus sub srtiatus, Yoldia myalis, Y. scissurata, Y. limatula, Pecten beringianus, Siligua patula, Spisula alascana, Mya intermedia, Nucula tenuis, Lyonsia arenosa, Thyasira gouldi.

Crustacea: Chionoecetes opilio, Hyas coarctatus alutaceus, Sclerocrangon borealis, Crangon septemradiata, Nectocrangon ovifer, Pagurus pubescens, Balanus crenatus.

Pantopoda: Ammothea borealis.

Echinodermata: Stegophiura nodosa, Ophiopholis aculeata, Hexaster polaris, Amphiodia craterodmeta, Gorgonocephalus caryi, Ophiopenia tetracantha.

Bryozoa: Alcyonidium disciforme.

In addition, there are a number of forms which have not yet been identified to the species: Hydroidea; Actiniaria; Bryozoa; Polychaeta; Lora; Scala; Turitella; Lunatia; Neptunea; Velutina; Trichotropis; Cumacea; Isopoda; Amphipoda; Decapoda.

The edible benthos makes up about 40g/m^2 (or 7% of the total biomass of this group, equalling 554g/m^2).

Such a relatively small percentage results from predominance of large sea urchins, whose mean size is 4cm and which cannot be comsumed by benthos-feeding fishes.

The bottom grab St. 563 (Table 11) characterizes the Echinarachnius-Macoma group of Anadyrskiy zaliv. The station lies on the N boundary for this benthic group where the bottom temperature ranges from 1.7 to 1.5°. One can observe a considerable admixture of cryophilic forms here consisting of bivalve mollusks. The other station sampling this group (St. 1524) lies more to the /32 south and is characterized by a greater quantity of polychaets, including their arctic-boreal and boreal forms.

Table 11

Composition of Fauna at a Station Typical of the community of Echinarachnius parma--Macoma calcarea St. 563, d. 37m, fine slightly muddy sand. Peterson grab, $0.4m^2$, 3 samples (= $1m^2$)

Forms	A	B	Biomass by groups, g/m^2
Echinarachnius parma	20	288,45	
Stegophiura nodosa	2	0,03	Echinodermata 288,48
Ampharcte scutifrons	3	2,56	
Nephthys longosetosa	3	0,41	
Phyllodoce groenlandica	1	0,31	
Praxillella praetermissa	8	1,25	
Glycinde armigera	3	0,13	
Onuphis geophiliformis	1	0,03	
Sabellidae	—	0,45	Polychaeta 5,14
Serripes groenlandicus	2	58,35	
Astarte borealis	2	25,5	
Liocyma fluctuosa	5	7,85	
Yoldia scissurata	2 fr.	10,03	
Macoma calcarea	50	30,12	
Musculus substriatus	1	0,04	
Solariella varicosa	1	0,12	
Lora sp.	1	0,83	Mollusca 132,84
Nemertini	1	0,02	Nemertini 0,02
Actiniaria	1	0,52	Coelenterata 0,52

Total biomass — 427,0 г/м²
Edible " — 56,2 г/м²

The benthic fauna of the Koryakskiy bereg (coast) of the Bering Sea, between m. Navarin and m. Olyutorskiy, was little investigated by the Vityaz' Expedition. Therefore, the distribution of the Echinarachnius group is only superficially known. Our data are based on samples obtained at three stations (3 bottom grab and two trawl samples), at depths 43 to 80m on bottoms covered with coarse sand with gravel. The composition of fauna resembled that of the W part of Anadyrskiy zaliv. The largest total biomass, $313.5g/m^2$ was at St. 593 (d. 55m, coarse sand); sea urchins made up $263g/m^2$. At St. 594 (d. 48m) only the trawl catches consisted of large numbers of sea urchins; they were absent in bottom grabs.

The trawl catches obtained at these stations consisted of Hyas coarctatus alutaceus, Chionoecetes opilio, Pagurus pubescens, P. splendescens, Argobuccinum oregonense, Neptunea beringiana, Solarieela obscura, etc.

4b. Group *Echinarachnius parma--Venericardia borealis--Tellina lutea*

In Olyutorskiy zaliv this community is widely distributed, occupying a relatively large shallow belt extending parallel the coast (Fig. 5). Such a distribution pattern is determined by the bottom relief of the gulf and by the distribution of sand bottoms which are preferred by this group. The Olyutorskiy zaliv exposed to the ocean represents a continental shoal with a smooth surface, about 25-30 miles wide. At places the slopes are as steep as 25° and intersected with numerous narrow submarine valleys beginning at the depth of 200m and ending in the abyssal part of the sea (Udintsev, Boychenko, Kanayev, 1959). As will be later seen, the presence of such trenches and canyons in Olyutorskiy zaliv is of great significance for the bathyal fauna which rises here to shallower areas and considerably affects the vertical distribution pattern of benthic fauna in sublitoral.

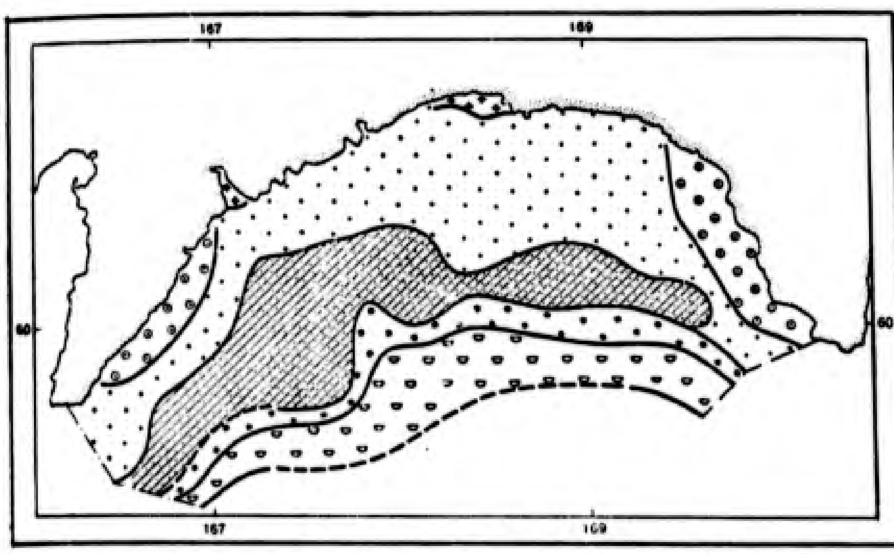

FIG. 5. Benthic Communities of Olyutorskiy zaliv

The same designations as in Fig. 2.

Owing to a wide distribution of gray and greenish-gray sand in this region (with admixture of pebble and gravel), the Echinarachnius--Venericardia--Tellina community is quite widespread here. It occurs in the entire coastal zone of Olyutorskiy zaliv at depths ranging from 8 to 80m (mean d = 46m); it is absent only in m. Olyutorskiy and m. Goven areas where strong currents and boulder-pebble bottom attract epifaunal communities. At the depth of about 100m and more, where fine sand is gradually replaced by coarse aleurites, runs the lower distribution boundary of the Echinarachnius group which abounds here on the Macoma calcarea--Amphipodia craterodmeta community.

The entire upper sublitoral of Olyutorskiy zaliv inhaibted by the above-mentioned community is subjected to a constant action of Anadyrskiy Current flowing from the gulf and bringing transformed water of Anadyrskiy zaliv from the NW part of the Bering Sea. /34
The temperature of the bottom water in the habitat of this group is always positive, changing little during the year: from 2-3.5° in summer to 2-3° in winter. Ice is not formed in winter.

Table 12

Composition of Group Echinarachnius parma--Venericardia borealis--Tellina lutea

Forms	A	B	Occurrence, %	Density index
Leading Form				
Echinarachnius parma	54	286,0	100	169
Typical Form				
Venericardia borealis	110	170,4	50	92
Secondary Form				
Tellina lutea	14	14,2	37	22,8
Macoma calcarea	27	12,2	37	21,2
Nephthys caeca	4	11,2	31	18,6
Praxillella practermissa	19	2,7	43	10,9
Liocyma fluctuosa	13	2,9	31	9,6
Nephthys longosetosa	36	1,0	68	8,3
Solcriella obscura	15	1,7	57	7,9
Nephthys ciliata	9	1,4	43	7,8
Pectinaria granulaia	7	0,7	56	6,2
Scoloplos armiger	12	0,7	43	5,4
Travisia kerguelensis	5	1,1	25	5,1
Lora	6	0,7	31	4,4
Pholoe minuta	8	0,1	62	2,7
Montacuta	9	0,1	37	2,0

The mean biomass of other forms is <0.1g/m^2 and the density index is less than 2. They consist of the following species:

Polychaeta: Ampharete reducta, A. acutifrons, A. arctica, Harmothoe imbricata, Eteone longa, E. flava, E. barbata, Ophelia limacina, Phyllodoce groenlandica, Glycera capitata, Polycirrus medusa, Axiothella catenata, Rhodine gracilior, Nicomache lumbricalis, Chaetozone sestosa, Amphicteis gunneri var. japonica, Lysippe labiala, Arcteobea anticostiensis, Gattyana cirrosa, Polynoe tarasovi, Scalibregma inflatum, Brada sachalina Spio filicornis, Owenia fusiformis, Sternaspis scutata, Lumbriconereis minuta, L. fragilis, Glycinde armigera, Proclea graffi, Nicolea zostericola, Laphania boecki, Travisia forbesii, Onuphis geophiliformis, Ammotrypane multipapilla, Syllis oerstedi.

Mollusca: Astarte montagui, A. rollandi, Serripes groenlandicus, S. laperousi, Macoma middendorfii, M. torelli, M. moesta, M. loveni, Yoldia myalis, Y. johanni, Y. scissurata, Nucula tenuis expansa, Leda minuta, Thyasira gouldi, Axinopsis orbiculata, Cardium ciliatum, Saxicava arctica, Mya truncata, Crenella decussata, Cylichna alba, Lunatia groenlandica, L. nana, Solariella varicosa, Natical clausa, Admete viridula, Trophon urcatus, Turritella erosa, Trichotropis borealis, Margarites helicina helicina, M. ochotensis, Neptunea laevigata, Plicifusus kroyeri, Lophyrochiton albus.

Crustacea: Melita dentata, Ampelisca macroceplala, A. furcigera, Anonyx nugax, Hyas coarctatus, Pagurus pubescens, Chionoecetes opilio, Nectocrangon lar lar.

Echinodermata: Ophiura maculata, Strongylocentrotus sachalinicus, S. droebachiensis, Stegophiura nodosa, Amphiodia craterodmeta.

In addition, there are a number of forms that have not been identified as to species: Spongia, Actina, Nemertini, Polychaeta, Amphipoda, Isopoda, Echinodermata, etc.

Therefore, Olyutorskiy zaliv differs considerably from Anadyrskiy zaliv. The salinity of bottom water usually does not exceed 33°/oo. /35

Thus, judging from temperature, the area inhabited by the given group has milder temperature conditions than the W part of Anadyrskiy zaliv where the northern community of Echinarachnius spends the greater part of the year in an area with negative bottom water temperatures. Due to higher bottom water temperature in Olyutorskiy zaliv, a number of Pacific northern-boreal forms that do not occur in Anadyrskiy zaliv are observed here:

Astarte rollandi, Venericardia borealis, Yoldia myalis, Ophiura maculata, Pectinaria granulata, etc. The presence of these forms lends a more thermophilic character to the benthos of Olyutorskiy zaliv in comparison to that of Anadyrskiy zaliv.

The greatest biomass of sea urchins (927g/m^2) was observed at St. 1574 (at the depth of 25m), constituting 98% of the entire benthos biomass (945g/m^2). At the other station (1590) the urchins made up 649g/m^2 or 97% of the total biomass (667g/m^2) at the depth of 66m.

The mean density of sea urchins in Olyutorskiy zaliv is 54ind/m^2, their main biomass 286g/m^2, but mean weight of one sea urchin 67g. About 0.5 ton of sea urchins was caught during one trawling lasting 20 minutes at this station. Here, as in Anadyrskiy zaliv, the main groups were echinoderms with mollusks and polychaets. Crustaceans were caught in considerably smaller numbers. The total number of species constituting this group was 150 (Table 12).

The mean total biomass of benthos in the area occupied by the Echinarachnius--Venericardia--Tellina group is 542g/m^2 against 554g/m^2 in Anadyrskiy zaliv. The quantity of benthos consumed by fishes is greater in Olyutorskiy zaliv: 749g/m^2 or 19% of the total quantity against 40g/m^2 in Anadyrskiy zaliv. The contributors are polychaets as well as small mollusks and ophiurids which live in Olyutorskiy zaliv.

The leading species, E. parma, makes up 53% of the total biomass of this group in Olyutorskiy zaliv. This area is inhabited by large quantities of polychaets, notably Praxillelia praetermissa, Scoloplos armiger, Travisia u Pectinaria granulata. The significance of mollusks in Olyutorskiy zaliv is less evident than in Anadyrskiy zaliv, while the quantity of polychaets increases in both of the areas. The quantities of Onuphis geophiliformis and Owenia fusiformis is smaller than in Anadyrskiy zaliv.

4c. Group *Echinarachnius parma--Macoma baltica*

A peculiar intermediate group between the upper sublitoral E. parma and litoral M. baltica--Mytilus edulis was observed in the upper sublitoral of Olyutorskiy zaliv, near the water's edge (Fig. 5). This group was observed at depths 8-11m, i.e., to the lower boundary of tides. The following stations were occupied here: 1582, 1852a (d. 8 and 8m) center of Olyutorskiy zaliv), 1592 (d. 11m, Guba Lavrova). Due to lack of data, it is impossible to calculate the quantitative indices for the group. Therefore, only the samples obtained at typical stations are discussed here (Table 13). The community lives on dense gray sand. It could be easily distinguished at the depth of 2-3m; we observed Macoma baltica and E. parma of various sizes. Sea urchins disappear near the coast, only M. baltica remains; its biomass gradually increases.

Table 13

Composition of Fauna At a Station Typical of the Echinarachnius parma--Macoma baltica Community
St. 1582, d. 11m; bottom: dense fine sand; Peterson grab, 0.25m^2; 2 samples

Forms	A	B	Biomass by groups g/m^2
Echinarachnius parma	30	422,5	Echinodermata 422,5
Macoma baltica	36	8,4	
Tellina lutea	6	1,42	
Siliqua lucida	4	5,9	
Polynices jv.	8	0,6	Mollusca 16,32
Nephthys longosetosa	14	1,06	
Travisia kerguelensis	8	1,96	
Glycinde armigera	2	0,04	
Spionidae	1	0,02	Polychaeta 3,18
Cumacea	8		
Amhpipoba	8	0,2	Crustacea 0,2

Total biomass — 442,2 г/м²;
Edible biomass— 20,8 г/м²

St. 1582a; d. 8m; bottom, dense fine sand, Peterson grab, 0.2m^2; 1 sample

Forms	A	B	Biomass by groups g/m^2
Echinarachnius parma	10	153,0	Echinodermata 153,0
Macoma baltica	20	12,2	Mollusca 12,2
Travisia kerguelensis	20	0,5	Polychaeta 0,5

Total biomass — 165,7 г/м²

The listed stations were located near the coast. A considerable quantity of M. baltica (36 ind/m^2) indicates that these stations lie in a zone adjacent to the habitats of Echinarachnius and the litoral M. baltica--M. edulis community.

The Echinarachnius group is rather widely distributed in the Korfo-Karginskiy zaliv. It was observed here at depths ranging from 20 to 54m (mean d. = 44m). Sand bottom typical of Echinarachnius occurs in patches in this region. The bottom water temperature fluctuates from 1 to 6° in August-September, salinity is about 33°/oo.

Samples of 8 stations characterize this community here. The samples were taken by the Peterson grab, 0.1m^2. Due to a small size of the bottom grab, the quantitative data can be considered as somewhat too high. Therefore, the quantitative indices are not listed here. /37

The greatest quantity of sea urchins was observed at the depth of 40m, namely 320ind/m^2. The mean biomass for the entire group is 617g/m^2.

5. Community *Astarte (Tridonta) rollandi*

This coastal shallow water community is represented by bivalve mollusks in two localities of Olyutorskiy zaliv (Fig. 5): in m. Olyutorskiy area (St. 1566) and near the peninsula (pol.) Goven (St. 606). Also St. 1573 could be considered as being in the area, though only young Astarte rollandi were observed here. This group evidently also inhabits Koryakskiy bereg (St. 1458, guba Glubokaya, d. 25m; 3 mature, 16 young forms were observed). The northernmost find was A. rollandi in m. Navaria area (St. 1540, d. 44m, 2 mature ind., 1 young); evidently this species does not enter Anadyrskiy zaliv. It is probable that the Astarte rollandi community has a patchy distribution here as in the case of bivalve mollusks.

The Astarte rollandi group of Olyutorskiy zaliv occurs at depths of 25-68m on coarse sand with pebbles. The location beyond those inhabited by E. parma; at many stations both of the species are observed. The most luxurious development of this group occurs off the coast of Kamchatka in Kronotskiy z. and Kamchatskiy z. (Kuznetsov, 1963).

Table 14
Composition of Fauna at a Station Typical of the *Astarte rollandi* Community
St. 1458, 7 June 1952; d. = 25m; bottom: coarse sand and fine gravel; bottom grab Okean-- 0.3m², 1 sample

Forms	A	B	Biomass by groups, g/m2
Ophelia limacina	133	34,5	
Glycera capitata	67	5,0	
Eteone bistriata	27		
Archiannelidae	many	14,2	
Terebellidae	4	0,1	Polychaeta—53,8
Actinia	3	0,5	Actiniaria—0,5
Astarte rollandi ad.	3	95,4	
Astarte rollandi juv.	16	21,7	
Astarte montagui	40	3,3	
Mytilus edulis	3	0,1	
Crenella decussata	3	0,1	
Thyasira	6	0,1	
Gastropoda varia	6	0,4	Mollusca—121,1
Cumacea	6	0,2	Crustacea—0,2
Asteroidea	Fr.	5,7	Echinodermata—5,7
	Total biomass 181,3 г/м²		

As in Olyutorskiy zaliv, the community occurs here at depths 40-60m on coarse sand with pebbles. Mollusks make up as much as 90% of the total biomass, but the quantity of A. rollandi reaches 210 ind/m², the biomass reaching 310g/m². In the Bering Sea A. rollandi does not reach such quantity. The composition of A. rollandi fauna at St. 1458 located at the entrance to guba Glubokaya is presented in Table 14. The existing data indicate that the area inhabited by A. rollandi is wide, if patchy, off the coasts of Far Eastern seas and the Pacific coast of Kamchatka, where often large concentrations are observed. Because the habitat is large occurring also in the E part of the Bering Sea (o-va Pribylovy, Aleutian Islands, Prince William Sound) the community must be widely distributed throughout the entire Bering Sea. /38

In addition to A. rollandi, there are other typical N Pacific forms, such as Ophelia limacina, Glycera capitata, Pectinaria granulata, Macoma middendorfi, M. loveni, Echinarachnius parma juv., Edvardsiidae, Ophiura maculata, various Cumacea and Amphipoda. The mean biomass of the group is 200g/m².

Communities in Which Infauna Predominates

6. Community *Macoma calcarea--Ophiura sarsi--Maldane sarsi--Nucula tenuis*

The community of infauna is not less typical of the Bering Sea than the above-mentioned sea urchins. The leading forms are bivalve mollusks, echinoderms and polychaets Macoma calcarea--Ophiura sarsi--Maldane sarsi--Nucula tenuis. This group occurs mainly in the central and eastern parts of Anadyrskiy zaliv, in an area known as the "cold Anadyr patch". It is very difficult to establish its distribution off Koryakskiy coast because the number of the Vityaz' stations was very small. It can only be assumed that this group may inhabit the area adjoining Anadyrskiy zaliv at depths less than 100m on soft muddy bottom. However, owing to the peculiarities of bottom relief, such conditions are very limited here. These conditions are still more limited in Olyutorskiy zaliv where the slope is steep and sand of varying graininess occurs at considerable depths. Evidently, the formation of soft sediments is obstructed by the strong Anadyrskiy Current running parallel to the coast southward.

From Anadyrskiy z. the Macoma--Ophiura--Maldane--Nucula community forms a broad tongue extending eastward and varying in its composition (Fig. 3).

Deryugin and Ivanov (1937) were the first ones to describe this community in general terms. The authors associated its distribution of soft muddy bottom types. The low bottom water temperature in this area of the gulf is caused by the cool surface water formed in winter and establishing a cold intermediate layer in deep areas of the Bering Sea where it settles on the shallow bottom. The /39
preservation of this patch for a considerable time period is evidently furthered by the existing current system (Gershanovich, 1962a and 1962b).

In some very warm years this cold water layer on the bottom can become washed out in summer, disappearing for a while, as in 1952. However, this is an exception for Anadyrskiy z. rather than the rule. The preservation of such local cooling can also be supported by the ice and cold water brought by currents flowing from z. Kresta and spreading over the open portions of Anadyrskiy z. Such characteristics exercise a great effect on the benthic fauna and its communities. The area with permanently low temperature is correctly considered by Anadriyashev (1935, 1939) to be a peculiar "faunal barrier" obstructing a uniform distribution of the N Pacific temperate-thermophilic fauna. The existing benthic community has not only a more cryophilic character than other communities surrounding the former, but it differs also by the prevalence of infauna made up of almost all of its benthic components. Deryugin and Ivanov mentioned Ophiura sarsi and Yoldia hyperborea as the main species, followed by Macoma calcarea, Leda pernula, Nucula tenuis, Cardium culiatum, Turritella erosa. The authors point out that sometimes as much as 90% of the trawl catches consist of Ophiura sarsi and that in the NW part of the region muddy bottom prevails. Here the leading species are Nucula tenuis and Macoma calacrea, occurring at depths 75-90m. In the peripheral belt of the area, at the depth of 55-65m lies muddy sand on which Macoma calcarea and Nucula tenuis predominate. The mean total biomass is 298g/m^2, the biomass of edible benthos is 208g/m^2.

This first brief review of the benthic population inhabiting the cold muddy Anadyrskiy location presents an accurate description of the complex but zoogeographically interesting benthic community of the Bering Sea.

As demonstrated by the investigations of VNIRO and TINRO Expeditions of the preceding years, the leading form Malcoma calcarea inhabits the shelf area and the E part of the Bering Sea where location with cold bottom water occur. M. calcarea constitutes as much as 57% of the total benthos biomass which includes also Yoldia hyperborea, Nucula tenuis, Leda pernula (Neyman, 1960a, 1960b, 1963). Altogether, these forms make up about 70% of the total biomass, while the 30 secondary species comprise only 24%. These 4 leading species belong to the pan-arctic group; ecologically they can be considered as detritus eaters of the upper bottom layer. Thus, the population of Anadyrskiy z. has a direct contact with the benthic populations of the open sea, which also inhabit the upper sublittoral. There is no additional information available on the benthic populations of the Bering Sea flocking around Macoma calcarea.

Almost all of the basic species of benthic organisms constituting the above-mentioned group are widely distributed in the Far Eastern seas. Nevertheless, their quantitative distribution is very uneven here and mass development of such an interesting community occurs only under certain conditions, such as shallow bottom depth (less than 100m), soft muddy sediments, negative bottom water temperature /40
during the larger part of the year and favorable food conditions (large quantities of detritus in the bottom). All of these conditions evidently are present in Anadyrskiy z. and the adjacent open parts of the Bering Sea. The presence of "cold patches" is typical of a number of areas in the Bering Sea, especially on the shelf of its NW and central parts. Off the coast of Alaska, where the warming effect of the current is pronounced, the "patches" or residual winter cooling are evidently dissipated.

In order to characterize the Macoma--Ophiura--Maldane--Nucula community of Anadyrskiy z. we utilized 36 bottom grab and trawling stations occupied by the Vityaz' and 7 quantitative stations of the Krasnoarmeyets (1933).

This community is widely distributed over the NE half of Anadyrskiy z., extending as a braod tongue northward, and occupying a large area at the entrance ot the gulf and S of St. Lawrence Island. The boundaries of its habitat in the gulf itself are associated with soft muddy bottom. Here it is bounded by the Echinarachnius community which inhabits areas with sandy bottom in the W part of the gulf. The majority of populous forms of the Macoma group do not inhabit areas with sandy ground, or inhabit it sporadically. The distribution of the community in the estuary area of Anadyr is evidently affected by the freshening of water.

On the whole, the community inhabits Anadyrskiy zaliv at depths from 50 to 143m (mean value being 75m).

A large mud location occupying the main part of Anadyrskiy zaliv is characterized by a regular shift in mechanical composition of sediments from periphery to center. Coarse aleurite envelop fine aleurite mud which are replaced by clayey aleurite mud in the exit of the gulf (Lisitsyn, 1959). The final result of the complex conditions is the prevalence of infauna (mud-eaters) which thrive on the tongue of fine aleurite deposits of the gulf. Indeed, the populous forms that form this community are Macoma species, Ophiura sarsi and Maldane sarsi. The latter, as other polychaets, utilize soft muddy sediments, not only for feeding but also for building their muddy tubes. The populous bivalve mollusks which collect detritus are Macoma calcarea, Nucula tenuis, Macoma moesta, Yoldia hyperborea, etc. According to the method of food collection they can be considered as detritus "collectors" from bottom surface (Sokolova, 1958). All of them live in the soft layer of sediments. This is possible due to the presence of long siphons suited for digging and the long appendages at mouth which facilitate the collection of food. A number of secondary forms, such as Priapulus caudatus, sipunculids, ophiurs, various polychaets, etc. can also be considered as mud-preferring forms.

Low positive (or even negative) bottom water temperature here creates conditions similar to the Arctic seas, which makes possible coexistence of a number of cryophilic forms with thermophilic forms. These cold regions are, however, isolated from the Arctic region and surrounded by warmer waters of the Bering Sea. Brodskiy (1950, 1956) named these areas coarctic /41
in contrast to the arctic proper whose boundaries run here through more northern areas, i.e., within the confines of the Chukchi Sea. Correspondingly, the population of such cold water patches

is rather typical of the low arctic regime than of the temperate regime of the Bering Sea.

The overall mean biomass of the Macoma--Ophiura--Maldane--Nucula community of Anadyrskiy z. makes up 298g/m^2 (Fig. 4). Bivalve mollusks make up about 50% of the total biomass. In addition, there are many polychaets, echinoderms, sipunculids and crustaceans. Most populous is Macoma calcarea (mean biomass = 111g/m^2), its maximum biomass for Anadyrskiy z. is 923g/m^2, the number being 392ind/m^2.

Ophiura sarsi forms considerable concentrations in certain places, with biomass reaching 92g/m^2. It should be pointed out that in Anadyrskiy z. some individuals of O. sarsi do not reach as large a size as in other areas, where one can encounter extreme large individuals. Evidently, this eurybenthic form, which is widely distributed over the northern and Far Eastern seas, reaches considerable sizes and numbers only in places that are favorable for foraging and growth.

The third leading form, Maldane sarsi, is a typical infauna inhabiting soft muddy areas of sublitoral. Its vertical distribution is extensive, concentrations reaching their maximum values only in places where foraging conditions and types of bottom are favorable. This community is very representative of Anadyrskiy z. Here the biomass of M. sarsi may reach 220g/m^2, the corresponding number being 2000ind/m^2, (St. 1532, d. = 100m, bottom: green-gray, viscous aleurite mud). This species is accompanied by Praxillella praetermissa, Axiothella catenata, etc. Thus, even such a ubiquitous form thrives only under certain conditions (suited bottom, food) which is noticeable in the quantitative distribution of the animal (Levenshteyn, 1960).

Nucula tenuis is represented in Anadyrskiy zaliv by its large-sized inflata subspecies, typical of the E sector of the Arctic. This lends the Anadyrskiy region a character similar to the Chukchi Sea where this subspecies thrives and is widely distributed. N. tenuis occurs more or less uniformly in its habitat; at places the biomass reaches 300g/m^2, the number 778 ind/m^2 (Krasnoarmeyets, St. 19, d. = 75m). It has been noted that the northern populations of N. tenuis inflata have a larger size than the southern populations (Allee's Rule).

The central areas of the community are represented by Yoldia hyperborea, Macoma moesta and Onuphis parva striata. If the first two species lend the community a well-pronounced cryophilic character, the last species represents a typical N Pacific (Asian) temperate thermophilic form (Ushakov, 1955; Levensteyn, 1960). Its presence among the typical forms of this community is indicative of a noticeable influence of temperate thermophilic forms of the Bering Sea on the composition of the given community.

There are some other Bering Sea forms that occur in the E sector of the Arctic, namely, Turritella erosa, Priapulus caudatus, Scalibergma inflatum, Chaetozone setosa, Scoloplos armiger and the N Pacific Amphiodia craterodmeta. /42

Despite the fact that a number of benthic species are ubiquitous with regard to the habitat of this community, their distribution is not uniform: local concentrations occur in various parts of the gulf. Thus, there are smaller groups characterized by local leading forms.

6a. Group *Macoma calcarea*

The vast zone, lying between the coastal "sand" population of Echinarachnius and the infaunal groups adhering to muddy bottom in the E part of the gulf (Fig. 3), is occupied by the M. calcarea community. Here it dominates. Often populous species are not found in the habitat of M. calcarea, e.g., Maldane sarsi and Ophiura sarsi. In addition the quantity of Nucula tenuis is somewhat limited. A gradual change of bottom sediments, from fine aleurite in the central part of the gulf to the sand in the coastal belt, is typical of the entire zone occupied by Macoma calcarea. If the coastal region occupied by the Echinarachnius community is characterized by low yet positive water temperature during the greater part of the year, while the eastern region has extremely low positive or even negative water temperatures, then the zone occupied by the Macoma calcarea community is evidently characterized by a rather unstable regime with considerable seasonal temperature fluctuations.

Regrettably, no stations were occupied in the northernmost part of Anadyrskiy zaliv, where the Macoma community can propagate; as a result, it is impossible to draw the northern boundary for the group. Evidently, it can continue as far as St. 567 (65°N) where muddy bottom is replaced by gravel-pebble bottom. Here the leading forms of this group disappear and are replaced by Astarte, Venericerdia and other groups. Various stars begin to appear (Leptasterias polaris, L. arctica, Hexaster polaris) as well as the large Gastropoda--Neptunea beringiana, Volutopsius, etc.

The M. calcarea community is represented by samples of 4 Vityaz' bottom grab stations, 1525, 1526, 1527 and 1528 one Krasnoarmeyets station 18, and one trawling station, 1006, near the boundary of the community. Here the depth varies from 66 to 88m (mean value = 80m), while the total biomass varies from 55 to 340g/m^2 (mean v. = 170g/m^2). M. calcarea is a definite leading form, its biomass ranging from 27 to 140g/m^2 (mean v. = 42g/m^2). The community is characterized by almost complete absence of echinoderms (only single Ophiopenia disacantha and Gorgonocephalus caryi f. stimpsoni occur) and a large number of polychaets which at places make up as much as 1/3 of the total biomass.

There are many carnivores in this region, mainly Chionoecetes opilio whose young are sometimes caught by bottom grabs. In addition to Ch. opilio, one can observe Paguridae forms, such as P. pubescens, P. rathbuni and P. splendescens) and crabs /43
Hyas coarctatus alutaceus. The large shrimps are represented Pandalus goniurus, Nectocrangon lar lar, N. dentata, Sclerocrangon communis, Eualus gaimardi belcheri, E. macilienta, Spirontocaris murdochi, etc. Gastropods are represented by many large Buccinidae (Neptunea borealis, Buccinum glaciale, Sipho kroyeri, etc.). Polychaets are represented by medium large polynoids which appear to be also carnivores. The number of sea stars is small.

The belt of carnivores noted some time ago by Deryugin and Ivanov (1937) and Vinogradova (1954) is associated with M. calcarea populations, small nuculids and various polychaets which offer good food for the large carnivores. It is also possible that the type of sediments, which are denser here than in S and SE parts of the gulf, affect distribution of the community. Carnivores are characterized by great mobility, i.e., the ability to migrate from place to place, leaving the boundaries of this community.

The influence of carnivores on the quantitative distribution of benthic organisms can be considerable. Thus, in many locations of Anadyrskiy z. the samples contained numerous empty shells of M. calcarea (Vinogradova, 1954) which evidently have been consumed by various carnivores, notably Ch. opilio.

The occurrence of other groups is 75 or less, density index 5. They are represented by the following forms:

Polychaeta: Praxillella praetermissa, Axiothella catenata, Maldane sarsi, Nicomache trispinata, Terebellides stroemi, Amphicteis gunneri v. japonica, Lysippe labiata, Ampharete acutifrones, Glycinde armigera, Phyllodoce groenlandica, Eteone longa, Brada villosa, Pholoe minuta, Nephthys ciliata, N.

Table 15

Composition of the M. calcarea Group

Forms	A	B	Occurrence, %	Density index
Leading Forms				
Macoma calcarea	18	42,0	100	64
Typical Forms				
Chionoecetes opilio	1	4,2	100	20
Nucula tenuis	42	2,6	100	16
Lumbriconereis fragilis	5	2,0	100	14
Chaetozone setosa	146	1,9	100	13
Secondary Forms				
Scoloplos armiger	80	0,6	100	8
Scalibregma inflatum	20	0,3	100	6
Nephthys longosetosa	7	0,2	100	5

paradoxa, Heteromastus filiformis, Lanassa nordenskioldi, Lumbriconereis minuta, Artacama proboscidea, Sternaspis scutata, Polycirrus medusa, Polynoe pavlovskii.

Crustacea: Pagurus rathbuni, Chionoecetes opilio.

Mollusca: Serripes groenlandicus, Yoldia hyperborea, Solariella obscura, S. varicosa.

Echinodermata: Ophiopenia disacantha.

In addition, there are many benthic forms that have not been identified to species, namely: Hydroidea, Nemertini, Polychaeta, Sipunculoidea, Crustacea, Bivalvia, Gastropoda, Bryozoa.

We list the composition of M. calcarea group in the indicated area of Anadyrskiy z. (Table 15) and one of the stations located within the habitat of the group (Table 16). /44

Table 16
Composition of Fauna at a Station Typical of the
M. calcarea Group
St. 1528, d. = 86m; bottom: aleurite mud with small admixture of pebble; Peterson grab--0.25m²; 2 samples

Forms	A	B	Biomass by groups, g/m²
Chaetozone setosa	480	6,0	
Terebellides stroemi	40	9,5	
Artacama proboscidea	6	14,1	
Nephthys paradoxa	2	9,5	
N. ciliata	6	0,9	
N. longosetosa	4	0,1	
Lumbriconereis	4	5,8	
Praxillella praetermissa	4	0,7	
Sternaspis scutata	8	1,1	
Polycirrus medusa	2	1,2	
Phyllodoce groenlandica	2	0,1	
Eteone longa	4	0,1	
Scoloplos armiger	16	0,2	
Scalibregma inflatum	8	0,1	
Polynoe pavlovskii	6	0,1	
Pholoe minuta	6	0,1	
Ampharete acutifrons	2	0,1	
Polychaeta varia	—	2,6	Polychaeta 52,3
Ophiopenia disacantha	4	0,6	Echinodermata 0,6
Macoma calcarea	16	139,5	
Nucula tenuis	34	8,0	
Yoldia hyperborea	12	10,0 (Yoldia, Thyasira, Periploma)	
Thyasira	8		
Periploma	2		
Sipho juv.	6	0,6	
Margarites	6	1,6	Mollusca 159,7
Melita	14	1,1	
Lysianassidae	24	0,3	
Pagurus	2	16,8	
Chionoecetes opilio	2	2,2	Crustacea 20,4
	Total biomass 233,0 g/m²		
	Edible biomass 233,0 g/m²		

6b. Group *Macoma calcarea--Ophiura sarsi--Yoldia hyerpborea*

This northern group inhabits the NE part of Anadyrskiy z. (Fig. 3). The bottom depth varies from 55 to 80m (mean v. = 70m). The bottom is covered with soft greenish-gray coarse mud which replace sand of the shallow coastal areas. The quantity of Corg is rather small, ranging from 0.5 to 1%. The bottom water /45 temperature is evidently always negative (Ratmanov, 1937).

The composition of this group is characterized by 4 bottom grab samples of the Vityaz' Expedition, 568, 571, 572, 573), and one St. of the Krasnoarmeyets Expedition (19). The total biomass of benthic fauna fluctuates from 71 to 395, the mean value being 217g/m^2.

The mean biomass of M. calcarea is 83 Ophiura sarsi 28, Y. hyperborea 25g/m^2 if the occurrence is 100% (Table 17). The large numbers of cryophilic Y. hyperborea which inhabits mud bottoms attest that the water temperature in this area is constantly low. Evidently, the nearness of the icy zal. Kresta is reponsible for the low temperature. It is possible that the decrease of Maldane sarsi population to 50% is associated with the low water temperature.

Table 17

Composition of Macoma calcarea--Ophiura sarsi--Yoldia hyperborea Group

Forms	A	B	Occurrence, %	Density index
Leading Forms				
Macoma calcarea	47	83	100	91
Ophiura sarsi	13	28,2	100	53
Yoldia hyperborea	12	24,7	100	49
Typical Forms				
Scalibregma inflatum	53	11,9	100	34
Secondary Forms				
Nucula tenuis inflata	14	7,2	100	27
Artacama proboscidea	4	7,9	75	24
Lumbriconereis fragilis	9	5,6	75	20
Macoma moesta	5	4,2	100	20
Terebellides stroemi	11	2,6	75	14
Nephthys caeca	2	2,9	50	12
Chaetozone setosa	62	1,1	100	10

Density index of other forms is less than 10. They consist of the following:

Polychaeta: Ampharete reducta, A. acutifrons, Lanassa venusta, Nephthys ciliata, Heteromastus filiformis, Arcteobea anticostiensis, Nemidia torelli, Antinoella sarsi, Brada villosa, Gattyana cirrosa, Pholoe minuta, Maldane sarsi, Glycinde armigera, Onuphis parva-striata, Pectinaria hyperborea, Praxillella praetermissa, Axiothella catenata, Sternaspis scutata, Scoloplos armiger.

Crustacea: Eualus macilienta, Hyas coarctatus.

Mollusca: Serripes groenlandicus, Buccinum tenue; Turritella erosa.

Echinodermata: Amphiodia craterodmeta.

In addition there are a number of forms that have not been identified to species: Hydroidea, Actiniaria, Nemertini, Polychaeta, Amphipoda, Gastropoda.

The great quantity of various polychaets is very typical of the group. The occurrence reaches 100% in Scalibregma inflatum and Scoloplos armiger, common are Lumbriconereis fragilis, Chaetozone setosa, etc.

All of these species are common and widely distributed in the sublitoral of northern and Far Eastern seas. Here we have Priapulus caudatus (70% occurrence), various Amphipoda and large but somewhat rare Maldane sarsi and Oxiothella catenata. The endemic Pacific forms, such as Onuphis parva-striata seldom occur here, which indicates that the effect of the open part of the Bering Sea is insignificant here. Some cryophilic forms, such as Macoma moesta are typical here. /46

The mean benthos biomass of this group is considerable, 217g/m^2. The main portion of the biomass is made up of bivalve mollusks (147g/m^2) and various polychaets (44g/m^2). The number of other forms is limited, only several percentages of the total biomass. /47 The quantity of amphipods is very great, as much as 370ind/m^2; the quantity of echinoderms, represented by Ophiura sarsi, is small. At places they are absent. Evidently the brackish water, ice and possible influx of Anadyr' water affect the faunal situation. Synidothea bicuspida is the sole representative of isopods. Amphipods are represented by Anonyx nugax, Stegocephalus inflatus, Ampelisca eschrichti, Byblis gaimardi, Pontoporeia femorata, Acanthonotozoma inflatum, Arrhis lutkei, Melita formosa etc. Decapods (trawl samples) by Pagurus pubescens, P. splendescens

Table 18

Composition of Fauna at a Station Typical of the Macoma calcarea--Ophiura sarsi--Yoldia hyperborea Group St. 571; d. = 67m; bottom: soft gray mud with Admixture of Pebbles. Peterson Grab--0.4m²; 2 samples

Forms	A	B	Biomass by groups, g/m²
Macoma calcarea	23	103,1	
» *moesta*	5	6,4	
Yoldia hyperborea	5	12,4	
Serripes groenlandicus	1	8,4	
Nucula tenuis inflata	7	1,4	
Gastropoda	1	0,1	Mollusca 131,8
Ophiura sarsi	28	69,5	Echinodermata 69,5
Lumbriconereis fragilis	24	14,2	
Onuphis parva-striata	2	0,8	
Nephthys caeca	1	11,2	
» *ciliata*	5	1,4	
Artacama proboscidea	6	10,0	
Scalibregma inflatum	60	8,7	
Terebellides stroemi	16	8,0	
Pectinaria hyperborea	1	2,2	
Maldane sarsi	24	3,1	
Praxillella praetermissa	1	0,2	
Notomastus	37	0,6	
Scoloplos armiger	21	0,7	
Chaetozone setosa	7	0,2	
Syllis variegata	4	0,1	
Polynoe	1	0,1	
Nemidia torelli	1	0,1	
Antinoella sarsi	1	0,1	
Arcteobea anticostiensis	2	0,1	
Gattyana cirrosa	1	0,1	Polychaeta 61,9
Actiniaria	1	3,0	Coelenterata 3,0
Nemertini	2	0,5	Nemertini 0,5
Priapulus caudatus	4	0,1	Priapuloidea 0,1
Cumacea	1	0,1	
Amphipoda	200	3,2	
Eualus macilienta	1	0,3	
Hyas coarctatus	2	0,1	Crustacea 3,7

Total biomass — 270,5 г/м²
Edible biomass — 270,5 г/м²

and P. rathbuni; shrimps by Pandalus goniurus, Nectocrangon dentata and Eualus macilienta; their large forms by Chionoecetes opilio and Hyas coarctatus alutaceus. These crab species and Paguridae represent strong and active carnivores together with large sea stars, urchins and Gastropods (Buccinidae). They feed on smaller ones and infauna. The most active crabs in the Bering Sea are Chionoecetes opilio and Ch. angulatus. We tabulated results of one station (571) representing the Macoma--Ophiura--Yoldia group inhabiting the NE part of the gulf (Table 18). About half of the biomass at this station is made up of bivalve mollusks, the other half consists of Ophiura sarsi and Polychaeta. The remainder consists of Collenterata, Priapulida, Crustacea, etc. As in the case of the whole group, the amphipod population inhabiting the area of this station is quite numerous. The edible benthos makes up 100% (which is also typical of the entire group) owing to large quantities of polychaets, small crustaceans and mollusks with relatively thin shells suited for benthos-eating fishes.

6c. Group *Macoma calcarea--Ophiura sarsi--Golfingia margaritaceum--Nucula tenuis--Maldane sarsi*

This central Anadyr benthos inhabits the coldest part of the gulf where the temperature of bottom water is below 1.7° throughout the year; at times even as low as 1.2°. The habitat lies south of the above-mentioned Macoma--Ophiura--Yoldia group and is quite large. The coarse aleurite, which is typical of the northern regions occupied by this community, is replaced here by aleurite mud. Only on the periphery of Macoma calcarea--Ophiura sarsi--Golfingia--Nucula tenuis--Maldane sarsi can one observe coarse aleurite mud. The bottom depth varies from 77 to 82m (mean v. = 80m).

Six stations characterize this benthic group: 4 Vityaz' stations (556a, 556b, 557 and 1151) and 2 Krasnoarmeyets stations (74 and 75).

The group in which M. calcarea is very populous (greatest biomass 923g/m^2, maximum number 392ind/m^2, mean biomass 299g/m^2) is composed of forms typical of infauna found on soft muddy bottom. In /48
addition to the four species, common for the entire community (M. calcarea, Ophiura sarsi (with maximum biomass at St. 556b equalling 92g/m^2, maximum number being 152ind/m^2, mean biomass 56g/m^2 etc.), Golfingia margaritaceum occurs where mud particles prevail in sediments. The greatest biomass of this species is 124g/m^2, the greatest number 8ind/m^2 mean biomass 35g/m^2. This form is almost always accompanied with Priapulus candatus (max.

biomass 1.3g/m^2, max. number 15ind/m^2). In comparison with the northern group, Maldane sarsi increases in this group; its mean biomass equalling 23g/m^2 (against 1.5g/m^2 in the northern group). Similarly, the number of Onuphis parva-striata increases (mean biomass 8.4g/m^2, mean number 45ind/m^2), that of Eteone bistriata and Amphiodia craterodmeta. The presence of these species is indicative of the intensification of the influx of water from the open sea which is liked by them. Very typical of this group are such cryophilic forms as Pectinaria hyperborea, Liocyma fluctuosa, Macoma moesta, Periploma fragilis, Socarnes bidenticulatus, Onisimus crassini, Neopleustes pulchellus, Turritella erosa, etc.

Table 19

Composition Of Macoma calcarea--Ophiura sarsi--Golfingia margaritaceum--Nucula tenuis--Maldane sarsi Group

Forms	A	B	Occurrence, %	Density index
Leading Forms				
Macoma calcarea	131	299,8	100	173
Ophiura sarsi	102	55,7	100	74
Golfingia margaritaceum	5	35,3	100	50
Nucula tenuis expansa	46	28,8	100	53
Maldane sarsi	40	22,7	100	47
Typical Forms				
Macoma moesta	12	13,0	100	36
Lumbriconereis fragilis	41	9,1	100	30
Axiothella catenata	4	8,8	100	29
Onuphis parva-striata	45	8,4	100	28
Turritella erosa	7	8,8	50	21
Secondary Forms				
Periploma fragilis	2	2,7	75	14
Chaetozone setosa	85	1,3	100	11

The density index of other forms is less than 11. They consist of the following species:

Polychaeta: Ampharete acutifrons, Heteromastus filiformis, Nemidia torelli, Antinoella sarsi, Pholoe minuta, Scoloplos armiger, Glycinde armigera, Scalibregma inflatum, S. robusta, Terebellides stroemi, Pectinaria hyperborea, Praxillella praetermissa, P. gracilis, Eteone bistriata, E. longa, Artacama proboscidea, Flabelligera mastigophora, Syllis oerstedi, Lumbriconereis latreilli japonica, L. minuta, Lysippe labiata, L. loveni, Owenia fusiformis, Gattyana amondseni, Polynoe canadensis.

Priapulida: Priapulus caudatus.

Grustacea: Ampelisca furcigera, A. eschrichtii, Onisimus turgidus.

Mollusca: Yoldia hyperborea; Nucula tenuis inflata, Macoma torelli, M. loveni, Liocyma fluctuosa, Thyasira gouldi, Natica nana, Solariella varicosa, Cylichna alda corticata.

Echinodermata: Amphiodia craterodmeta.

In addition there are forms which have not been identified to the species: Cumacea, Amphipoda, Nemertini, Mollusca.

Interesting is the presence of large Oxiothella catenata and numerous small Scoloplos armiger and Chaetozone setosa (as much as 217ind/m^2), as well as Artacama probscidea. This group is characterized by the presence of various mud eaters, namely polychaets. /49

Trawl samples obtained at St. 556 also contained several Gorgonocephalus caryi and Leptasterias groenlandicus including various Hexasterias. Being carnivores, the latter feed on small bivalve mollusks and polychaets. In addition, the following large benthic animals were found: Buccinidae--Plicifusus kroyeri, Buccinum angulosum, a number of Sipho, Beringius, Natica clausa, Margarites striata, M. rossica and Solariella obscura. Also large Decapoda, especially Poguridae, Hyas coarctatus and Chionoecetes opilio were numerous in this habitat.

The total biomass of the Macoma calcarea--Ophiura sarsi--Golfingia--Nucula tenuis group varies from 205 to 1074g/m^2 (mean v. = 473g/m^2). Large biomass was observed at St. 557, (d. = 86m, bottom: greenish aleurite mud), consisting of bivalve mollusks, mainly Macoma calcarea (923g/m^2, number 392ind/m2) and Ophiura sarsi (69.5 and 156g/m^2). Absent were Maldane sarsi, but the numbers of Axiothella catenata (11g/m^2), Scalibregma inflatum (9g/m^2) and Chaetozone setosa (217ind/m^2 and biomass 6.7g/m^2) were considered. Also some Pacific arctic-boreal forms were observed, namely Onuphis parvastriata, Lumbriconereis latreilli japonica and Lumbriconereis impatiens, which is indicative of the effect of open sea water.

The large quantities of polychaets and small bivalve mollusks offer food for benthos eaters. The species composition of the

Macoma--Ophiura sarsi--Golfingia--Nucula tenuis group is listed in Tables 19 and 20.

6d. Group *Ophiura sarsi--Macoma calcarea--Nucula tenuis--Onuphis parva-striata*

The preceding Macoma--Ophiura--Golfingia--Nucula--Maldane group occupies a large area in the middle of Anadyrskiy z. As we move from its center to periphery, the benthos changes, gradually loosing the leading forms. They are replaced by other forms less typical of the central nucleus. A new group is formed, namely, the Ophiura sarsi--Macoma calcarea--Nucula tenuis--Onuphis parva-striata. This is clearly noticeable by the number of Maldane sarsi, the mean biomass of which decreases to $2.5g/m^2$ or by Yoldia hyperborea (mean biomass only $1.2g/m^2$). The open water forms, on the contrary increase, e.g., Onuphis parva-striata. Macoma moesta, M. torelli and Periploma fragilis are numerous. On the E periphery of this habitat one can observe the cryophilic east-Anadyrskiy coastal fauna represented by Astarte borealis placenta.

The periphery of this habitat forms a broad transitional zone. /51
Ophiura sarsi remains here as the only leading form (mean biomass $36g/m^2$, mean number $103ind/m^2$). The biomass of Macoma calcarea, Nucula tenuis and Maldane sarsi decreases rapidly, but Golfingia margaritaceum disappears. It is partly substituted by Priapulus caudatus. But since its number is smaller than that of G. margaritaceum, it is considered as a secondary form (mean biomass $3.7g/m2$, $7ind/m^2$).

The leading form of this transitional group is Ophura sarsi, other significant forms are Macoma calcarea, Nucula tenuis inflata and Onuphis parva-striata (Table 21).

This group is represented by 5 bottom grab stations occupied by the Vityaz' (548, 549, 1501, 1510, 1512 and one trawl St. 992). The depth ranges from 69 to 83m (mean v. = 74m), the bottom was covered by greenish-gray aleurite mud. The temperature of bottom water is about 1° during the year with minor fluctuations. The /53
population includes many cryophilic arctic forms, which were mentioned before. St. 1501, lying in the E part of the habitat near St. Lawrence Island is typical of this population (Table 22). The total biomass varies from 78.5 to $1613.2g/m^2$, the mean value being $503g/m^2$.

Table 20

Composition of Fauna at a Station Typical of the Macoma--Ophiura--Golfingia--Nucula--Maldane St. 556a, d. = 77m; bottom: gray viscous aleurite-clayey mud. Peterson grab--0.4m^2, 1 sample

Forms	A	B	Biomass by groups, g/m^2
Macoma calcarea	85	152,4	
» *moesta*	13	29,4	
» *torelli*	2	1,3	
Nucula tenuis inflata	140	60,2	
Periploma fragilis	5	8,2	
Liocyma fluctuosa	2	8,9	
Thyasira gouldi	5	0,1	
Cylichna alba corticata	2	0,1	
Turritella erosa	17	4,7	
Gastropoda	5	0,1	Mollusca—265,4
Ophiura sarsi	108	61,8	Echinodermata—61,8
Axiothella catenata	7	14,8	
Maldane sarsi	120	67,2	
Lumbriconereis minuta	147	2,6	
» *fragilis*	5	7,8	
Praxillella gracilis	3	3,5	
Polynoe	3	0,6	
Gattyana cirrosa	2	0,1	
Onuphis parva-striata	45	6,0	
Ampharete acutifrons	2	2,3	
Eteone	2	0,1	
Eteone bistriata	3	0,1	
Trichobranchiidae	2	0,3	
Artacama proboscidea	8	0,7	
Terebellides stroemi	2	0,8	
Scalibregma inflatum	20	0,6	
Glycinde armigera	5	0,3	
Chaetozone setosa	82	1,9	
Scoloplos armiger	5	0,1	
Flabelligera mastigophora	2	6,4	
Syllis oerstedi	10	0,4	
Polychaeta varia	—	2,4	Polychaeta—119,0
Golfingia margaritaceum	5	16,9	
Priapulus caudatus	15	1,3	Priapulida и Sipunculoidea—18,2
Ampelisca furcigera	170	10,2	
» *eschrichti*	7	2,6	
Onisimus turgidus	70	3,1	
Amphipoda	113	0,5	
Cumacea	20	0,6	Crustacea—17,0
Nemertini	7	1,1	Nemertini—1,1

Total biomass — 482,6 г/$м^2$

Table 21

Composition of Ophiura sarsi--Macoma calcarea--
Nucula tenuis--Onuphis parva-striata Group

Forms	A	B	Occurrence, %	Density index
Leading Forms				
Ophiura sarsi	103	36,0	83	54
Typical Forms				
Macoma calcarea	11	10,9	66	27
Nucula tenuis inflata	16	8,7	66	24
Macoma moesta	6	6,8	66	21
Onuphis parva-striata	21	6,5	66	20
Secondary forms				
Lumbriconereis fragilis	9	3,8	83	18
Priapulus caudatus	7	3,7	83	17
Scoloplos armiger	123	2,3	100	15
Maldane sarsi	13	2,5	50	15
Yoldia hyperborea	3	1,2	66	8

The density index of other species is less than 8. They form the following groups:

Polychaeta: Ampharete acutifrons, Heteromastus filiformis, H. giganteus, Arcteobea anticostiensis, Nemidia torelli, Gattyana cirrosa, Nephthys ciliata, N. caeca, Brada villosa, Glycinde armigera, Scalibregma inflatum, Terebellides stroemi, Pectinaria hyperborea, Praxillella praetermissa, Axiothella catenata, Eteone bistriata, E. flava, Flabelligera mastigophora, Syllis oerstedi, Lumbriconereis latreilli japonica, L. minuta, Lysippe labiata, L. loveni, Owenia fusiformis, Phyllodoce groenlandica, Polycirrus medusa, Notomastus latericeus, Amphitrite cirrata, Proclea emmi, Travisia forbesii.

Crustacea: Ampelisca macrocephala.

Mollusca: Macoma torelli, Periploma fragilis, Liocyma fluctuosa, Nucula tenuis expansa, Axinopsis orbiculata, Thyasira flexuosa, Turritella erosa, Cylichna alba corticata, Natica nana.

Echinodermata: Amphiodia craterodmeta.

In addition there are forms which have not been identified to the species: Hydroidea, Actiniaria, Nemertini, Polychaeta, Amphipoda, Cumacea, Mollusca, Ascidia.

Table 22

Composition of Fauna at a Station Typical of the Ophiura--Macoma--Nucula--Onuphis Group St. 1501, 12 June 1952; d. = 72m; bottom: fine aleurite mud. Peterson grab--0.25m^2; 2 samples

Forms	A	B	Biomass by groups, g/m^2
Macoma calcarea	22	46,7	
Macoma moesta	16	15,5	
Macoma torelli	2	2,4	
Yoldia hyperborea	2	0,4	
Thyasira flexuosa	2	0,1	
Nucula tenuis (inflata, expansa)	26	15,6	
Lora	2	2,6	Mollusca 83,3
Ophiura sarsi	212	79,1	
Holothurioidea	6	5,7	Echinodermata 84,8
Scoloplos armiger	400	8,8	
Notomastus latericeus	2	12,8	
Heteromastus	10	0,2	
Onuphis parva-striata	12	9,0	
Lumbriconereis minuta	20	0,3	
» *fragilis*	2	3,6	
Praxillella praetermissa	10	1,4	
Maldane sarsi	6	0,4	
Axiothella catenata	2	0,3	
Chaetozone setosa	24	0,4	
Glycinde armigera	16	0,3	
Scalibregma inflatum	2	0,4	
Sternaspis scutata	400	8,8	
Syllis oerstedi	4	0,2	
Eteone bistriata	4	0,1	
» *flava*	2	0,1	
Lysippe labiata	2	0,1	
Nemidia torelli	2	0,2	
Polychaeta varia		5,6	Polychaeta 53,0
Hydroidea	2	0,2	
Actiniaria	2	0,2	Coelenterata 0,4
Priapulus caudatus	6	8,5	Priapulida 8,5
Cumacea	2	0,1	
Amphipoda	36	3,5	Crustacea 3,6
Nemertini	2	0,1	Nemertini 0,1

Total biomass- 233,7 г/м²;
Edible biomass-233,7 г/м²

Judging by the trawl sample (St. 992), the group consists of large quantities of Amphipoda (Anonyx nugax, Byblis gaimardi, Ampeliscidae), Decopoda (large Nectocrangon lar lar, Sclerocrangon communis, Eualus macilienta, E. gaimardi belcheri and young Chionoecetes opilio; Gastropoda (single Buccinidae, Trochidae and considerable numbers of Turritella erosa.

Samples taken at some of the stations contain interesting species of the given group. Thus, St. 1510 (d. = 82m; bottom: viscous aleurite mud) in the E part of the habitat was devoid of Macoma calcarea and M. moesta, Maldane sarsi (12.9g/m^2), N. tenuis (12.5g/m^2), and Ophiura sarsi (59g/m^2). Onuphis parva-striata thrived (100ind/m^2, biomass 25.0g/m^2) making up almost half of the biomass of polychaets and exceeding twice the biomass of Maldane sarsi (12.9g/m^2).

At places Amphipoda thrived, e.g., at St. 1512 (in the central part) where 800ind/m^2 and 45.2g/m^2 were obtained.

6e. Group *Maldane sarsi--Ophiura sarsi--Macoma calcarea--Nucula tenuis*

This group inhabits the southernmost part of the region almost in the entrance to Anadyrskiy zaliv. This is a vast habitat in the central and eastern parts of the Macoma territory, reaching the latitude of m. Navarin and extending to the east. Here the temperature of bottom water is low, often negative, subjected to the influence of the open water of the Bering Sea. This group is represented by 7 Vityaz' stations (546, 547, 1513, 1514, 1530, 1531, 1532) and 3 Krasnoarmeyets St. (7, 8, 11). Depth varies from 49 to 100m (mean v. = 77m). The bottom is very soft, softer than in areas occupied by the two preceding groups. Fine aleurite and viscous clayey-aleurite muds prevail. Only at one station near St. Lawrence Island can one observe admixture of muddy sand (St. 8, Krasnoarmeyets).

In accordance with a change in the force of the local current, and the type of bottom, the composition of this group changes. The quantity and biomass of bivalve mollusks decrease, and Maldane sarsi becomes the leading form, which evidently prefers the soft clayey bottom. Its biomass in this area exceeds that of Macoma calcarea. The mean biomass of the latter decreases in comparison with northern for s more than 3 times (121 and 30g/m^2). The mean biomass of Ophiura sarsi being 69g/m^2 in the central part, decreases in this area by almost twice, as in the case of Nucula tenuis. In accordance with these changes, first of all, with a decrease of the quantity of mollusks, the overall biomass of the entire group decreases.

Table 23a

Relationship Among the Benthic Animals in the Maldane sarsi--Ophiura sarsi--Macoma calcarea--Nucula tenuis

Groups	Mean number, ind/m²	Mean biomass, g/m²	Occurrence, %	% of total biomass
Coelenterata	1	11,67	15	4,0
Nemertini	8	1,68	79	0,6
Polychaeta	400	53,87	100	18,0
Echiuroidea	1	1,1	5	0,5
Sipunculoidea	11	14,88	83	4,9
Crustacea	261	12,13	89	4,0
Mollusca	134	151,06	100	50,8
Echinodermata	99	50,6	88	16,9
Tunicata	1	0,9	5	0,3
Totals		297,80		100,0

Table 23b

Composition of the Maldane sarsi--Ophiura sarsi--Macoma calcarea--Nucula tenuis Group

Forms	A	B	Occurrence, %	Density index
Leading Form				
Maldane sarsi	111	49,0	100	70
Ophiura sarsi	90	40,1	100	63
Macoma calcarea	17	30,1	100	54
Nucula tenuis	46	18,7	86	40
Typical Form				
Yoldia hyperborea	7	7,0	100	26
Onuphis parva-striata	28	6,1	100	24
Turritella erosa	8	5,2	100	23
Macoma moesta	8	5,4	58	17
Secondary Form				
Lumbriconereis fragilis	55	0,5	100	7
Amphiodia craterodmeta	16	0,7	58	6
Chaetozone setosa	32	0,5	44	4
Eteone bistriata	3	0,1	100	3

The density index of other groups is less than 3. They are arranged as follows:

Polychaeta: Praxillella praetermissa, Axiothella catenata, Scoloplos armiger, Scalibregma inflatum, Brada vilesa, Heteromastus filiformis, Artacama proboscidea, Glycinde latreilli japonica, L. minuta, Eteone longa, Pholoe minuta, Phyllodoce groenlandica, Nephthys ciliata, Gattyana amondseni, Neoamphitrite groenlandica, Polycirrus medusa, Ampharete acutifrons.

Sipunculida and Priapulida: Phascolion stroembi, Priapulus caudatus.

Crustacea: Ampelisca macrocephala, Anonyx nugax, Byblis gaimardi, Pagurus splendescens.

Mollusca: Macoma torelli, M. loveni, Nucula tenuis inflata, Cylichna alba corticata, Natica nana, Solariella obscura, Margarites helicina.

Echinodermata: Ophiopenia vicina, Amphiodia cyclaspis, Leptasterias polaris.

Some of the forms have not been identified to the species: Hydroidea, Actiniaria, Polychaeta, Sipunculoidea, Amphipoda, Gastropoda, Holothurioidea, Asteroidea.

It makes up here 298g/m^2, against 473 and 503g/m^2 of the above- /55
mentioned northern groups. The species of echinoderms increase. In addition to O. sarsi, whose occurrence is 100% and mean biomass 40g/m^2, we observed Amphiodia craterodmeta, Ophiopenia vicina /56
and Amphiodia cyclaspis holorturians (including Myriotrochus) and, in trawl samples, Gorgonecephalus caryi, Leptasterias polaris, Henricia, etc. Such a composition of echinoderms is typical of shallow and open portions of the Bering Sea. The composition of leading and typical forms of the given group is presented in Tables 23a and 23b.

The total biomass of this benthic group fluctuates from 18 to 763g/m^2, the mean biomass being 267g/m^2. One of the typical bottom grab stations for this group is listed in Table 24. The typical north-boreal and amphi-boreal Pacific forms of this group (represented singly in trawls) are Serripes laperousi, Yoldia thraciaeformis, Amphiodia cyclaspis, Ophiopenia vicina and Phyllochaetopterus claparedii. More clearly pronounced cryophilic forms are Pectinaria hyperborea, Macoma loveni, M. moesta, Priapulus caudatus. The quantity of Maldane sarsi is at places

Table 24

Composition of Fauna at a Station Typical of Maldane sarsi--Ophiura sarsi--Macoma calcarea--Nucula tenuis
St. 1513; 13 June 1952; d. = 83m; bottom: fine aleurite mud. Peterson grab--0.25m^2; 2 samples

Forms	A	B	Biomass by groups, g/m^2
Nucula tenuis inflata	96	46,5	
Yoldia hyperborea	18	4,4	
Macoma calcarea	6	49,4	
" *moesta*	18	9,4	
" *torelli*	2	0,2	
Periploma fragilis	4	7,3	
Turritella erosa	6	0,7	
Cylichna alba corticata	4	0,01	
Retusa	4	0,1	
Gastropoda varia	8	0,8	Mollusca 118,7
Onuphis parva-striata	32	8,4	
Lumbriconereis minuta	80	0,9	
Maldane sarsi	20	1,9	
Praxillella praetermissa	8	0,6	
Axiothella catenata	2	0,9	
Chaetozone setosa	2	0,6	
Scalibregma inflatum	70	3,5	
Brada villosa	12	0,6	
Heteromastus filiformis	14	0,2	
Artacama proboscidea	6	0,1	
Glycinde armigera	4	0,2	
Terebellides stroemi	2	0,6	
Eteone bistriata	2	0,1	
Pectinaria hyperborea	2	0,9	
Praxillura emmi	2	0,1	
Polychaeta varia	—	8,7	Polychaeta 28,3
Ophiura sarsi	72	49,5	
Amphiodia craterodmeta	10	1,7	
Holothurioidea	50	23,8	Echinodermata 75,0
Cumacea	118	0,2	
Amphipoda	560	9,7	Crustacea 9,9
Priapulus caudatus	6	1,1	
Sipunculoidea	4	23,8	Sipunculoidea 24,9
Nemertini	12	0,4	Nemertini 0,4

Total biomass—257,2 g/m^2.
Edible biomass—257,2 g/m^2

very great, reaching 2000ind/m^2 and 220g/m^2 (St. 1532, d. = 100m, on aleurite greenish gray and viscous mud). The total biomass of polychaets at this station exceeded greatly the biomass of other groups, including mollusks. Large-sized Venericardia increased considerably in biomass, (18.5g/m^2) at one of the marginal stations (1514). The biomass and number of Amphipoda decrease sharply in comparison with northern areas of this community.

This is the general status of the Macoma calcarea--Ophiura sarsi--Maldane sarsi--Nucula tenuis group inhabiting Anadyrskiy zaliv.

All of these groups gradually replace one another depending upon changes in living conditions, first of all in the type of bottom, salinity, available food for infauna, temperature of bottom water and the speed of bottom currents. Some of the leading forms may occur outside the boundaries of this group, but their quantity is considerably reduced. At places they occur together with forms of a different ecological character. Sometimes some of the forms, such as Maldane sarsi and Ophiura sarsi fall out outside the regular habitat, while Macoma calcarea and Nucula tenuis become rare.

Judging from the available data (Neyman, 1960a, b, 1962) the Macoma calcarea--Ophiura sarsi--Maldane sarsi--Nucula tenuis community, which is widely distributed in Anadyrskiy zaliv, spreads over the eastern shelf of the Bering Sea where the bottom is covered with muddy clay sediments and the temperature of bottom water is sufficiently low (though only for part of the year).

6f. Group *Macoma calcarea--Nicomache lumbricalis*

This group (Fig. 3) occupies a vast zone in the open part of the gulf, thus being a transitory group between the gulf and open sea species of the group Ophiura sarsi--Yoldia thraciaeformis--Ctenodiscus crispatus (see the Macoma--Nicomache group below, where salinity and temperature conditions are different from those in Anadyrskiy zaliv. The temperature of bottom water is /57 low here, yet constantly positive (about 1.5-2.0°), salinity about 33°/oo.

This group is represented by 9 Vityaz' stations, 558, 584, 1515, 1516, 1520, 1521, 1529, 1537, 1538 and 1542. The depth range 84-143m (106m mean d.). Bottom: coarse aleurite mud. The total biomass of this fauna ranges from 15.6 to 103.7g/m^2, the mean total biomass being 57g/m^2.

The large quantity of various polychaets, whose frequency percentage is high but biomass value low lend a peculiar character to this typical infauna. The presence of such species as Nicomache lumbricalis, Nucula tenuis, Leda pernula and 5-6 other species of polychaets indicate that this group is closely associated with soft muddy bottom that is widely distributed in this area.

Table 25

Composition of Macoma calcarea--Nicomache lumbricalis Group

Forms	A	B	Occurrence, %	Density index
Leading Forms				
Macoma calcarea	11	9.0	90	29
Nicomache lumbricalis	8	6.1	100	25
Typical Forms				
Nucula tenuis	15	0.9	100	9
Terebellides stroemi	7	0.6	90	7
Leda pernula	5	0.6	80	6
Secondary Forms				
Scalibregma inflatum	6	0.3	80	5
Polynoe tarasovi	4	0.4	80	5
Chaetozone setosa	28	0.3	70	4
Amphiodia craterodmeta	7	0.5	50	4

The density index of other species does not exceed 4. They form the following groups:

Polychaeta: Terebellides stroemi, Axiothella catenata, Glycinde armigera, Maldane sarsi, Lumbriconereis fragilis, L. minuta, L. impatiens, Nephthys paradoxa, N. ciliata, N. longosetosa, Harmothoe imbricata, H. rarispina, Arcteobea spinelytris, A. anticostiensis, Gattyana amondseni, G. cirrosa, Scalibregma robusta, Pectinaria moorei, P. hyperborea, Travisia forbesii, Lanassa venusta, Pista cristata, P. zachsi, Rhodine glacilior, Phyllodoce groenlandica, Eteone flava, E. longa, Scoloplos armiger, Pholoe minuta, Nicomache minor, Praxillella praetermissa, P. gracilis, Syllis fasciata, Lysilla loveni, Ammotrypane aulogaster, Heteromastus filiformis, Polycirrus medusa, Amphicteis gunneri, Drilonereis filum, Chone infundibuliformis, Owenia fusiformis, Onuphis parva-striata, Lysippe labiata, Polynoe pavlovskii, Ophelia limacina.

Sipunculida and Priapulida: Golfingia margaritaceum, G. hudsoniana, Phascolion strombi, Priapulus caudatus.

Crustacea: Pagurus rathbuni, P. pubescens, Chionoecetes opilio.

Mollusca: Axinopsis orbiculata, Propeamussium alaskensis, Yoldia hyperborea, Y. myalis, Y. scissurata, Leda pernula, Macoma loveni, M. moesta, M. middendorfii, Thyasira flexuosa, Rictozyma zenkevitshi, Chlamys beringianus, Plycifusus kroyeri, Lophyrus albus, Cylichna alba corticata.

Echinodermata: Amphiura sundevalli, Gorgonocephalus caryi f. stimpsoni, Ophiopenia vicina.

In addition, not all of the forms have been identified to the species: Hydroidea, Actiniaria, Eunephthya, Nemertini, Polychaeta, Bryozoa, Amphipoda, Pantopoda, Gastropoda.

The effect of open water is evident by the presence of Polynoe tarasovi, Pectinaria moorei, Travisia forbesii, Golfingia hudsoniana, Rictozyma zenkevitchi, Propeamussium alaskensis, Ophiopenia vicina, etc. /58

The species composition of Macoma--Nicomache group is presented in Table 25. Judging from trawling samples (St. 558, 584, etc.), various mollusks are consumed, mainly Macoma, in a number of locations inhabited by this group. It is also possible that polychaets are consumed by carnivores, mainly by the large crabs Chionoecetes opilio, Paguridae and Gastropoda (Buccinidae). Thus, a great number of remains of mature and young Macoma calcarea were sampled at St. 558. Interestingly, the quantity of polychaets and bivalve mollusks was small at this station.

The Macoma--Nicomache group occupies an intermediate position between the open sea, and the gulf and is is inhabited by a large community of Macoma calcarea--Ophiura sarsi--Maldane sarsi--Nucula tenuis, changing and enriching gradually with the open sea forms, this huge community extends eastward from Anadyrskiy z., following the distribution of soft sediments and low temperatures of bottom water. As to its extent, this group is next to the coastal Echinarachnius parma.

6g. Group *Macoma calcarea--Amphiodia craterodmeta*

This group is typical of the lower sublitoral of the open part of Olyutorskiy zaliv (Fig. 5).

The characteristic morphometry of the gulf, which is represented by complex bottom relief, very steep slopes, deep submarine canyons and the presence of Anadyrskoye Current flowing in N-S direction along the coast, affects the distribution of bottom sediments. The lower boundary of the sand bottom is here observed deeper, and, correspondingly the soft muddy sediments are observed deeper. Therefore, this group of infauna is found deeper, at a depth of 174m, i.e., almost 100m deeper than in Anadyrskiy z. M. calcarea somewhat changes its usual external form, the shells become more rounded, the rear fold is less pronounced, sinus is lower and slightly oval.

As seen in Table 26, Amphiodia craterodmeta, a small endemic North Pacific form, inhabiting the Pacific west coast and locked marginal seas is quite numerous in the given community (D'yakonov, 1958). It seems to replace Ophiura sarsi which is a populous species in Anadyrskiy zaliv.

Judging by the composition of leading and typical forms, the Macoma-Amphiodia group is related to the Macoma calcarea--Ophiura sarsi--Maldane sarsi--Nucula tenuis group of the Anadyrskiy zaliv, but it has certain differencies, inasmuch as M. calcarea occurs here at an unusual depth.

The Macoma-Amphiodia group occurs in Olyutorskiy zaliv at depth ranging from 117 to 227 (mean depth 174m) on soft bottom with viscous aleurite mud and admixture of scattered pebbles. The position of the group lies near the transitional area between sublitoral and upper bathyal zones. The community consists of large quantities of forms representing infauna of soft bottoms: polychaets (Nicomache lumbracalis, Pista zachsi, Praxillella praetermissa, etc.) sipunculids and echiurids (Golfingia hudsonianus, Echiurus echiurus) various ophiurs (Amphiura sundevalli, A. psilopora, Ophiura leptoctenia) bivalve mollusks (Periploma fragilis, Yoldia myalis, Macoma moesta, M. loveni, etc.). /59

The bottom water temperature in the habitat of this community is always positive, varying from 1.5 to 3°, because the water rises from great depths in the central part of the gulf where its temperature is about 3°. This upwelling is furthered by the presence of deep canyons near the sublitoral zone of Olyutorskiy zaliv.

The Macoma-Amphiodia group is represented by 7 Vityaz' stations occupied in the open part of the gulf: 605, 1576, 1585, 1587a, 1588, 1589, 1595. The total biomass of benthic fauna varies from 92 to 351, the mean value being 209g/m^2. Such a relatively high total biomass is caused by the presence of large quantities of small bivalve mollusks and polychaets (Table 26).

The habitat of this group adjoins the coastal group Echinarachnius inhabiting sandy and shallow bottom areas and the upper bathyal group Brisaster which here reaches the lower sublitoral due to the upwelling of bottom water along the steep slopes of the gulf.

Table 26

The Composition of Macoma calcarea--Amphiodia craterodmeta Group

Form	A	B	Occurrence, %	Density index
Leading Form				
Macoma calcarea	7	41,7	71	54
Typical Form				
Amphiodia craterodmeta	119	8,2	100	28
Golfingia hudsoniana	5	10,1	57	24
Leda fossa	15	10,7	57	24
Secondary Form				
Nucula tenuis	20	3,7	71	16
Nicomache lumbricalis	10	4,4	57	15
Nephthys paradoxa	6	2,9	86	15

The density index of other forms is less than 15. They consist of the following forms:

Polychaeta: Onuphis parva-striata, Pista zachsi, Amphicteis gunneri, Ampharete acutifrons, Pectinaria granulata, Owenia fusiformis, Capitella capitata, Ammotrypane aulogaster, Nephthys ciliata, N. longosetosa, Praxillella praetermissa, Axiothella catenata, Gattyana amondseni, G. cirrosa, Scalibregma inflatum, Lumbriconereis fragilis, L. minuta, Maldane sarsi, Scoloplos armiger, Chaetozone setosa, Brada villosa.

Sipunculida, Priapulida, Echiurida: Phascolion strombi, Golfingia margaritaceum, Priapus caudatus, Echiurus echiurus.

Mollusca: Cardium ciliatum, Periploma fragilis, Leda minuta, Macoma lata, M. loveni, M. moesta, Crenella columbiana, Yoldia myalis, Serripes groenlandicus, Thyasira gouldi.

Echinodermata: Amphiura sundevalli, A. psilopora, Ophiura leptoctenia, O. maculata, O. vicina.

In addition, some groups of benthic fauna were not identified to the species.

The latter is evidently associated with the Macoma-Amphiodia group, maintaining unnoticeable transitions, whereas the boundary between this group and the Echinarachnius parma group is more sharply pronounced. It should be pointed out that the mentioned region of Olyutorskiy zaliv is for the time being the only area in the Bering Sea where this group is so clearly pronounced. All the other groups where Macoma calcarea prevails inhabited shallower areas. It is possible that M. calcarea adheres to areas where the bottom sediments are to its liking. Fine aleurite mud with a considerable quantity of organic detritus favors the development of this species in the lower sublitoral or even somewhat deeper. /60

Thus, the Macoma-Amphiodia group of Olyutorskiy zaliv represents the most pelagic variety of sublitoral community which led by M. calcarea is widely distributed in the Bering and other Far Eastern seas.

Summing up the main features of the Macoma calcarea--Ophiura sarsi--Maldane sarsi--Nucula tenuis group, the following conclusions can be drawn.

Judging by zoogeographical characteristics of the leading and typical forms of the given community, it appears to be a lower arctic group. However, by considering its position among the more thermophilic N Pacific benthic communities and its separation from the Arctic region, it cannot be considered as a truly lower arctic group. In addition to the lower arctic forms, this group includes a considerable admixture of northern-boreal Bering and Pacific species due to which the Macoma calcarea--Ophiura sarsi--Maldane sarsi--Nucula tenuis community of Anadyrskiy zaliv appears to be a transitional group between the genuine low arctic community of northern seas and the northern-boreal community of the marginal seas of the Pacific Ocean.

7. The Population of Anadyrskiy Liman and Estuary Area

Three bottom grabs and one trawl sample were taken from the Anadyrskiy liman and its frontal sector (Fig. 3, St. 561, 560, 564). The first one (561) was taken at a depth of 20m, where the salinity was 26°/oo in the center of the liman; it contained brackish fauna consisting of Mesidothea entomon orientalis (?) and amphipods (biomass about 0.5g/m^2). Dryugin and Ivanov (1937) point out other brackish water forms that inhabit Anadyrskiy liman, namely, crustaceans Synidothea bicuspida and Pleurodon murdochi, mollusks Portlandia aestuariorum f. anadyrensis Derjugin, which is a Bering Sea subspecies typical of the brackish areas of high Arctic. This species was not observed in the Vityaz' samples. It should be pointed out that the finding of such three species in Anadyrskiy liman, which are typical estuary areas in the high arctic, lends the group a very cryophilic character.

From Anadyrskiy liman to the estuary area (St. 560), where salinity increases to 30 and later to 32 and 33°/oo (St. 564), the fauna /61 is gradually changing. Thus, at St. 560, echinoderms are not observed, the variety of polychaets and mollusks is reduced (about 10 and 4 species, respectively). At St. 564, lying farther in the open part of the gulf in front of the Anadyr' estuary, one can observe only 3 species of echinoderms, 12 species of Bivalvia and about 25 species of polychaets. These two groups are enriched with forms that are typical of the opne part of the gulf with normal salinity, such as Onuphis geophiliformis, Scalibregma inflatum, Macoma loveni, Serripes groenlandicus and Astarte montagui. Thus, St. 564 lies on the boundary between the brackish forms and those typical of the open part of the gulf with higher salinity.

It is noteworthy that in the northeasternmost part of Anadyrskiy zaliv (St. 552, coastal zone of bukhta Provideniya covered boulders, and St. 569, N of mys Bering, where the depth is 8m and bottom is covered with pebbles and boulders) Mytlus edulis (live and dead) was repeatedly observed. In bukhta Provideniya the following forms were observed: Paralithodes platypus, Mesidothea and many hammarids. At St. 569, in addition to Mytilus, the following shallow water forms were noted: Ophelia limacina, Harmathoe imbricata, Acmaea, Balanus, Anonyx nugax, etc.

8. Community *Ophiura sarsi--Myriotrochus* (*zaliv Kresta*)

Interesting are two Vityaz' bottom grab samples obtained in zaliv Kresta area (Fig. 3): one in the exit from the gulf (St. 566, d. = 67m), the other opposite the entrance in the N part of Anadyrskiy zaliv (St. 565, d. = 64m). In both of the cases the bottom consists of black mud smelling of H_2S. The total biomasses are 133.2 and 49.7g/m^2, respectively. The small number of samples does not enable us to characterize quantitatively this interesting area with a peculiar benthic community (Fig. 3). Its leading forms are Ophiura sarsi (mean biomass 42.7g/m^2) and Myriotrochus (m. b. 22. 3g/m^2) Sic! omitted species name. Translator). The quantity of these two species is 198 and 116ind/m^2, respectively. These forms, a small number of polychaets and almost complete absence of mollusks, attest to the effect of unstable temperature and salinity regimes in the area, which are affected by the melting of ice brought out of zal. Kresta in summer.

The main polychaets of this peculiar cryophilic community are Brada ochotensis, B. nuda, Lumbriconereis fragilis, L. minuta, Ampharete arctica, Proclea graffi, etc. In both of the cases the samples contained a considerable quantity of small actinians (10-11ind/m^2, 2.7-4.5g/m^2), nemertins, amphipods, etc.

9. Community *Ophiura sarsi--Yoldia thraciaeformis--Ctenodiscus crispatus*

This community inhabits the outer side of shelf in the exit of Anadyrskiy z. (Fig. 3). With an increase in the depth, the thinning of sediment layer, increase in the salinity of bottom water and temperature, the general character of benthic fauna changes. This /62 community occurs at depths ranging from 96 to 200m (m. d. = 142m) on the lower sublitoral of Anadyrskiy region.

All of this region is characterized by relatively high salinity, exceeding 33o/oo in comparison with other parts of the gulf. The temperature of bottom water is more or less constant, always positive, varying from 1.2 to 3.0°.

All this sector of the Bering Sea is exposed to the influence of the open sea, mainly to the so-called "Transversal Current" flowing here from the east (Dobrovol'skiy and Arsen'yev, 1959). Therefore, the species composition of the community varies considerably in comparison with adjacent communities which inhabit Anadyrskiy z. A number of open sea forsm appear, namely: Yoldia thraciaeformis, Amphiodia craterodmeta, A. cyclaspis, Ophiopenia vicina, Crenella columbiana, etc. In addition there are other forms of shallow-water infauna (Ophiura sarsi, Macoma calcarea, Nucula tenuis, etc.). Thus, the given community has connections with other communities, transitions being very gradual.

These data may give the idea that Y. thrasiaeformis is associated with positive bottom water temperature (2-3°), soft muddy bottom, large quantity of organic matter and normal salinity. This evidently explains the peculiarities of its distribution in Anadyrskiy region. The cold Anadyr' patch with negative bottom water temperature for the major part of the year evidently obstructs the propagation of Y. thraciaeformis and Ctenodiscus crispatus to shallower areas of the gulf. Y. thracieformis is one of the large forms among bivalve mollusks; its mean biomass in the community, as seen in Table 27, is 10g/m^2, number 5ind/m^2. The maximum weight of one individual is

15g. Being a typical detritus-eater, collecting food from the upper bottom layer, Y. thraciaeformis propagates only in places where sufficient quantity of food is available. In addition, this species being a northern-boreal (amphi-boreal) form widely distributed in Far Eastern seas and along the Atlantic coast of America, requires constant positive bottom water temperatures.

The Ophiura--Yoldia--Ctenodiscus community is represented by 14 bottom grab and trawl stations occupied by the Vityaz' Expedition (543, 545, 585, 586; 1494, 1495, 1533, 1534, 1535, 1536. 1543, 1544, 1546, 1547). The total biomass of benthic fauna varies from 46 to 242g/m^2 (mean v. = 88g/m^2). It appeared that the greatest biomass, i.e., 242g/m^2, is observed in the shallowest bottom depths, but the smallest biomass in the greatest bottom depths (199m). In the first instance, the echinoderms make up 124g/m^2, polychaets 52g/m^2, and mollusks 57g/m^2.

In addition to the mentioned Anadyrskiy region, the Ophiura--Yoldia--Ctenodiscus community is widely distributed over the lower sublitoral of the NE part of the Bering Sea. It extends from here to the Anadyr' estuary in the form of a broad tongue, at similar depths and on similar bottom types (Neyman, 1960a, 1963).

Table 27 /63

Composition of the Ophiura sarsi--Yoldia thraciaeformis--Ctenodiscus crispatus

Forms	A	B	Occurrence, %	Density index
Leading Forms				
Ophiura sarsi	200	24,5	70	41
Yoldia thraciaeformis	5	10,3	100	32
Typical Forms				
Ctenodiscus crispatus	2	8,9	70	25
Secondary Forms				
Pista zachsi	2	4,7	50	15
Axiothella catenata	2	2,6	60	12
Nephthys ciliata	5	0,5	50	12
Macoma calcarea	15	1,8	70	11
Leda pernula	9	0,8	60	7
Terebellides stroemi	6	0,6	90	7
Praxillella praetermissa	3	0,4	60	5
Sternaspis scutata	9	0,4	60	5
Nephthys longosetosa	3	0,5	50	5

The density index of other forms is less than 5. They represent the following groups:

Coelenterata: Tubularia indivisa.

Polychaeta: Nephtys caeca, N. paradoxa, Lumbriconereis minuta, L. latreilli japonica, Onuphis parva-striata, Artacama proboscidea, Praxillella gracilis, Scalibregma robusta, S. inflatum, Laonice cirrata, Travisia forbesii, Ammotrypane aulogaster, Capitella capitata, Scoloplos armiger, Maldane sarsi, Flabelligera mastigophora, Lanassa venusta, Proclea emmi, Arcteobea anticostiensis, Ephesia gracilis, Tharyx epitoca, Heteromastus filiformis, Amphicteis gunneri japonica, Brada villosa, Polycirrus medusa, Polynoe pavlovskii, P. tarasovi, Antinoella sarsi, Phyllodoce groenlandica, Laphania boecki, Drilonereis filum, Pectinaria morrei, Melinna cristata, Gattyana cirrosa, G. amondseni, Nicomache lumbricalis, Ampharete acutiforns.

Crustacea: Ampelisca macrocephala, A. eschrichtii, Byblis gaimardi, Sclerocrangon communis, Eualus macilienta, Chionoecetes opilio.

Mollusca: Yoldia hyperborea, Nucula tenuis, Leda fossa, Venericardia borealis, Macoma moesta, Yoldia hyperborea, Nucula tenuis, Leda fossa, Venericardia borealis, Macoma moesta, M. torelli, Solariella obscura, S. varicosa, Cylichna alba corticata, Turritella erosa, Sipho togatus, Natica clausa.

Echinodermata: Amphiodia craterodmeta, A. cyclaspis, Ophiopenia vicina, Ophiura leptoctenia, Myriotrochus rinkii.

In addition, many forms have not been identified to the species, namely: Hydroidea, Actiniaria, Nemertini, Polychaeta, Sipunculoidea, Amphipoda, Cumacea, Solenogastres, Gastropoda, Ascidia.

A similar community, in which Y. thraciaeformis prevails, inhabits the Sea of Okhotsk, or rather its N part, Penzhinskiy zaliv (depth about 50m) and off the W coast of Kamchatka (depth about 300-350m) (Savilov, 1961). Noteworthy is the absence of Y. thraciaeformis and its community from the coast of Kamchatka, though some of the accompanying forms occur here, namely, Acila castrensis (Kuznetsov, 1963).

Equally interesting is the distribution of another leading form of the given community, namely, Ctenodiscus crispatus, which is one of the usual low arctic forms of the W sector of the Arctic-Barents and part of the Kara Seas. Bypassing the cold mud patch of Anadyrskiy region in the south, where negative bottom water temperature predominates, Ctenodiscus crispatus, being a typical mud-eater, appears only in places where the mud bottom is associated with positive water temperature. Its distribution almost coincides with that of Y. thraciaeformis, with which it forms the typical community. Such "behavior" of Ctenodiscus crispatus agrees with the pattern of its distribution in the Kara Sea (Filatova and Zenkevich, 1957). Similarly, here the species inhabits only the SW margin of the sea where it joins the "Barents Sea" communities and those of the W margin of the Kara Sea on the slopes of zhelob Sv. Anny (trench) which are warmed by the deep Atlantic Current. Thus, this most usual form of the Barents Sea avoids such areas of the Kara and Bering Seas where the bottom water temperature is constantly negative so that the boundary of Ctenadiscus preferable habitat is clearly delineated.

Table 28

Composition of Fauna at a Station Typical of the Ophiura--Yoldia--Ctenodiscus
St. 1534; 18 June 1952, d. = 122m., bottom: mud.
Peterson grab -0.25m^2; 2 samples

Forms	A	B	Biomass by groups, g/m^2
Nemertini	fr.	1,6	Nemertini 1,6
Nephthys ciliata	28	10,7	
Axiothella catenata	2	5,2	
Tharyx epitoca	60	0,6	
Heteromastus filiformis	20	0,2	
Amphicteis gunneri v. japonica	2	1,1	
Sternaspis scutata	14	0,3	
Lumbriconereis minuta	10	0,1	
Arcteobea anticostiensis	2	0,1	
Scoloplos armiger	2	0,2	
Terebellides stroemi	2	0,2	
Scalibregma inflatum	2	0,1	
Spionidae	fr.	0,1	
Polychaeta varia		1,1	Polychaeta 20,0
Priapulidae	2	0,1	Priapulida 0,1
Yoldia thraciaeformis	24	44,5	
Nucula tenuis	4	0,2	
Thyasira gouldii	2	0,1	
Yoldiella sp.	6	0,1	
Solariella varicosa	4	0,1	Mollusca 45,0
Cumacea	20	0,1	
Amphipoda	80	2,4	Crustacea 2,5
Ophiura sarsi	16	3,6	
Ctenodiscus crispatus	4	29,6	Echinodermata 33,2

Total biomass — 102,4 г/м^2;
Edible biomass — 27. г/м^2.

In contrast to these two leading forms of the community, Ophiura sarsi is more eurythermal. It occurs in cold parts of the gulf as well as in places where the bottom water temperature is always positive.

The Ophiura--Yoldia--Ctenodiscus community is characterized by the prevalence of infauna and can be considered as a transitional group between sublitoral and upper bathyal groups.

On the whole, the community is sublitoral by its nature, though there is an admixture of several more abyssal forms (Crenella columbiana, etc.). Judging from trawl samples, the community is characterized by Rhizopoda (numerous Hyperammina), Gastropoda Neptunea oncoda, N. pribiloffensis, N. vinosa, Plicifusus kroyeri, Liomesus, Fusus), various Buccinum, Antiplanes, Turritella erosa, Cryptonatica clausa, various Solariella, etc. There are also Bivalvia, namely: Thracia trapezoides, Macoma loveni, M. torelli, Cuspidaria beringiensis, etc.. Large numbers of young can be observed in the upper sublitoral forms, such as Hyas coarctatus and Chionoecetes opilio. The predominant polychaets are Axiothella catenata, Pista zachsi, which live in muddy bottoms; there were also echinoderms, namely: Gorgonocephalus caryi, Henricia tumida, Amphiura sundevalli, Amphiodia craterodmeta, Ophiopenia vicina, etc.

Table 28 lists one of the typical stations (1534).

Bathyal Communities

10. Community *Brisaster* (*B. townsendi* and *B. latifrons*)

Brisaster townsendi and Br. latifrons are leading forms widely distributed in the bathyal sectors of Far Eastern Seas and in the N Pacific Ocean. Infauna prevails in this group (Fig. 2 and 5). As to its composition and distribution, the Brisaster group is sufficiently clearly pronounced in the Bering Sea. There are, however, a number of difficulties in the taxonomic arrangement of sea urchins because of the variability of morphological properties is not yet quite clear. Judging by the existing data (processed by Z. I. Baranova, G. M. Belyayev and B. G. Ivanov) both species of the sea urchins occur in the Bering Sea. They mainly inhabit the upper part of continental slope. It appears that Br. townsendi inhabits the slopes of the W depression of the Bering Sea and adjacent slopes of the E Kamchatka shelf, whereas Br. latifrons inhabits the E part of the sea and the slopes of its central depression. The Vityaz' data were later supplemented

by collections of the VNIRO expeditions which confirm the above statements. The submarine Khrebet Shirshova, which divides both of the depressions serves as a boundary zone in the distribution of these two sea urchins. Regrettably, data on its occurrence on the slopes of Aleutian Islands are not yet available. Similarly, the causes for such a division between the two species are not yet clear. If new data would corroborate the existing information as valid, the deep currents might be considered as the reasons affecting the distribution of bathyal forms, notably the distribution of both of the species of sea urchins. It is possible that Khrebet Shirshova may influence the direction of these currents and the distribution of many benthic animals. In addition to the /66
E part of the Bering Sea, Br. latifrons occurs in the deep portion of the Sea of Okhotsk where Br. townsendi is absent. Outside the limits of the Bering Sea, both of the species occur together in the Pacific bathyal along the N American coast as far south as S. California (Br. latifrons) and Gulf of Panama (Br. townsendi). In addition, the first one has also been observed in proliv Laperuza and off the coast of Japan. However, in order to solve the question on the general character of their distribution, more detailed information about the variation of taxonomic properties in these sea urchins is needed.

In Bering Sea, Br. townsendi rise almost to the lower boundary of sublitoral zone, as for example, in Olyutorskiy zaliv (St. 1586, d. = 317m) or off ostrov Beringa (St. 1052, d. = 213m). This may be associated with the upwelling of bottom water due to the existing currents and the presence of submarine canyons. It should be pointed out that, judging by preliminary data, Br. latifrons appears to be more eurybathic form than Br. townsendi. If the former occurs in Bering Sea from depths 417 to 1805m or even to 2990m (St. 1599), the latter has been observed only at depths ranging from 317 to 740m. Clark observed Br. latifrons at the depth of 2000m in the Bauers Bank area (S part of the Bering Sea).

However, their main habitat is in the upper bathyal zone with depths ranging from 300 to 1000-1500m. It is difficult to catch these animals of infaunal group as they hide themselves in the mud layer, but the existing data suggest that their zonal character is strictly pronounced. For the same reason, the samples obtained in a zone characteristic of the Brisaster community are often devoid of the urchins themselves, though the other faunal elements correspond to the group. Brisaster occurs as a rule in all trawl samples. In lower horizons the Brisaster community is gradually replaced with the more bathyal Yoldia beringiana species.

Off the Pacific coast of Kamchatka the Br. townsendi community is more clearly pronounced than in the Bering Sea, which is associated, first, with larger scope and better quality of data. Kuznetsov (1963) analyses this biocoenosis in detail, showing that in the Bering Sea it occurs mainly on the upper part of the continental slope at depths ranging from 300 to 800m where the bottom is covered with slightly sandy aleurite consisting of coarse and fine particles. Salinity is high here, temperature stable and positive, 2-4°, O_2 is somewhat low, sometimes as little as fractions of O_2ml/l. The leading form on the Kamchatka east coast is Br. townsendi. Br. latifrons was not observed here. The typical forms are: Ammotrypane aulogaster, Ampelisca macrocephala, Laonice cirrata and Nicomache lumbricalis (Ophiura leptoctenia is casual here). The mean biomass of Br. townsendi is 80.6g/m^2 with 100% occurrence, the mean biomass is 185g/m^2. Present are thermophilic forms typical of slopes, such as Acila castrensis, Rictocyma zenkewitchi, Aphrodite talpa, Asteronyx loveni, etc. Infauna, led by Br. townsendi (80% biomass), lends the community a peculiar aspect typical of communities inhabiting soft sediments of slopes. /67

According to data gathered during the latest VNIRO expeditions, the Brisaster--Ophiura leptoctenia community appears to inhabit also the E part of the Bering Sea (Neyman, 1960a, b) where it is noted only on the upper slope of the continental shoal (200-460m). Undoubtedly, the community is also found on deeper slopes, but such data were not obtained by the expedition. The author points out that here we have to deal with eastward continuation of the Brisaster community that inhabits the W slope of the Bering Sea. The mean biomass of this group, according to Neyman, is 17g/m2 in the E part of the sea, the biomass of Br. latifrons alone being only 4g/m^2. Here the group is associated with muddy sand bottom as in the case of the W part of the sea.

Below are listed three stations that characterize the Brisaster community in the eastern part of the sea (Zhemchug, 1958, and Pervenets, 1959). Similarity, between the Brisaster-Ophiura community and the Brisaster latifrons group which inhabits the slopes of the central depression is obvious. However, the great significance of Ophiura leptoctenia and the appearance of Chiridota ochotensis sets the first group apart from the Br. latifrons group (Table 32).

Vityaz' data on the Brisaster biocoenosis in the W part of the Bering Sea are limited (Table 29), yet these data give a good idea about the general character of this community and its confinement to the upper part of the slope. These stations were scattered over a large area of the continental slope of western and central depressions, beginning with o. Beringa in the south as far as 180°. As seen from the chart (Fig. 2), the distribution of the Brisaster group has a clearly pronounced zonal character which is repeated in the delineation of the edge of continental slope.

In the W part of the sea, which is occupied by this community, the appropriate zone lies between the depths of 213 and 1805m (mean value being 680m). However, the main habitat of the community is limited within 400-800m depth. As seen in Table 29, the living conditions are rather constant here: stable positive temperature of bottom water (1.2-3.4°, the mean value being 3°; the mean for all the stations is 2.9°), high salinity (exceeding 34°/oo) and soft fine aleurite (muddy sand) bottom layer typical of most of the zone inhabited by this community. As in the case of temperature conditions, so with regard to the leading forms, the Brisaster community of the Bering Sea has a clearly pronounced northern boreal character, which makes it ecologically similar to the *Brisaster fragilis* community of the N Atlantic Ocean and the Barents Sea (Filatova, 1938).

Regrettably, the lack of sufficiently high quality data with regard to the slope area of the Bering Sea does not enable us to calculate the quantitative indices of the community. Therefore, we have to limit ourselves to the description of data gathered at individual stations.

Within the boundaries of the Bering Sea, the Brisaster community has two natural groups: the western community with *Br. townsendi* in the lead, and eastern community with *Br. latiforns* in the lead. Despite these differences, in the composition of species, the ecological aspect of both of the groups is completely identical. /69

10a. Group *Brisaster townsendi*

This group is distributed on the slopes of the W depression of the Bering Sea, thus being a direct continuation of the *Br. townsendi* community northward. The community thrives on the Pacific slope of Kamchatka. Judging by the distribution of the leading form, the natural boundary for the given group is the submarine ridge Khrebet shirshova which divides the entire S part of the sea into two large depressions--the W and the Central (Udintsev, Baychenko and Kanayev, 1959). This meridional ridge must affect the deep current system of the S part of the Bering Sea. It is possible that the currents cause certain biological differences between these two depressions. In fact, the influence of the submarine ridge and the system of deep currents may affect the quantitative distribution of benthic fauna. Thus, the total benthos biomass in the W depression with its mean value of 14.6g/m^2 exceeds more than twice the total biomass in the C dpression where the mean value of biomass is 6.7g/m^2 (Belyayev, 1960). These quantitative differences are still more manifest at maximum depths

__Brisaster__ Community

No. of station	Equipment	Depth, m	Bottom	Bottom water temperature, °C	Bottom water salinity, o/oo	Species	Total biomass g/m²	Region
Vityaz' 1949–1952 [illegible]								
1062	Д. (К.)	213	Coarse aleurite			Brisaster sp.		Of o. Beringa
1577	Д.	347	" "	3.44	34.14	Brisaster juv	72.7	Slope of Olyutorskiy g.
1578	Д.	761	" "	3,43	34.26	Br. townsendi	102,9	" " " "
1586	Д. ОТТ	317	Fine aleurite	1.25	33,43	" "	138,2	" " " "
608	Д. Т. С.	492	Fine sand	3.38	34.16	" "	33,3	Khrebet Shirshova
1023	Д. (К.)	1551	Fine aleurite		—	Br. latifrons	—	Slope of C. depression
1361	Д.	417–427	Coarse aleurite	3.42	33,93	" "	86,0	S. of m. Navarina Slope of Koryakskiy bereg
1519	Д., Д. (К.)	1860	" "	2.32	34.56	" " (?)	74,6	Slope of C. depression
Zhemchug 1958 g.								
297	Д.	440	Muddy sand	—	—	" "	23,6	E. slope of C. depression
179	Д.	458	" "	—	—	" "	49,1	same
Pervenets 1959 g.								
161	Д.	453	" "			" "	203,6	same

NOTE: Д. (К.) – Bottom (grab)
Д. – Bottom
Д.; ОТТ – Bottom; other trawl
Д. Т. С. – Bottom Sigsby trawl

of the two depressions. If for the W depression with mean depth of 3763m the value is 66.4g/m2, then for the C. depression with the mean depth of 3684m the value is five times smaller, i.e., only 3.1g/m^2 (Belyayev, 1960). As correctly assumed by the author, such differences are associated, first of all, with the quantity of food for benthic animals that live in the sediments. The peculiarities of hydrological regime should be added to the characteristics, first of all, the aeration of bottom water layers and the quantity of CO_2 in them, which are closely associated with the system of deep currents. The slopes of W depression lie near the Anadyrsko-Kamchatskoye techeniye current, which brings waters rich in organic matter from gulfs, affecting the bathyal water. Whereas the slopes of the C. depression with its benthic fauna are washed by much poorer water of the oceanic currents, the Attu and Tanaga, which flow into the Bering Sea through the Aleutian straits (Dobrovol'skiy and Arsen'yev, 1959).

The Br. townsendi group is especially well pronounced on the slopes of Olyutorskiy zaliv. Four stations, occupied in this region, characterize the given benthic group of the W depression; three of which were in the gulf, one at the base of Khrebet Shishova (1577, 1578, 1586, 608). These stations were occupied at depths ranging from 317 to 740m (mean v. = 514m). The total biomass of benthic fauna varies from 33 to 138g/m^2 (mean v. = 87g/m^2). Br. townsendi was observed at all of the stations, its maximum biomass amounted to 36g/m^2. At St. 1586, which is typical of the given group (d. = 317m) 25 specimens of large sea urchins were caught by the trawl.

As typical forms of the group can be considered Ophiura leptoctenia, Amphiura sundevalli, Amphiodia craterodmeta and various holoturians of the family Deimatidae; the typical polychaets are Pectinaria moorei, Rhodine gracilior, Terebellides stroemi, Lumbriconereis /70 bifurcata, L. latreilli japonica, Aphrodita talpa, Maldane sarsi, Nephthys brachycephala, Lysippe labiata; mollusks Dacridium vitreum, Acila castrensis, Yoldiella derjugini, Propeamussium davidsoni, Crenella columbiana and Rictocyma zenkewitchi.

In Olyutorskiy z. the Br. townsendi group is gradually replaced by Macoma calcarea-Amphiodia craterodmeta group which prefers shallower depths. Due to the influence of the cold Anadyrskoye Current, the temperature of bottom water is somewhat lower than in the bathyal zone, i.e., about 1.2°. At the depth of 300m one could observe a considerable quantity of shallow water and eurythermal forms, such as Macoma calcarea, Liocyma fluctuosa, Serripes groenlandicus, Venericardia borealis, Owenia fusiformis and Nicomache lumbricalis; trawl samples contained numerous large holoturians, Stichapus, as well as Buccinidae of the following genera Argobuccinum

Table 30

Composition of Fauna at a Station Typical of the Brisaster townsendi Group
St. 1577; Olyutorskiy z.; d. = 507m; bottom: coarse aleurite; Peterson grab-0.25m²; 1 sample

Forms	A	B	Biomass by groups g/m²
Brisaster townsendi juv.	4	0,96	Echinodermata 0,96
Nicomache lumbricalis	32	8,00	
Rhodine gracilior	60	0,80	
Praxillella praetermissa	16	0,12	
Maldane sarsi	4	0,12	
Lumbriconereis bifurcata	4	4,80	
Lumbriconereis latreilli japonica	4	0,04	
Nephthys brachycephala	4	2,60	
Ammotrypane aulogaster	32	1,24	
Ampharete acutifrons	8	0,04	
Lysippe labiata	20	0,48	
Tharyx epitoca	8	0,52	
Pectinaria moorei	4	0,72	
Terebellides stroemi	8	1,16	
Sabellidae	12	1,44	
Spionidae		1,88	
Polychaeta varia		5,40	Polychaeta 29,36
Nucula tenuis	4	0,52	
Dacridium pacificum	4	0,12	Bivalvia 0,64
Siphonodentalium	4	0,40	Scaphopoda 0,40
Cumacea	200	0,80	
Amphipoda	4256	39,60	
Varia	8	0,92	Crustacea 41,32

Total biomass — 72,7 г/м².

Neptunea and Plisifucus, various Paguridae, including P. splendescens, and crabs Chionoecetes opilio. Echinoderms were represented by Gorgonocephalus caryi, Stegophiura nodosa, various sea stars of genera Henricia, Ceramaster, Pseudarchaster, Solaster. /71
All this lends a mixed character to the fauna. The presence of more deep-water forms results from the upwelling of deep water from submarine canyons which are typical of Olyutorskiy zaliv.

Table 31

Composition of Fauna at a Station Typical of the Brisaster townsendi Group

St. 1578; 25 June 1952; d. = 741m; bottom: fine aleurite mud with sand; Peterson grab 0.25m^2; 1 sample

Forms	A	B	Biomass by groups, g/m^2
Brisaster townsendi	4	36,00	
Ophiuroidea	6 juv.	0,05	Echinodermata 36,05
Maldane sarsi	200	39,3	
Praxillella, *Rhodine*, *Nicomache*, Terebellidae, Spionidae	fr.	22,4	
Lumbriconereis bifurcata	4	1,60	
Nemidia torelli	8	1,40	
Scalibregma inflatum	12		
Nephthys malmgreni	40	0,24	
Amphicteis gunneri japonica	4	0,08	
Ammotrypane aulogaster	8	0,04	
Varia		0,88	Polychaeta 65,94
Nucula tenuis	2	0,04	
Montacuta	6	0,10	
Dentalium	4	0,80	Mollusca 0,94

Total biomass — 102 9 г/м²;
Edible biomass — 86,0 г/м².

Trawling in the gulf yielded large quantities of bathyal crab Chionoecetes angulatus angulatus which replaces here the shallow-water form Ch. opilio (St. 1586, d. = 317m).

St. 1578 (d. = 741m) lying near the lower boundary for this community was represented by large quantities of Maldane sarsi (39.3g/m^2); as a result, the polychaets (66g/m^2) together with Br. townsendi (36g/m^2) make up 103g/m^2, which is a large quantity for such a depth. Two bottom grab stations occupied in Olyutorskiy z. (Tables 30, 31) represent the fauna of the W depression of the Bering Sea. It is seen that the composition of the group is similar to that on the shelf of E. Kamchatka (Kuznetsov, 1963). The similarity is evident not only by the species of the sea urchins but also by a number of typical and secondary forms, such as Acila castrensis, Crenella columbiana, Rictocyma zenkewitchi, etc.

St. 608, lying on the upper part of khrebet Shirshova (d. = 492m) seems to mark the boundary between two groups of the Brisaster community. The W groups, however, seems to dominate, inasmuch as the leading form is Br. townsendi. Let us list data on the composition of fauna at this station. The total biomass is 33g/m^2, of which 22g/m^2 are made up of bivalve mollusks (Limopsis, Propeamussium davidsoni, Yoldiella derjugini, etc.); Golfinga improvisa and polychaets (Goniada annulata, Onuphis conchylega, Axiothella catenata, Lumbriconereis, etc.) make up almost 10g/m^2. At this rich station Br. townsendi occurred only in trawls. Various holoturians of the family Deimotidae were numerous, ophiurs such as Oph. leptoctenia and Oph. quadrispina; in addition, there were large quantities of deep-water Chionoecetes angulatus angulatus, four species of Pagurus (cornutus, pubescens, undosus, rathbuni). Bivalve mollusks were represented by Acila castrensis, Rictocyma zenkewitchi, a number of species of genera Limopsis, Leda, Poromya, etc. Thus, many species appear to be common with the Br. townsendi group of the W depression and E Kamchatka shelf. /72

10b. Group *Brisaster latifrons*

This "E" group associated with the slope of the C depression of the Bering Sea is represented by six stations 1023, 1461 and 1549 (Vityaz'); 207 and 179 (Zhemchug) and 161 (Pervenets). These stations lie at depths from 417 to 1805m (the mean d. = 854m), on coarse and fine aleurite bottom; temperatures are similar to those of the W region, namely: 2.3-2.4°. As in the W group, infauna prevails. The total biomass varies from 23 to 203g/m^2 (mean v. = 87g/m^2). Thus, the mean biomass is there somewhat smaller than in the W depression (93g/m^2). The leading form at all of the stations is Br. latifrons. Br. townsendi was not observed here.

The fauna inhabiting the area of Br. latifrons group is characterized by the predominance of polychaets, sinupculids and ophiurs.

The following polychaets were found: Nephthys brachycephala, N. malmgreni, Rhodine gracilior, Goniada maculata, Harmothoe pellucelytris, Travisia kerguelensis, T. forbesii, Lumbriconereis heteropoda and Sternaspis scutata; echinoderms Ophiura leptoctenia, Amphiacantha derjugini, Amphiodia craterodmeta and various holoturians. Small bivalve mollusks of genera Axinopsis /73

Table 32
Composition of Fauna at Stations Typical of the Br. latifrons Group

Forms	Zhemchug, St. 179/31, 1958, d. 458m, Peterson grab, 1 sample		Zhemchug St. 207/57, 1958 d. 4??m, Peterson grab, 1 sample		Pervenets, St. 161, 1959, d. 453m, Peterson grab, 1 sample	
	A	B	A	B	A	B
Brisaster latifrons	4	42,4	4	8,9	12	97,2
Ophiura leptoctenia	—	—	104	6,8	96	41,6
Amphiodia	4	2,1	12	2,7	—	—
Chiridota ochotensis	8	3,8	—	—	8	59,8
Travisia, *Nephthys*, *Lumbriconereis*, Glyceridae, *Axiothella*, *Owenia*, *Laonice*, Aphroditidae	—	—	64	4,2	4	5,0
Yoldia, Ungulinidae, *Dacridium*, Solenogastres	44	0,3	28	0,3	—	—
Ampelisca catalinensis	8	0,1	16	0,2	—	—
Amphipoda varia		0,4	—	0,5	—	—
Total biomass g/m²		49,1		23,6		203,6

NOTE: The bottom at all stations is covered with muddy sand.

and Montacuta make up a very small quantity of biomass. A rear form Listriolobus pelodes was also observed. The rather great biomass (74.6g/m^2) for the depth of 1805m is achieved by the presence of Golfingia margaritaceum (41.6g/m^2) and echinoderms (27.7g/m^2). Almost all of the animals at these stations can be considered as infauna, which is typical of the Brisaster group in general. In addition to Br. latifrons, the typical E coast forms are Chiridota ochotensis and Ampelisca catalinensis, which contribute to the formation of large numerical and weight values for the upper horizons of this benthos group. In order to characterize the group, the composition of fauna at three stations of the E sector are tabulated (T. 32). /73

11. Community *Yoldia beringiana--Travisia forbesii*

The above-mentioned Brisaster group is bounded on the lower bathyal community of infauna referred to as the Yoldia beringiana--Travisia forbesii group (Fig. 2). As in the case of the Brisaster group, the distribution of the Yoldia-Travisia group has a rather clearly pronounced zonal character.

Inasmuch as Yoldia beringiana was observed by Deryugin and Ivanov (1937) on the slope of the Pacific coast of Kamchatka (inflated deep-water Yoldia), one may think that the distribution of Y. beringiana community is similar to that of the Brisaster group (Dal'nevostochnik, St. 3, depth 800-1000m; St. 4, d. 1500-2000m in the cross section of Avachinskaya guba).

This community is characterized by the presence of the large temperate-bathyal bivalve mollusk Y. beringiana and the rather eurybathic Polychaeta Travisia forbessii.

Six Vityaz' stations occupied in the W depression characterize this community. Altogether 5 bottom grab and 4 trawl samples were obtained. These stations lie on the lower sector of the bathyal zone at depths varying from 533 to 1928m (the mean v = 1400m). The bottom was covered with soft, coarse and fine aleurite, and clayey mud. The bottom water temperature was always positive, about 2-3.9° (Table 23). Regrettably, the VNIRO Expedition of 1958/59 did not take samples from depths exceeding 500m. Therefore, we have no data on the distribution of Y. beringiana in the C depression.

In a number of areas in the W depression (in Olyutorskiy z., for example) the current flowing from the north parallel to the coast involves huge water masses which extend to the bottom of the sea.

The leading form is Y. beringiana; at places its length is 55mm (one of the largest mollusks in the Bering Sea). The quantity of Y. beringiana varies from 4 to 6 ind/m^2. One catch with the Sigsby trawl contained 63ind (at St. 542). At places large numbers of empty shells were found. Evidently the mollusks had been eaten by large carnivores, probably by the deep-water crabs Chionoecetes angulatus angulatus, which often occur there in large quantities. In addition to mature individuals, young /74
Y. beringiana were observed everywhere. Evidently they thrive there. This is attested by large sizes of the species. Consequently, Y. beringiana, as a typical detritus eater, finds enough food in the upper sediment layer. Indeed, the greatest quantity of organic carbon (1.5-2% and more) is observed in these abyssal areas that adjoin the slope as well as in the lower horizons of the continental slope (Lisitsyn, 1959, Fig. 23). In addition to the W part of the Bering Sea, Y. beringiana is undoubtedly inhabiting the E slope of the C depression. However, the VNIRO and TINRO expeditions did not sample such depths. Y. beringiana was observed off Pribylov Islands (Pribylovyye o-va) (Depth 1775m; Dall, 1917), off the Oregon (Vityaz' St. 4179, depth

1300m) and California coasts (Dull, 1921). It was also observed off the E coast of Kamchatka (Kronotskiy zaliv, depth 1000-1100m). It seems that the community formed by Y. beringiana enbraces the lower slopes of the continental shelf of the entire N Pacific coastline, just as in the case of the Brisaster group.

The other important form in the Y. beringiana community is Travisia forbesii. At places the population density reaches 35ind/m^2, biomass 3.5g/m^2. Being a eurybathic mud eater, T. forbesii thrives in this area like Harmothoe pellucelytris, though the latter does not contribute much to the biomass. According to trawl samples, numerous Chionoecetes angulatus and Sclerocrangon abyssorum inhabit this area, as well as Ctenodiscus crispatus and Psilaster pectinatus. A clearly pronounced bathyal character is lent to this group by pogonophores (Polybrachia annulata) and polychaets Nephthys brachycephala, Lumbriconereis bifurcata, etc. A large number of eurybathic species of polychaets, mollusks and echinoderms that live at such depths indicate that the presence of the needed food and constant temperature lure the sublitoral animals to the bathyal zone. Here is a station typical of the Yoldia-Travisia community (Table 34).

Table 33

Vityaz' Stations in the Yoldia-Travisia Community

Station	Depth m	Equipment	Bottom	°C	S, o/oo	Region	Biomass, g/m^2
542	1469	т. С.	Coarse aleurite with pebbles	2,62	32,44	N slope of C depression	—
602	927	д. П; т. С.	Fine aleurite	2,94	34,33	Slope of Olyutorskiy z.	58,1
604	533	д. П.	Coarse aleurite	3,28	34,22	Same	23,3
611	1711	д. П; т. С.	" "	2,05	34,60	Slope of m. Olyutorskiy	40,7
1030	1928	д. П; т. С.	Aleurite-clay mud	—	—	Slope off Koryakskiy b.	9,3
1587	1800	д. П.	Coarse aleurite	—	—	Slope off Olyutorskiy z.	16,5

NOTE: T. C. = Sigsby trawl
Д. П. = Peterson grab

Table 34
Composition of Fauna at a Station Typical of the Yoldia beringiana--Travisia forbesii Community
St. 602, d. - 927m; clayey mud; Peterson grab 04m^2, 1.5 samples

Forms	A	B	Biomass by groups, g/m^2
Nicomache lumbricalis	12	0,67	
Rhodine gracilior		0,08	
Praxillella praetermissa	2	0,25	
Tharyx epitoca	12	2,3	
Terebellides stroemi	2	0,07	
Scalibregma inflatum	2	0,25	
Drilonereis	fr.	0,08	
Aricia norvegica	fr.	0,17	
Arcteobea spinelytris	2	0,08	
Pista pacifica	12	9,0	
Artacama proboscidea	2	0,12 (together with *Lanassa nordenskioldi*)	
Lanassa nordenskioldi	3		
Asclerocheilus beringianus	40	2,8	
Chaetozone setosa	2	0,03	
Laonice	2	0,58	
Spiophanes kroyeri	2	0,25	
Prionospio steenstrupi	3	0,08	
Chone infundibuliformis	12	0,42	
Harmothoe pellucelytris	7	0,17	Polychaeta 17,4
Yoldia beringiana	13	5,71	
Nucula tenuis	2	0,06	
Solenogastres	2	0,51	
Lophyrochiton albus	2	2,8	
Lepeta caeca	3	0,12	Mollusca 9,2
Brachiopoda	8	9,6	Brachiopoda 9,6
Cumacea	8	0,22	
Amphipoda	23	0,22	
Ampeliscidae	24	0,3	Crustacea 0,72
Ophiura leptoctenia	2	0,02	
Amphiodia craterodmeta	10	0,08	Echinodermata 0,1
Coelenterata	15	0,61	Coelenterata 0,61
Nemertini	3	0,42	Nemertini 0,42

Total biomass —38,05 г/м²

The community as a whole can be considered as a typical bathyal group of the lower part of slope. It is moderately thermophilic, with infauna in predominance.

The general benthos biomass varies from 9.3 to 40.7g/m^2 (the mean value being 25.6g/m^2), i.e., almost three times less than the mean biomass of the Br. latifrons and Br. townsendi groups. This is undoubtedly associated with a gradual deterioration of food conditions for the benthic animals with an increase in the depth of the habitat. /76

Communities of the Abyssal Benthic Fauna

In the S part of the Bering Sea the bottom depth exceeds 3km in some locations. The submarine khrebet Shirshova, which extends from m. Olyutorskiy southward about 700km, divides the S part of the sea into two inequal parts: the smaller, western (or Komandorskaya) and the larger, central (or Aleutian) depressions. The width of the ridge is about 120 miles in northern part and 15 miles in the southern part. Despite its considerable depth (600 to 700m in the N part and 2000m in the S part), the ridge is undoubtedly formidable in exerting influence on the water regime of both depressions. It isolates the Central Depression with its benthic fauna from the influx of continental runoff and currents that flow in the shallow coastal belts of the W part of the sea and transport large quantities of detritus with organic remains. Owing to the steepness of slopes of the continental shelf, which reaches at places 25-32°, as in the case of Olyutorskiy zaliv and Koryakskiy bereg (Udintsev, et al., 1959) and due to the submarine canyons, the abyssal deeps appear to be instilled with life that is similar to the sublitoral zone as regards its quantity and variety. This is attested by large quantities of organic remains in the W Depression in comparison with the isolated C Depression. Similarly, the bottom water of the former is better aerated. Therefore, the benthic abyssal fauna lives under better conditions which are manifest by the variety of species, larger size and greater biomass, even in places that are relatively far from the coast line. Here are some comparative data on both of the depressions.

It can be seen that the total biomass of benthos in the W Depression reaches considerable magnitudes, from 4 to 16g/m^2; near Kamchatskiy proliv rising to 30g/m^2; in the southernmost part of the depression, near Aleutian Islands, the total biomass does not decrease below 1.8g/m^2. At the same time, in the C Depression the

Table 35
The Mean Quantity of Organic Carbon (%) and Pigments (mg per 100g of dry sediment) in Clayey Mud and the Total Biomass of Benthos in the S Part of the Bering Sea (Lisitsyn, 1959; Belyayev, 1960)

Indices	Western Depression	Central Depression
C_{org} (on natural sediments) .	1.70	1.52
C_{org} (on unsoluble remains) .	2.27	2.16
Yellow pigments (on natural sediments).	15.94	2.50
Green pigments (on natural sediments).	15.12	1.38
Mean total biomass, g/m^2. . .	14.6	6.7
Mean total biomass for greatest bottom depths. . .	16.4	3.1

total biomass of benthos only in one location near the continental slope reaches $18.5g/m^2$, in open places only fractions of grams per $1m^2$ can be observed. /78

Thus, the general circulation and the chemical composition of bottom water, the bottom relief and food resources for benthic animals in the abyssal part of the Bering Sea exercise great influence on the composition and distribution of benthic fauna. Beginning with the depth of about 2000m, a very typical benthic fauna is developed there. This fauna is characterized by a number of abyssal forms (foraminifera, coelenterates, bivalve and gastropod mollusks, echinoderms, tunicates) and complete groups of abyssal animals such as triaxonids, antipatarians, pogonophores, etc.

The abyssal benthic fauna of the Bering Sea is greatly affected by the abyssal fauna of adjacent Pacific Ocean. This is natural, inasmuch as the deepest Aleutian straits make the exchange of deep waters and fauna possible. The bathyal benthic fauna of the Bering Sea contains elements of different origin. First, the N Pacific forms are present, such as rhizopods (Bathysiphon) polychaets (Macellicephala abyssicola, Onuphis pycnobranchiata, Travisia profundi, etc., 14 species; Levenshteyn, 1961; echiurids

Table 36

Vityaz' Stations (1950-1952) in the Abyssal Portion of the Bering Sea (at depths >2000m), Where the Benthic Fauna Was Sampled

No. of Stations	Region	Depth, m	Sampling Gear	Bottom	Bottom Water Temp. °C	Total biomass
1950 г.						
524	Kamchatskiy pr.	4382	*т. С.	Clayey mud	1,50	—
530	S tip	3936	*д. П.	Gray clayey mud	1,56	1,8
535	C depression	387[illegible]	д. П., т. С.	Gray aleurite mud	1,58	0,1
537	C depression	3804	д. П.	Green-gray mud	1,58	0,2
539	N part of C. depression	3747	д. П., т. С.	Dense clayey mud	1,62	0,1
541	N slope of C depression	2796—3260	д. П., т. С.	Clayey mud with pebble	1,58	7,8
591	Slope of Koryakskiy b.	2160	т. С.	Muddy sand	1,86	—
603	Same	2622—3034	д. П., т. С.	Clayey-aleurite mud	1,66	30,0
612	Slope of NE part of Khr. Shirshova	2597	д. П.	Clayey mud	1,68	5,7
614	C of C depression	3612	д. П.	Clayey mud	—	6,8
617	S p. of Kr. Shirshova	2359	т. С.	Gray clayey mud	1,72	—
618	C part of W depression	3875—3940	д. О., т. С.	Aleurite-clayey mud	1,56	3,8
620	Slope of o. Karaginskiy	3482	*д. О.	Clayey mud	1,55	4,1
624	Kamchatskiy pr.	3789	д. О.	Aleurite mud with pebbles	—	30,5
626	Kamchatskiy pr.	2393	т. С.	Boulders, gravel	—	—
531	C depression	1690—2170	д. О., beam trawl	Sandy mud with pebbles	—	—
1951 г.						
956	Kamchatskiy pr.	4391	д. О. (к.), т. С.	Viscous clayey mud	—	—
956a	Kamchatskiy pr.	4811	д. О.	Viscous clayey mud with pebbles	1,50	
965	S tip of khr. Shirshova	3713	д. О.	Clayey mud	—	3,5
966	same	2608	д. О.	gray clay	1,64	0,2
970	S tip of C depression	3819	д. О.	Clayey mud	—	0,5
972	same	3788	д. О., т. С.	" "	—	1,6
1031	Slope of Koryakskiy	2735	д. О. (к.)	" "	—	—
1952 г.						
1410	S par:t of W dr,ression	3980	т. С.	Red clayey-diatom mud	1,61	—
1550	N slope of C depression	2420	д. О.	Green-gray mud	1,71	0,05
1552	Same	3490	д. О.	" " "	1,61	8,5
1557	C depression	3680	д. О., т. С.	Gray mud	—	0,1
1599	N slope of W depression	2995, 3390	д. О., т. С.	" "	—	15,6
1604	W depression	3680	т. С.	Clayey mud	1,5[illegible]	—
1615	Same	3840	д. О.	Gray aleurite mud	—	[illegible]2,5

NOTE: T. C. = Sigsby trawl; Д. П. = Peterson grab; O. = Okean.

(Tatjarella gracilis), sipunculids (Phascolion lutense); crustaceans (Sclerocrangon zenkewitchi); echinoderms (Eremicaster tenebrarius, E. pacificus, Sphaerothuria bitentaculata, etc.) and lastly pogonophores (Polybrachia annulata, Heptabrachia gracilis, etc.).

The other group consists of eurybathic and widely distributed forms, such as Maldane sarsi, Terebellides stroemi, Ophiura leptoctenia, etc.

Lastly, a very typical group is formed by endemic abyssal animals of the Bering Sea, namely, the pogonophores Siboglinum fedotovi, S. pellucidum, Birsteinia vityazi, etc.

Despite the fact that the quantity of deep-water samples obtained from the Bering Sea is generally small (30 stations; Table 36) and the data processing is not of a high standard, it is, however, possible to characterize in general terms the existing benthic communities.

This is facilitated for the reason that living conditions in the abyssal bottom layers generally change relatively little, and, therefore, the composition of benthic fauna is more or less constant over rather vast areas.

As was pointed out above, in the western depression as a whole, especially in the parts contiguous to the slope (St. 603, 620, 1599) and the Kamchatskiy proliv (624), the total biomass of benthic fauna reaches considerable magnitudes.

At places it reaches 30-32g/m^2 (St. 603, 615), whereas in the C depression it reaches 18.5g/m^2 only in one case out of 14 cases. Correspondingly, the variety of benthic fauna and even the size of some animals inhabiting the W depression are greater. Thus, at St. 1604 (d. = 3680m) a trawl sample contained a number of large forms of the most diverse benthic animals, such as polychaets (Maldane sarsi, Asychis ramosus; as much as 12 cm long), rhizopods (Bathysiphon) whose tubes reaches 12 cm; holoturians (Psychropotes raripes, 30 cm long, Paelopatides solea, 19 cm long), also of large sizes, fragments of large mollusks (Cuspidaria), crustaceans (Sclerocrangon zenkewitchi and Munnidopsis beringiana). All this indicates that the living conditions, especially with regard to availability of food, are favorable for the benthic fauna of the W depression. In addition, the quantity of food affects not only the general abundance and variety of abyssal animals, but also their growth rate. In this connection, it is interesting to note that at comparable depths in the Pacific Ocean the population of /79 benthic animals is scattered, their sizes and biomass are small.

In the peripheral part of the W depression, which adjoins the slope and is subjected to its influence, the community (and, possibly, a group of communities) occupies an intermediate position between the true abyssal communities and the communities inhabiting the continental slopes. Here one can encounter a number of eurybathic forms which usually inhabit the slope or even sublitoral, as, for example, Ctenodiscus crispatus, young Brisaster and single Chionoecetes angulatus a. However, the true abyssal species are in majority. The appearance of various pogonophores indicate the beginning of abyssal zone which is their main habitat in the Bering Sea.

In this abyssal region one can usually observe empty shells of various sublitoral mollusks rafted in the area by ice (?): Nucula tenuis, Saxicava arctica, Macoma calcarea, M. baltica, etc. such transport has been repeatedly observed in similar areas of the Arctic Ocean.

The abyssal portion of the W depression, especially its peripheral belt; is inhabited by ecological groups typical of great depths, which are adapted to life in specific abyssal conditions. However, there is also a rich infauna inhabiting the soft muddy and clayey sediments. This group, called by us "the epifauna of soft bottoms" is somewhat elevated over the bottom by means of various typed of legs, stems, tubes and various skeletal supporting formations. This group consists of many deep-water Coelenterata forms, such as Umbellula, Radicipes, Kophobelemnon, Stephanoscyphus, some Actiniaria, Alcyonaria, ascidions, sponges, tubular polychaets and possibly pogonophores. Such an elevation of a number of single and colonial forms over soft muddy bottom evidently facilitates their foraging (seston) and, to a degree, protects them from direct influence of unfavorable factors in the lowest layer, such as excess of CO_2 and lack of O. Thus, this animal group, extremely refined in structure and sensitive to water movements as well as to the gas regime, has developed in abyssal depths over soft sediments. Its existence appears to be very useful to a number of benthic animals. It should be pointed out that these forms also inhabit open parts of the Pacific Ocean, namely, the areas with very soft bottom sediments, such as red clay, where other benthic animals can barely live. There the sessile animals utilize iron-maganese /80 concretions, shark teeth, spicules of silicon sponges and remains of other organisms as a substratum to which to cling. One can always observe tubes of small polychaets, remains of Stephanoscypus and actinians on such objects.

As to the effect of abyssal fauna of the Arctic Ocean on the deep-sea fauna of the Bering Sea, it is not evident at all. There are almost no common deep-sea benthic animals, which is natural, inasmuch as the wide shallow area of the Chukchi-Alaska shelf and the narrow and shallow Bering Strait exclude such an exchange. In addition, the absence of pelagic larvae in many abyssal benthic animals obstructs such an exchange.

The distribution of such species as Elpidia glacialis, which occur in the Bering Sea, as well as in many deep depressions of Pacific and Indian Oceans and the sublitoral of the Kara Sea (Novozemel'skiy zhelob), evidently represents a complex case of broken yet somewhat ubiquitous species of the World Ocean.

The general distribution and composition of the abyssal benthic fauna of the Bering Sea can be divided into several natural regions:

region adjacent the Kamchatskiy proliv where a peculiar benthic fauna, dominated by epifauna, has developed;

western (Komandorskaya) depression with diverse and quantitatively numerous benthic population;

central (Aleutian) depression with a noticeably pauperized population;

submarine khrebet Shirshova representing a transitional zone between these two depressions;

Aleutian deep region where the abyssal benthic fauna is subjected to a noticeable influence of the fauna inhabiting the island slope.

Benthic Communities of the Western (Komandorskaya) kotlovina

The abyssal communities are widely distributed in the W depression, but little is known about them. Only six representative stations (603, 618, 620, 1599, 1604 and 1615) at depths ranging from 2620 to 3940m can be utilized for the characterization of these communities. Altogether 5 bottom grab and 4 trawl samples were obtained at these stations, which is of course a small number. There is no doubt that these communities consist of several groups, but more data are needed to describe them. Very soft (at places even liquid) clay or aleurite-clay mud with admixture of concretions or pebbles are typical of the region inhabited by these communities.

Judging by the existing quantitative samples, the total biomass of the benthic fauna varies from 3.8 to 32.5g/m^2 (mean v. = 14.2g/m^2). The highest values occur in areas near the continental slope, the main contributors being large holoturians, polychaets (as much as 6g/m^2), amphipods (as much as 7g/m^2), etc. Such a high total biomass of benthic animals shows that foraging conditions are very good on the bottom. Nearness to the slope, the rich sublitoral flora and fauna of the western Bering Sea, the /81
currents transport water rich in organic substances from Anadyrskiy z. and Olyutorskiy z., mixing of water, which evidently involves the deep water of the W depression--all this furthers the accumulation of organic remains on the bottom and in bottom water layer as well as the water exchange.

12. Community Spongia--*Phascolion lutense*--*Eremicaster tenebrarius*--*Heptabrachia gracilis*--*Onuphis (nothria) picnobranchiata*

This community evidently is distributed in the central area of the W depression (Fig. 2) but there is only one station (618) that characterizes this community. Two samples were obtained by bottom grab from a depth of 3875m, and one obtained by the Sigsby trawl from a depth of 3940m. The bottom consisted of gray aleurite-clay mud with concretions and a few pebbles. The total biomass of 3.8g/m^2 is made up mainly of large Onuphis (Nothria) picnobranchiata; the length of tubes covered with a thin mud layer and long spicules of sponges and foraminiferal shells reached 110mm. These spicules obstruct the submergence of tubes into the semiliquid mud (Levenshteyn, 1957). A complete biocoenosis of epiphites congregates on the tubes, namely: foraminifera, Stephanoscyphus, actinians and polychaets Thelepus cincinnatus. Hence, it is seen how important is the hard substratum for the animals that live on the liquid mud.

The community, based on samples of St. 618, is rich and variegated. There are many various deep-sea sponges, leaf-like, spherical and tree-like. Among them one can observe Asbestopluma lycopodium and a number of Triaxonida species. The spicules of sponges are used as substratum by small actinians, Stephanoscyhus and even small Golfingia improvisa (in corals of sponges). Phascolion lutense occurred in large quantities, establishing this species as a leading group (approximately 200 ind per trawl catch and many empty tubes). This abyssal form living in short and thick mud holes deserves special mention. Large quantities of Ph. latense occurred only in the central part of the W depression, but singly the species occur in the S area, on the boundary with the C depression. Undoubtedly, Ph. lutense is more widely distributed in the W depression and only lack of data prevents us from establishing it. This species also occurs in the N part of the Pacific Ocean, on the slopes of depressions and in the Indian Ocean (Murina, 1961). Its development in the abyssal portion of the Bering Sea attests to a direct connection between this region and the abyssal fauna of the Pacific Ocean. The same is true of Porcellanasteridae--Eremicaster tenebrarius--which is the most numerous echinoderm of this community (about 40 ind. per trawl catch). This species, as E. pacificus which inhabits the depression, represents a typical oceanic form that is widely distributed in Pacific and Indian Oceans.

The community is also represented by holoturians, such as Scotoplanes murrayi, Sphaerothuria bitentaculata and Cucumaria abyssorum (each consisting of 10-15 ind. per catch). Various Molpadonia and Brisingidae are also typical of the community as well as the deep-sea ophiurs Ophiura irrorata, Ophiocantha bathybia, etc.

As to the pogonophores, Heptabrachia gracilis and Siboglinum fedotovi, they, together with Polybrachia annulata, are the most widely distributed species of pogonophores in the Bering Sea. At places their quantity is so great that the lower part /82 of the trawl is entangled with thin, long, red tubes (diam. 0.25mm, length as much as 25cm).

At station 618 we observed the whole complex of abyssal Pacific and endemic polychaets (?). There were reasonable quantities of large Onuphis picnobranchiata (as much as 15cm long), Jasmineria filatovae Lev. (about 20 ind.), large Melinnexis annenkovae and its tubes; in addition, one can encounter the abyssal Pacific species Lumbriconereis abyssicola (about 20 ind.) and lastly very large (as long as 12cm) Asychis ramosus, a new species, lately discovered in the Bering Sea (Levenshteyn, 1961).

All of these forms are followed by a group of eurybenthic and widely distributed species: Thelepus cincinnatus, that stick to the tubes of Onuphis picnobranchiata, Terebellides stroemi, Spiochaetopterus typicus, Pista cristata, Nephthys malmgreni, etc. Bivalve mollusks are represented by the large Neilo pacifica, a number of species of genera Tindaria and Cuspidaria; Gastropods consist of various Mohnia, Liomesus and Polynices.

Several colonies of hydroids Lafoea fruticosa gracillima, as well as small actinians and Stephanoscyphus that sit on the spicules of sponges make up most of the Coelenterata. Of great interest are findings of pennatularians Kophobelemnon biflorum Past. (5 ind.) each of which supports one sea anemone. Evidently it utilizes the hard inner stem of the colony as a support for staying above the ground (i.e., both represent a peculiar epifauna of soft bottom). In addition to the Bering Sea, K. biflorum occurs on the slopes of the Kurile-Kamchatka Depression and off the Pacific coast of America.

Tatjanella gracilis is another new species inhabiting the area of the community, which was also observed in Kamchatskiy proliv (d. = 4820m, 64 ind.) and on the slopes of the Aleutian Depression (d. = 5020m). This species is a good example for showing the penetration of abyssal fauna across the deep areas of Kamchatskiy proliv. Typical are Munna beringiana and Sclerocrangon zenkewitchi.

The community, as a whole, is typical of the central W depression which is not subjected to direct influence of the slope.

13. Community *Bathysiphon*--*Eremicaster*--*Psychropotes raripes*--Pogonophora (*Heptabrachia gracilis* and *Siboglinum fedotovi*)--Amphipoda

This rich community inhabits the N part of the W depression (Fig. 2). Samples from two stations, 1604 and 1599, characterize it. The former lies at the depth of 3680m on gray clayey diatom mud (Sigsby trawl), the latter at the depth of 2995-3390m on the same type of bottom (bottom grab, Sigsby trawl). The total biomass makes up 15.6g/m^2 (i.e., four times greater than in the center of the depression).

This community is characterized by a great variety of benthic fauna and by large sizes of animals. The tubes of rhizopods Bathysiphon are as long as 110m, holoturians Psychropotes 30 cm, the body length of polychaets Asychis ramosus reaches 12cm, its tube 25cm. Large sizes were also observed in Phyllochaetopterus claparedii (inhabiting thick leathery tubes), Maldane sarsi, Aphrodite talpa, shrimps Sclerocrangon zenkewitchi, Pantopoda (Colossendeis), Pasiphea princeps, Hymenodora glacialis, H. frontalis, mollusks Cuspidaria, /83
etc. Numerous holoturians and sea stars Eremicaster tenebrarius (St. 1604) and E. pacificus were filled with mud. It was here at the base of the continental slope that one could observe an increase in organic carbon, in comparison with open parts of the depression (as much as 2%, according to Lisitsyn, 1959). A luxurious development of infauna which feeds on the organic matter of the bottom tends to confirm this.

In addition to Bathysiphon, the leading forms of the group are Eremicaster: E. tenebrarius, in the more seaward sector of the habitat, and E. pacificus near the slope of the continental terrace (see distribution of the species in the central depression). The former was represented by about 50 ind., the latter by 13 ind. in trawl catches. The same two species of pogonophous (Heptobrachia gracilis and Siboglinum fedotovi) that were observed in the preceding community occurred here in large quantities (the lower part of the trawl at St. 1599 was entangled by their tubes). Large (as long as 30cm long) holoturians, Psychropotes raripes, a large quantity of semitransparent small Scotoplanes (murrayi?), Sphaerothuria bitentaculata and various Molpadonia are the most typical representatives of the community. There are large quantities of various sea anemones (St. 1599) of differing forms and sizes (as high as 3cm) with sharp rigid tentacles and soft basal disk that supports it on the soft bottom. Only the crown of tentacles is seen on the surface, on which small Stephanoscyphus are sitting.

Interesting are Kophobelemnon biflorum (St. 1604, 8 ind.) Pennatula phosphorea (15 cm long) and Umbellula (St. 1599, 70 cm long), as well as colonies of Radicipes. In addition, very large Aphrodite talpa, Maldane sarsi and Pantopoda--Colossendeis were observed. Numerous amphipods of family Ampelescidae were noted in mud domes (as much as 300ind/m^2, the biomass being 7.2g/m^2; a trawl catch contained more than 600 ind.) as well as large Sclerocrangon zenkewitchi, and Hymenodora frontalis and H. gracilis.

Mollusks are weakly represented, probably due to a soft and thin upper sediment layer, which is not suited for crustaceans. There were several small Taxodonta (Neilonella, Malletia, Yoldiella) and Cuspidaria make up almost the entire group of mollusks. Single specimens of Buccinidae were observed, and only Chaetodermatidae (two species) were moderately represented (18 ind. in a trawl catch).

Judging from the general composition of fauna, two ecological groups predominate in the given community: the thriving infauna (mud-eaters: holoturians, sea stars, maldanid-worms, etc.) and epifauna of soft sea bottom (actinians, pennatularians, sponges, etc.). Since the habitat lies near the slope, the feeding conditions are better, and as a result the value of biomass is higher and the size of individual animals is greater. The oceanic features of the community are, however, preserved: the so-called slope forms are absent and the oceanic abyssal forms predominate.

14. Community *Bathysiphon--Maldane sarsi--Ophiura leptoctenia--Golfingia improvisa--Melinnampharete eoa*

This community inhabits abyssal regions of the W depression which is bounded on the lower horizons of the continental slope (Fig. 2). Two stations provided the data on the community: St. 603 at the depth of 2970m on clayey-aleurite mud with admixture of pebbles (bottom grab) and at the depth of 2620-3030m (Sigsby trawl) and St. 620 at the depth of 3480m on clayey mud (bottom grab). The total biomass amounted to 4.0 and 30.0g/m^2, consisting mainly of polychaets, holoturians, actinians, etc.

In addition to large rhizopods Bathysiphon, the leading forms include polychaets, 1/3 of which is made up of the widely distributed eurybathic Maldane sarsi. In addition, large quantities of the following species were observed: Melinnampharete eoa (N Pacific Asian sp.) and Potamilla abyssiola (Pacific abyssal sp. which was also noted in Kamchatskiy proliv and in the abyssal part of SE Kamchatka sector). Large quantities of Phyllochaetopterus (empty leathery tubes) and Melinna cristata link this community to the other communities inhabiting the abyssal part of the W depression.

We observed Ophiura teptoctenia to be typical of the continental slope and, to a degree, of the sublitoral. Its presence (as well as that of Maldane sarsi) confirm the association of this community with the fauna of shallow slopes. The small Golfingia improvisa thrives here (30 ind/m^2 and 1.0g/m^2); it lives in the empty tubes of Foraminifera. Also echinoderms occur here, notably the small holoturians Sphaerothuria bitentaculata and Cucumaria abyssorum, as well as Chiridota. Large Psychropotes as well as sea stars Porcellanasteridae (Eremicaster tenebrarius and E. pacificus) do not occur here. Other typical forms for this area are the small brittle urchin Pourtalesia laguncula berinigiana, stars Hymenaster quadrospinosus and ophirus Ophiocantha bathybia, as well as the larger mollusks of genera Leda, Neilo and Neilonella, crustaceans Hymenodora frontalis and H. gracilis.

Pogonophores, typical of the preceding groups, are absent: Siboglinum fedotovi and Heptabrachia gracilis are replaced by Polybrachia annulata which are widely distributed in the abyssal sectors of the Bering Sea. Their rigid dark-red or almost black tubes, 50-60cm long (diam. 1.1mm) often support small chitinoids Stephanoscyphus, foraminiferous, sponges, hydroids, alcyonarians, small actinians Hormathiidae, serpulids, bryozoans, etc. According to Ivanov (1960), such a quantity of various epibionts indicates that the greater part of the rigid tubeof Polybrachia annulata protrudes above the bottom.

Benthic Communities of the Central (Aleutian) Depression

In the central depression the benthic fauna is less dense and more pauperized than in the W depression. The total biomass is smaller and the species composition less diverse except for several groups, such as pogonophores. Abyssal forms here are well developed, but their composition has not yet been investigated. There are Triaxonida and Tetraxonida groups with extremely soft and brittle skeleton. They usually inhabit soft mud bottoms where their spicules form a peculiar cover that penetrates the mud sediments. Individual long spicules are often used as supports by actinians Stephanoscyphus or polychaets.

Pogonophores are widely distributed in the central depression. At places oen can observe their colonies consisting of 8-10 /85 species. Some of them have relatively rigid tubes, (e.g., Polybrachia annulata) with one end in mud and the other above it. In such "clumps" the tubes of pogonophores lie near one another, which obviously facilitates their reproduction. Ivanov (1960) writes that pogonophores are dioecious animals and that they do not have the pelagic larval stages. Instead, the fertilization of eggs and the development of young take place in the maternal tube whose diameter does not exceed fractions of millimeters. Thus, the young forms of pogonophores must independently leave the maternal tube and conquer certain resistance prior to making their own tube and assuming a sessile form of life. Possibly this factor explains certain patchiness in the distribution of pogonophores so that two adjacent sample-stations contain various compositions of species.

As to the thriving of pogonophores in the C depression, it depends upon certain isolation of the depression, soft sediments and sufficient food.

15. *Population of the N Periphery of the C Depression*

The given area near the continental slope is characterized by 3 scattered stations which are not convenient for a quantitative evaluation of the population: St. 612, depth 2597m on clayey bottom (bottom grab), St. 591, d. 2160, clayey bottom (Sigsby trawl), St. 1550, d. 2420m, greenish-gray mud with admixture of pebbles (Sigsby trawl). This area adjoins the lower horizons inhabited by the bathyal community of Yoldia beringiana. The total biomass varies from 0.05 to 5.7g/m^2. Pogonophores are absent, as well the typical abyssal forms such as Eremicaster tenibrarius and E. pacificus. Here, they are replaced by the rather eurybathic Ctenodiscus crispatus descending from the continental terrace (St. 591). Other illustrative representatives of the bathyal fauna are Chionoecetes angulatus angulatus, polychaets, Nephthys brachicephala and Streblosoma bairdi, pennatularians, as well as echinoderms Psilaster pectinatus, Chiridota and several other forms. Of the true abyssal forms one can encounter small amounts of large holoturians Paelopatides solea and bivalve mollusks Neilo (pacifica), crustaceans Sclerocrangon abyssorum, Hymenodora frontalis, etc. Empty tubes of Phyllochaetopterus indicate the presence of this typical abyssal form of the Bering Sea.

16. Community *Polybrachia annulata--Heptabrachia gracilis--Eremicaster*--Spongia

This community evidently occupies the entire center of the C depression of the Bering Sea (Fig. 2) which is very little affected by the action of coastal water and currents. The shallow straits of the E part of the Aleutian Islands and the /86 submarine Shirshov Ridge somewhat isolate this place. Similarly, the Bowers Ridge contributes to the isolation of the given area.

Six stations characterized this community: St. 541, d. 2796-3260m (N part of depression) clayey mud with admixture of pebble (bottom grab, Sigsby trawl); biomass 7.8g/m^2; St. 1552, d. 3490m, greenish-gray mud (bottom grab); biomass 18.5g/m^2; St. 539, d. 3747m, dense gray clayey mud (bottom grab, Sigsby trawl), biomass 0.1g/m^2; St. 535, d. 3874m; gray aleurite mud (bottom grab, Sigsby trawl), biomass 0.1g/m^2; St. 970, d. 3819m, clayey mud (bottom grab), biomass 0.5g/m^2; St. 1410, d. 3980m, red diatom clayey mud (Sigsby trawl). The last station was occupied in the S part of the region, between the Bower's Ridge and Aleutian Islands. This community evidently occurs in the entire C depression; but, regrettably, the Vityaz' activity was limited there.

The highest total biomass of benthic fauna (7.8 and 18.5g/m^2) was observed in the N part of the habitat, the main contributor being polychaets, namely, large maldanids (A..chis ramosus, Maldane sarsi), Glycera onomichiensis, etc.

Pogonophores are represented by 10 species of which 2 (Polybrachia annulata and Heptabrachia gracilis) are most widely distributed, forming large concentrations at places. The greatest concentrations of pogonophores were observed at St. 541 (10 species of 6 genera, including 4 species of Siboglinum genus); at St. 972, pertaining to the neighboring community (d. 3788m), 9 species of pogonophores were observed, 5 of which belong to the Siboglinum genus. Pogonophore populations were observed at 5 stations out of 6 stations (being absent only at St. 1410, d. 3980m in the S part of the habitat).

Sea stars Eremicaster tenebrarius were observed at 3 stations (535, 539 and 1410) and E. pacificus at 1st (541). As in the W depression, E. pacificus occurred at the marginal station nearest to the base of the continental slope. The number of sea stars varies per trawl sample from 2 to 15, which, accounting for the paucity of the C depression, is a reasonable amount (in the W part the number of sea stars amounted to 50 ind. per trawl catch. Lastly, deep-water sponges, Triaxonida and Tetraxonida, also represent leading forms. Especially well represented were sponges at St. 539 (d. 3747m, N part of the region occupied by the community) and at St. 537 (d. 3874m, C part). Regrettably, only part of the samples with bathyal sponges have been processed. Therefore, it is impossible to indicate the leading species. Thus, at St. 539 Cladorhiza abyssiola and Cl. rectangularis predominate. They are the basic forms here. The form and size of sponges are diverse. There are sponges with branching tree-like tubes and with small compressed tubules. Stephanoscyphus use sponges as a base. Their inner canals are occupied by sipunculides Golfingia improvisa. Individual large spicules of sponges (up to 15-16cm long) are used as substratum for small abyssal actinians and by Stephanoscyphus. The sponges sampled at St. 535 are not less diverse, though the fauna in the area was scarce. Here the sponges differ by their form, some /87 being cone-shaped, others beaker-shaped, rounded or laterally compressed. Large quantity of spicules, noted in the bottom, evidently do not further the development of infauna. Rhizopods are poorly represented. Bathysiphon species, which occur in large quantities in the W depression, are almost absent here. Only 1-2 times did we observe fragments of empty sponges. H Haplophragmoides subglobosum, Rhabdammina abyssorum, R. linearis, etc. occur in limited quantities on soft (even liquid) muddy sediments of the C depression.

The development of the "soft-bottom epifauna" (St. 535, 1410, etc.) is rather luxurious. We observed Ascidia (Boltenia) actinians and Stephanoscyphus, Umbellula; it is possible that the Polybrachia annulata inhabiting the rigid elastic tubes belong to the same ecological group, inasmuch as its tubes are elevated over the bottom. To this group also belong the soft bryozoans Kinetoskias (St. 539) which adhere to pebbles or concretions. Infauna is well developed, but noticeably weaker than in the W depression.

Holoturians represent the echinoderm population, namely: Cucumaria abyssorum, Sphaerothuria bitentaculata, Molpadonia, as well as Brisingidae, Ophiocantha bathybia, Ophiura leptoctenia, Amphiura carhara, Aeropsis fulva and Pourtalesia. Polychaets are represented by Macellicephala abyssicola, Travisia profundi (observed only in the C part of the Bering Sea and in Kamchatskiy proliv), Lumbriconereis abyssocila and new species--the large Asychis ramosus and Jasmineira filatovae. In the N part of the habitat one can encounter Melinnampharete eoa, Pista cristata, Glycera onomichiensis, etc.

Sipunculids are represented by small Golfingia improvisa, which settle in the tubes of agglutinated rhizopods Hyperammina and in the canals of sponges. Phascolion lutense, which lives in mud tubes, was observed only once (St. 1410). Echiurids were represented by Alomasoma nordpacifica which, as far as is known, inhabit only the C depression (St. 539 and 541). The number of mollusks is limited indeed, as it is natural under the existing conditions. Bivalve mollusks are represented by very small Nucula darella, Yoldiella derjugini, a few Tindaria and Neilo, as well as Axinopsis, Cuspidaria and Mycnera. The small Chaetodaerma are common, as well as small Siphonodentalium (of Scaphopoda) and Mohnia (of Gastropoda).

Crustaceans are seldom observed, namely Hymenodora glacialis, H. frontalis, Munidopsis beringiana, young Sclerocrangon zenkewitchi, Scl. abyssorum, Pantopoda, Nymphon hodgsoni, Colossendeis japonica, etc.

Thus, the given community is composed of several ecological groups of benthic animals; of the typical infauna which is characterized by the animals that inhabit the bottom and feed on it; of the abyssal epifauna consisting of numerous and diverse sponges and other animals which forage in water and, lastly, of the soft- /88 bottom epifauna whose development is determined mainly by the soft clayey mud.

17. Community Spongia--*Polybrachia annulata*--*Heptabrachia gracilis*--*Travisia profundi*

This community seems to embrace from the N and W of the preceding community (Fig. 2), extending in a wide belt SW from 60°N. Bypassing in the W the Bower's Ridge (where bathyal sponges thrive) it runs toward the great depths of Kamchatskiy proliv where it gradually wedges out. Nine stations represent this community (530, 531, 537, 614, 617, 965, 966, 972 and 1557) from which 8 bottom grab and 4 trawl samples have been obtained. St. 531 was occupied on the slope of a relatively shallow bank where the abyssal character of fauna is preserved, though sediments consist of sand.

This community differs from the preceding one by an increased role of deep-water sponges, the appearance of polychaets Travisia profundi and the absence of sea stars Porcellanasteridae; the common features for both of these communities are the presence of a considerable quantity of pogonophores Polybrachia annulata, Heptabrachia gracilis, etc., as well as the constant presence of sponges that develop on soft muddy sediments. The total biomass of benthic fauna is similarly rather small. The only exception is St. 531, where at the depth of less than 2000m on a muddy sand bottom of the submarine elevation one can observe large quantities of sponges which make up almost 1/3 of the biomass. Here for the first time we learn that the Bering Sea is inhabited by large Maldanella harai (deep-water form of Pacific, Indian and Atlantic Oceans), Travisia profundi replace here Travisia pupa and Harmothoe pellucelythris, forms which are associated with the continental slope (Levenshteyn, 1961).

Trawl samples taken at this station (d. 1730-2172) contain numerous sponges mainly Forcepia fabricans. Also typical was the bathyal Chionoecetes angulatus a., some echinoderms of Deimatidae and Myriotrochus groups. Pogonophores were represented by Polybrachia annulata, Heptabrachia gracilis and Siboglinum pellucidum.

Crustaceans were represented by Hymenodora glacialis, H. frontalis, Sclerocrangon abyssorum. These data enable us to consider the population on the submarine elevation as a shallow water modification of the group that surrounds it.

Except for St. 531, the bottom depth in the area occupied by the given group varies from 2359 to 3936m. The clayey mud is usually very soft. Ubiquitous are deep-water sponges (Triaxonida and Tetraxonida) with different forms. They leave large quantities of spicules on the bottom. These spicules, which are sometimes 10-20cm long, are used as substratum by small sessile actinians, such as Stephanoscyphus, etc. The base of the actinians which embraces the spicules is stretched along its axis.

As to the various rhizopods, they were encountered in scattered locations, representing mainly Rhabdammina abyssorum pacifica, which are similar to Hyperammina, Rheophax nodulosus, Haplophragmoides nodulosus, Uvigerina peregrina, etc. Small numbers of /89 Bathysiphon (very large, sometimes 103mm) were observed (St. 1557, d. 3680m).

The main pogonophores were Polybrachia annulata and Heptabrachia gracilis, which at places (St. 972, 1557) occurred together with Siboglynum pellucidum, S. minutum, S. fedotovi, Birsteinia vityazi, Polybrachia barbata, etc.).

The most numerous polychaet was Travisia profundi which occurred at half of the stations, 10ind/m^2 and 5.8g/m^2. Some trawl catches contain as many as 40 ind. Travisia papa was not so numerous. In addition, we observed Macellicephala abyssicola, Asychis ramosus, Leanira areolata. Crustaceans were represented by Hymenodora glacialis, H. frontalis, Sclerocrangon zenkewitchi, Scl. abyssorum and Munidopsis beringiana. Echinoderms consisted mainly of small holoturians, such as Sphaerothuria bitentaculata, at places Ophiura leptoctenia and various Molpadonia which were not determined to species.

At St. 617, on the slopes of Khrebet Shirshova, we observed large holoturians, notably, a new species Paelopatides solea (Baranova, 1955). This complex includes acidians, Boltenia ovifera, sometimes Umbellula and Chondractinia. Thus, the epifauna of soft bottoms is little represented.

18. Community of Bathyal Epifauna in Kamchatskiy proliv *Spongia--Stylasteridae--Bryozoa--Brachiopoda*

Kamchatskiy proliv, where the maximum bottom depth is 4420m, is the deepest strait of the Aleutian Islands. Only proliv Blizhniy has the depth of 2000m, other straits are shallower. Thus, Kamchatskiy proliv is the deepest strait of the World Ocean within the boundaries of the continental slope (Udintsev, et al. 1959).

Judging by the distribution of benthic fauna in the strait and in the adjacent abyssal sectors of the Bering Sea and Pacific Ocean, the significance of Kamchatskiy proliv in the exchange of benthic fauna between the ocean and the sea is very great. It is a real gateway between the two water basins. The true abyssal benthic forms can live and propagate here. It is evident that strong currents are present at depths exceeding 2000m. Some of them even reach the bottom layer of Kamchatskiy proliv, causing the formation of a rigid bottom and affecting the distribution of abyssal benthic fauna. In places where the bottom is uneven and rough, the force of currents weaken and soft sediments accumulate with a different fauna.

Here, one can also observe a rich infauna (Fig. 2). Regrettably, the limited amount of samples taken from the great depths of Kamchatskiy proliv does not enable us to present a good quantitative evaluation or benthic fauna. But inasmuch as this is a unique strait, it is of great value to discuss its benthic fauna in a greater detail.

The community of Spongia--Stylasteridae--Bryozoa--Brachiopoda, /90
undoubtedly represents a special group of abyssal benthic fauna typical of sublitoral epifaunae community that is widely distributed in shallow regions of seas. They are associated with rigid bottoms covered with boulders as a result of permanent and tide

currents. The sessile epifauna is usually characterized by the predominance of sponges, bryozoans, hydroids, brachiopods, barnacles, ascidians and a number of large motile forms of echinoderms, crustaceans, gastropods, worms, etc. The epifaunal community of shallow zones is usually characterized by high values of biomass and by a variety of benthic species of animals. Often the total biomass reaches $1kg/m^2$ or even more. Of course, the abyssal epifaunal community that has been observed in Kamchatskiy proliv cannot have a very high biomass; besides it has a different composition of benthic fauna in which abyssal forms prevail. However, considering all these differences, the ecological aspect of the community remains the same as in the sublitoral zone. As can be expected, sessile forms prevail. As to the way of feeding, these animals represent typical seston and plankton feeders. It is in place to recall in this case the statements of Thorson (1958) about parallel communities.

Regrettably, only one station (626) characterizes the abyssal epifauna. It was occupied at the depth of 2393m on the E slope of Kamchatskiy proliv. The bottom was covered with boulders, pebbles, gravel and cliffs. As a result, the Sigsby trawl was damaged at this station. Though part of the catch was lost, the sample gives a good idea about the rich and specific epifauna of this location.

Of greatest significance are various silicon sponges (Triaxonida and Tetraxonida). Quantitatively prevail Melonchela clathriata (new genus and species of sponges described by V. M. Koltun). There were also hydrocoralls, such as Stylaster eximius which form small clusters of communities. The limited colonies of bryozoans (10 or more ind.) use boulders as substratum. The cork forms of Membranipora cover the surface of boulders. Relatively Brachiopoda (Frieleia halli and Gryphus sp.) constitute one of the typical components of the community that uses boulders and pebbles as substratum. The number of hydroids is limited: Cryptolaria flabellum, Filellum serpens and the usual Abietinaria abietina. Pavonaria finmarchica and Gorgonaria are also typical of rocky bottom. Similarly, the sessile Lepidopleurus alveolus which occurred here in large numbers. There also were young Velutina Potamilla abyssicola, etc. Single ascidians, Boltenia ovifera supplement the epifauna. In addition, the sample contained a number of new species of ophiurs, such as Astrophiura chariplax Ophiocantha nutrix and Ophiolence oxycraspedon (described by Baranova, 1955).

The nearness of the station ot the continental slope is, of course, responsible for the presence of a number of species that are associated with shallower depths: Ophiura leptoctenia, large Chionoecetes angulatus angulatus, Nucula tenuis, Margarites striata cinerea, M. ochotensis avachensis, polychaets Melinna ochotica, Potamilla abyssicola. Amphipoda seem to be limited in numbers (6 species were represented, 2-3 ind. of each): Schisturella pulchra, Paradalisca abyssi, Phippsiella longicirra, etc. Of interest are the large Gnathophausia gigas and Hymendora frontalis. Various sea stars of genera Crossaster and Ceramaster also characterize the epifauna. In addition, we encountered one specimen of sea lilly, a rare form from the abyssal part of the Bering Sea. Cephalopods were represented by the abyssal Octopus leioderma. Other mollusks, notably the bivalves, were scarce.

Thus, the community has a dual character: epifaunal animals and animals with a wide depth range in their distribution.

CONCLUSIONS

Summing up the discussion, the following conclusions can be drawn with regard to the composition, distribution and quantitative characterization of benthic communities in the W part of the Bering Sea.

First of all, it is seen that the distribution of benthos in the sublitoral of the Bering Sea is extremely irregular when compared with the benthos inhabiting the bathyal and abyssal sectors of the sea. This irregularity and even spottiness is especially noticeable when examing the quantitative data on the characteristics of benthic communities and their groups. These data enable us to trace the behavior of various benthic groups in connection with changes in living conditions. In places where these conditions are optimal, the above species predominate quantitatively, becoming leading or typical forms, and they become casual and secondary forms if the conditions worsen. Due to pronounced changes in living conditions on the Bering Sea shelf, one can naturally observe a certain mosaic pattern in the distribution of benthic animals. This especially clearly manifested in places where the community includes shallow-water bivalve mollusks that have a tendency toward spotty distribution in general due to irregularities in the settlement of their larvae forms.

The irregular composition and distribution of benthic communities on the Bering Sea shelf, especially in its vast E sector, is a significant aspect of the community depending upon the character and distribution of benthic sediments water temperature and its seasonal changes. Thus, the presence of a huge mass of water with low temperature, which is formed each summer in the central part of the shelf due to the residual winter cooling, contributes to the development of the large community of Macoma calcarea--Ophiura sarsi--Maldane sarsi--Nucula tenuis and other smaller communities. These communities containing a number of leading forms, constituted by arctic and arctic-boreal species represent the so-called "coarctic" group, i.e., an analogous (not homogenious) arctic community (Brodskiy, 1956). This population, which was formed under the influence of local and temporary conditions characterized by low temperature, is not directly associated with the cryophilic forms of the arctic proper. It contains a number of northern-boreal Pacific forms which separate it from the true Arctic communities.

As a rule, the benthic community of the Bering Sea shelf has a rather large biomass, fluctuating from 25 to 1000g/m^2 (the latter figure pertains to epifauna). Rich resources of organic matter in the form of live organisms in the sublitoral of the Bering Sea, (including coastal macrophytes) undoubtedly provide a constant supply of organic matter and detritus to the lower belts of the slope and the contiguous abyssal sectors of the Bering Sea. This circumstance exercises a great influence on the increase of the quantity of organic matter in bottom sediments and on the increase of biomass of benthic fauna in the entire deep S part of the Bering Sea. Thus, the total biomass of benthic fauna may here reach considerable magnitudes (as much as 30g/m^2 at depths exceeding 3000m); especially in the W depression. /92

With an increase in depth, the mosaic pattern in the distribution of benthic fauna gradually smoothes out. The more uniform the distribution of benthic sediments, temperature and other characteristics of lower water layers, the greater the effect on the general distribution of benthic fauna. Thus, the continental shelf is characterized by zonal distribution of the Brisaster and Yoldia beringiana groups which are coordinated with bottom relief, and the distribution of sediments and water masses (Fig. 2). These leading forms are followed by a number of species of other animal groups, which are also associated with the continental slope. These bathyal communities embrace the slopes of the Bering Sea, projecting far into the ocean and preserving their ecological features.

Abyssal communities of the benthic fauna, when compared with the communities inhabiting the continental slope, especially its sublitoral belt, have a great many typical forms. First of all, the boundaries of these abyssal communities become more diffuse and the habitats expand. This is in complete agreement with a more uniform distribution of factors of the medium in abyssal sectors of the sea, first of all, with regard to temperature, bottom sediments and food resources for benthic animals. This is coordinated with a more rarefied and pauperized population in comparison with the higher zones of benthic groups. A number of benthic groups do not inhabit abyssal depths, while a number of abyssal benthic groups are absent in sublitoral.

The most typical feature of abyssal communities in the Bering Sea is their oceanic character with regard to the main inhabitants. From this point of view, the abyssal fauna of the two basins represents a unified group with its counterpart in the abyssal deeps of the Pacific Ocean. Moreover, it should be pointed out that the abyssal community of the Bering Sea is completely devoid of abyssal components of the Arctic Ocean. This repeatedly underscores the statement concerning the insurmountability of the shallow Chukchi-Alaska shelf zone by the two benthic groups.

The greatest role in the maintenance of contact between the Bering and Pacific abyssal benthos is undoubtedly played by the western straits, the Blizhniy pr. and especially the Kamchatskiy pr., whose bottom depths exceed the bottom depth of the W depression of the Bering Sea. These conditions facilitate the influx of Pacific water and its fauna into the Bering Sea. The considerable force of the deep current in the upper abyssal layers is /93 confirmed by the deep-water epifauna on the E slope of Kamchatskiy proliv (at the depth of 2500m).

One of the typical properties of abyssal benthic communities is the presence of two ecological groups, the quantitatively predominant infauna (with mud and detritus eaters in majority) and the epifauna of soft bottom, a peculiar group of abyssal animals adapted to life on soft muddy bottom. These animals are somewhat elevated above the bottom (with the aid of stalks, tubes, etc.), which evidently helps them avoid the unfavorable conditions that exist in the lowermost part of the ocean (oxygen deficit, accumulation of CO_2) and facilitates their foraging. Filterable forms are in majority.

Lastly, one of the most important properties of abyssal communities is the method of their reproduction and development, which are important factors in the formation of benthic communities. In analogy with arctic species, Thorson (1952, 1955, 1957, 1958) considers that the abyssal benthic animals, which live in deeps where the water temperature is almost constant (2°), must reproduce themselves in a manner similar to the arctic benthos. They should lack or have a short pelagic larval stage; their eggs should be large and rich in nutrients so as to secure food for embryos because the upper water layers with their food resources cannot be reached by the abyssal benthos.

These assumptions appear to be approximately correct. The latest Vityaz' and Galatei studies support them. Moreover, new data have been collected by Ivanov (1960), namely that the eggs of abyssal benthic form are large (up to 0.65m) and the original development of embryos takes place in ducts. Especially large eggs are laid by sea stars Porcellanasteridae (0.5mm) (Madsen, 1961). He points out the lack of pelagic larval stage, which is also known to be absent in polychaets.

Thus, the specific living conditions in abyssal depths are reflected in the biology and ecology of benthic animals, and, consequently, in the formation and general features of benthic communities at great ocean depths.

Reviewing the entire Bering Sea community, its composition and distribution, as well as eoclogical aspects and food resources, we have to agree with the Thornson's theory (1958) of parallel communities of benthic fauna. The benthos inhabiting the shelf as well as the slopes of Bering Sea has certain common features with the benthos of the Sea of Okhotsk, the Pacific coast of Kamchatka, North Atlantic and other northern seas. Similar depths and nature of bottom sediments, similar bottom water temperatures and other features contribute to certain similarities in benthic animals with regard to ecological and zoogeographical factors. Therefore, the vast community with infauna in majority is of great interest. In this case the leading forms are four forms which are widely distributed in the seas of the N hemisphere, namely: Maldane sarsi, Ophiura sarsi and Nucula tenuis. In the Bering Sea this community inhabits a large area in the C part of the shelf where the bottom water temperature is low (as a result of residual winter cooling). The quantitative significance of these and several other species of the community changes in accordance with local conditions, which determines the creation of many commercial groups. This community is also known to exist in the Sea of Okhotsk (Ushakov, 1955; Savilov, 1961), in the Pacific coast of Kamchatka (Kuznetsov, 1963), in S part of the Kara Sea (Filatova and Zenkevich, 1957), in many areas of the Barents Sea (Brotskaya and Zenkevich, 1939; Zatsepin, 1962), in the W Atlantic Ocean (Thorson, 1952, 1958). In almost all of the regions Macoma calcarea predominates. Various small mollusks, polychaets and ophiures are also significant. The same can be said about the litoral community of Macoma baltica which inhabits the upper sublitoral of the Bering Sea together with Echinarachnius parma community. Off the Murman coast the community of M. baltica is widely distributed over the litoral. /94

The Brisaster community is similarly distributed in many seas. Two species of echinoderms are very widely distributed over the upper belt of the Bering Slope, off the E coast of Kamchatka and in the Sea of Okhotsk, forming here a typical community. It also probably inhabits the N. Pacific Ocean depths. Brisaster fragilis is a leading form in N Atlantic and its marginal seas. It is ecologically similar to the Pacific group; only the latter groups contain a different composition of Atlantic polychaets, ophiurs, bivalve mollusks, etc. In the Barents Sea this community is also observed in lower sublitoral (Filatova, 1938). In addition to these communities, the Bering Sea is inhabited by several Pacific (endemic) communities which are not yet known to occur in other oceans (possibly part of them exist in the Atlantic O.). Here we have to deal with the widely distributed upper sublitoral form Echinarachnius parma which inhabits all of the shallow locations of Far Eastern Seas (possibly also the Pacific coast) with the lower bathyal community of Yoldia beringiana, etc. It seems, however, they occur also in many other areas which have not yet been sufficiently investigated by us.

BIBLIOGRAPHY

1. ANDRIYASHEV, A. P. (Geographical Distribution of Commercial Fishes in the Bering Sea and the Problems Associated With It). ISSLEDOVANIYA MOREY SSSR, Vol. 22, 1935.

2. ANDRIYASHEV, A. P. OCHERKI PO ZOOGEOGRAFII I PROISKHOZHDENIYA RYB BERINGOVA MORYA I SOPREDEL'NYKH VOD (Notes on the Geography and Origin of Fishes of the Bering Sea and Adjacent Waters). IZD. LGY, 1939.

3. BARANOVA, Z. I. (New Species of Echinodermata in the Bering Sea). TRUDY ZOOL. INST. AN SSSR, Vol. 18, 1955.

4. BARANOVA, Z. I. (Echinodermata of the Bering Sea). ISSLED. DAL'NEVOST. MOREY SSSR, Vol. IV, 1957.

5. BELYAYEV, G. M. (Quantitative Distribution of Benthic Fauna in NW Bering Sea). TRUDY INST. OKEAN. AN SSSR, Vol. 34, 1960.

6. BIRSHTEYN, Ya. A. and VINOGRADOV, L. G. (New Data on the Fauna of Decapoda in the Bering Sea). ZOOL. ZH., Vol. 32, No. 2, 1953.

7. BRODSKIY, K. A. (Calanoida of the Far Eastern Seas of USSR and the Arctic Basin). OPREDELITEL' PO FAUNE SSSR, No. 35, 1950.

8. BRODSKIY, K. A. (Zonation of Pelagic Sectors of Far Eastern Seas and the Adjacent Pacific Sectors Based on the Distribution of Calonoida). TRUDY PROBL. I TEMAT. SOV. ZIN AN SSSR, Vol. VI, 1956. /95

9. BROTSKAYA, V. A. and ZENKEVICH, L. A. (Quantitative Account of the Benthic Fauna of the Barents Sea). TRUDY VNIRO, Vol. IV, 1939.

10. VINOGRADOVA, N. G. (Data on the Quantitative Evaluation of Benthic Fauna in Some of the Gulfs of the Bering And Okhotsk Seas). TRUDY INST. OKEAN. AN SSSR, Vol. IX, 1954.

11. GALKIN, Yu. I. (Gastropods of Far Eastern and Northern Seas of USSR). OPREDELITEL' PO FAUNE SSSR, Vol. 57, 1955.

12. GERSHANOVICH, D. Ye. (New Data on the Recent Sediments of the Bering Sea). TRUDY VNIRO, Vol. 46, 1962a.

13. GERSHANOVICH, D. Ye. (Bottom Relief and Recent Sediments on the Bering Shelf). TRUDY VSES. N.-I. INST. RYBN. KHOZ. I OKEAN., Vol. 46, 1962b.

14. DERYUGIN, K. M. (Zones and Biocoenoses of zal. Petra Velikogo). In Sb. posv. nauchnoy deyat. N. M. Knipovicha, 1939.

15. DERYUGIN, K. M. and IVANOV, A. V. (Preliminary Review of Papers Dealing With the Benthos of Bering and Chukchi Seas). ISSLED. MOREY SSSR, Vol. 25, 1937.

16. DERYUGIN, K. M. and SOMOVA, N. M. (Data on the Quantitative Evaluation of Benthos of zaliv Petra Velikogo). ISSLED. DAL'NEV. MOREY SSSR, Vol. 1, 1941.

17. DOBROVOL'SKIY, A. D. and ARSEN'YEV, V. S. (The Problem of Bering Sea Currents). PROBLEMY SEVERA, Vol. 3, 1959.

18. D'YAKONOV, A. M. (Echinodermata of zal. Syaukhu in the Sea of Japan). TRUDY GIDROB. EKSP. ZOOL. INST. AN SSSR V 1934 NA YAPONSKOM MORE, Vol. 1, 1938.

19. D'YAKONOV, A. M. (Echinodermata of the Chukchi and Bering Seas). KRAYNIY SEV.-VOSTOK SOYUZA SSR, Vol. II, 1952.

20. D'YAKONOV, A. M. (Echinodermata, Except for Noloturians, Collected by the Kurile-Kamchatka Exped. in 1947-1949). ISSLED. DAL'NEV. MOREY, Vol. V, 1958.

21. ZARENKOV, N. A. (notes on Some of the Decapoda and Crustacea of the Bering and Okhotsk Seas). TRUDY INST. OKEAN., Vol. 34, 1960.

22. ZATSEPIN, V. I. (Communities of Benthic Invertebrates of the Murman Coast of the Barents Sea and Their Connection With N Atlantic Communities). TRUDY VSES. GIDROB. OB-VA, Vol. 12, 1962.

23. ZENKEVICH, L. A. FAUNA I BIOLOGICHESKAYA PRODUKTIVNOST' MORYA (Fauna and Biological Productivity of the Sea). VOL. II, 1947.

24. ZENKEVICH, L. A. (A New Genus and Two New Species of Abyssal Echiurids of Far Eastern Seas and NW Pacific). TRUDY INST. OKEAN. AN SSSR, Vol. 23, 1957.

25. ZENKEVICH, L. A. (Abyssal Echiurids of the NW Pacific Ocean). TRUDY INST. OKEAN AN SSSR, Vol. 27, 1958.

26. ZENKEVICH, L. A. and FILATOVA, Z. A. (General Features of Composition and Quantity of Benthic Fauna in Far Eastern Seas and NW Pacific). TRUDY INST. OKEAN. AN SSSR, Vol. 27, 1958.

27. ZUBOV, N. N. OSNOVY UCHENIYA O PROLIVAKH MIROVOGO OKEANA (Fundamentals in the Study of Straits of the World Ocean). GEOGRAFGIZ, 1956.

28. IVANOV, A. V. (New Pogonophora of the Far Eastern Seas). ZOOL. ZH., Vol. 30, No. 3, 1952.

29. IVANOV, A. V. (Data on the Ecology and Geographical Distribution of Pogonophores). TRUDY INST. OKEAN. AN SSSR, Vol. 34, 1960.

30. KOBYAKOVA, Z. I. (Marine Fauna in S Sakhalin Region). VESTNIK LENINGR. GOS. UN-TA, Vol. 1, 1949.

31. KOLTUN, V. M. (New Genera and Species of Sponges--Spongia, Cornacuspongida) in the Bering and Okhotsk Seas). TRUDY ZOOL. INST AN SSSR, Vol. 18, 1955.

32. KOLTUN, V. M. (Cornacuspongidae of Northern and Far Eastern Seas). OPREDELITEL' PO FAUNE SSSR, No. 67, 1959.

33. KUZNETSOV, A. P. (Benthic Fauna of Kamchatka Region, Pacific Ocean and N Kurile Region). Candidates Dissertation, 1959.

34. KUZNETSOV, A. P. (Data On Quantitative Evaluation of Benthic Fauna in Kamchatskiy zaliv). TRUDY INST. OKEAN. AN SSSR, Vol. 41, 1961a.

35. KUZNETSOV, A. P. (Data on the Ecology of Several Mass Forms of Benthos in E. Kamchatka and N. Kurile Regions). TRUDY INST. OKEAN. AN SSSR, Vol. 46, 1961b.

36. KUZNETSOV, A. P. FAUNA DONNYKH BESPOZ. PRIKAMCHATSKIKH VOD TIKHOGO OKEANA I SEVERNYKH KURIL'SKIKH OSTROVOB (Fauna of Benthic Groups Inhabiting Kamchatka and N Kurile Sectors of the Pacific Ocean). IZD. AN SSSR, 1963.

37. LEVENSHTEYN, R. Ya. (New and Rare Forms of Abyssal Polychaets in the Bering Sea). TRUDY INST. OKEAN., Vol. 23, 1957.

38. LEVENSHTEYN, R. Ya. (Quantitative Distribution of Polychaets in the NW Bering Sea). TRUDY INST. OKEAN., Vol. 34, 1960.

39. LEVENSHTEYN, R. Ya. (Polychaeta of the Abyssal parts of the Bering Sea). TRUDY INST. OKEAN. AN SSSR, Vol. 41, 1961. /96

40. LEONOV, A. K. (Water Masses of the Bering Sea and Its Surface Currents). METEOR. I. GIDROL., No. 2, 1947.

41. LISITSYN, A. P. (Processes of Recent Sedimentation in the Bering Sea). TRUDY OKEANOGR. KOM., Vol. III, 1958.

42. LISITSYN, A. P. (Bottom Sediments of the Bering Sea). TRUDY INST. OKEANOL. AN SSSR, Vol. 29, 1959.

43. LOMAKINA, N. B. (Cumacea of Far Eastern Seas). TRUDY ZOOL. INST. AN SSSR, Vol. 18, 1955.

44. LOMAKINA, N. B. (Cumacea of Far Eastern Seas). TRUDY PROBL. I TEM. SOV. ZIN AN SSSR, Vol. VI, 1956.

45. LOMAKINA, N. B. (Cumacea of Far Eastern Seas). OPREDELITEL' PO FAUNE, No. 66, 1958).

46. LUS, V. Ya. and KUZNETSOV, A. P. (Data on the Quantitative Calculation of Bottom Fauna in the Korfo-Karaginskiy Region of the Bering Sea). TRUDY INST. OKEANOL. AN SSSR, Vol. 46, 1961.

47. MAKAROV, V. V. (Data on the Quantitative Calculation of Benthic Fauna of the N Bering Sea and the S Chukchi Sea). ISSLED. MOREY SSSR, Vol. 25, 1937.

48. MOKIYEVSKAYA, V. V. (Some data on the Chemistry of Biogenic Components of the Bering Sea). TRUDY INST. OKEANOL. AN SSSR, Vol. 17, 1956.

49. MURINA, V. V. (Abyssal Phascolion of the NW Pacific Collected by the Vityaz Exp. of 1950-1955). ZOOL. ZH., Vol. 36, No. 12, 1957.

50. MURINA, V. V. (Systematics and Zoogeography of Abyssal Sipunculoidea of the World Ocean). Candidate's dissert., 1959.

51. MURINA, V. V. (Geographical Distribution of Abyssal Phascolion lutense Selenka). OKEANOLOGIYA, Vol. 1, No. 1, 1961.

52. MURINA, V. V. and STAROBOGATOV, Ya. I. (Taxonomy and Zoogeography of Priapulids). TRUDY INST. OKEANOL. AN SSSR, Vol. 41, 1961.

53. NAUMOV, D. V. (Hydroids and Medusae). OPREDELITEL' PO FAUNE SSSR, Vol. 70, 1960.

54. NEYMAN, A. A. (Quantitative Distribution of Benthos in the E Bering Sea). ZOOL. ZH., Vol. 39, No. 9, 1960a.

55. NEYMAN, A. A. (Food Resources of Flounders in the E Bering Sea). RYBNOYE KHOZ., No. 10, 1960b.

56. NEYMAN, A. A. (Some Regularities in the Quantitative Distribution of Benthos in the Bering Sea). OKEANOLOGIYA, Vol 1, No. 2, 1961a.

57. NEYMAN, A. A. (Vertical Distribution of Benthic Fauna on the Shelf and Upper Slope of the E Bering Sea). OKEANOLOGIYA, Vol. 1, No. 6, 1961.

58. NEYMAN, A. A. (Quantitative Distribution of Benthos on the Shelf of and on the Upper Part of Slope of the E Bering Sea). TRUDY VNIRO, Vol. 48, 1963.

59. PASTERNAK, F. A. (Quantitative Distribution and Faunal Groups of Benthos in Sakhalinskiy zaliv and Contiguous Sectors of the Sea of Okhotsk). TRUDY INST. OKEAN., Vol. 23, 1957.

60. PASTERNAK, F. A. (Abyssal Pennatularians of the Bering Sea and Kurile-Kamchatka Trench). TRUDY INST. OKEAN., Vol. 34, 1960.

61. PASTERNAK, F. A. (New Data on Species Composition and Distribution of Aybssal Kophobelemnon in the N Pacific Ocean). TRUDY INST. OKEAN., Vol. 45, 1961.

62. PLAKHOTNIK, A. F. (Hydrology of the NE Pacific). TRUDY VNIRO, Vol. 46, 1962a.

63. PLAKHOTNIK, A. F. (Water Exchange of the Bering Sea). TRUDY VNIRO, Vol. 46, 1962b.

64. RATMANOV, G. Ye. (Hydrology of the Bering and Chukchi Seas). ISSLED. MOREY SSSR, Vol. 25, 1937.

65. SAVILOV, A. I. (Ecological Properties of Benthic Invertebrates Inhabiting the Sea of Okhotsk). TRUDY INST. OKEANOL., Vol. 46, 1961.

66. SKARLATO, O. A. (Biogeography of Far Eastern Seas of USSR by Using Bivalve Mollusks as Examples). TRUDY PROBL. I TEMAT. SOV ZIN AN SSSR, Vol. VI, 1956.

67. SKARLATO, O. A. (Bivalve Mollusks of Far Eastern Seas of USSR). OPREDELITEL' PO FAUNE SSSR, Vol. 71, 1960.

68. SOKOLOVA, M. N. (Feeding of Some Detritus-Eating Invertebrates of Abyssal Benthos Inhabiting Far Eastern Seas). TRUDY INST. OKEANOL., Vol. 27, 1958.

69. SOKOLOVA, M. N. and KUZNETSOV, A. P. (The Character of Feeding and the Role of Trophical Factor in the Distribution of Sea-Urchin). ZOOL. ZH., Vol. 39, No. 8, 1960.

70. TARASOV, N. I. and ZEVINA, G. B. FAUNA SSSR (Fauna of USSR). Rakoobraznyye (Crustaceans), Vol. VI, No. 1, 1957.

71. UDINTSEV, G. B., et al. (Bottom Relief of the Bering Sea). TRUDY INST. OKEANOL., Vol. 29, 1959. /97

72. USHAKOV, P. V. (Chukchi Sea and its Benthic Fauna). KRAYNIY SEVEROVOSTOK SSSR, Vol. 2, 1952.

73. USHAKOV, P. V. FAUNA OKHOTSKOGO MORYA I USLOVIYA EYE SUSHCHESTVOVANIYA (Fauna of the Sea of Okhotsk and Its Living Conditions). IZD. AN SSSR, 1953.

74. USHAKOV. P. V. MNOGOSHCHETINKOVYYE CHERVI DAL'NEVASTOCHNYKH MOREY SSSR (Polychaeta of the Soviet Far Eastern Seas). IZD. AN SSSR, 1955.

75. FILATOVA, Z. A. (Quantitative Evaluation of Benthic Fauna of the SW Barents Sea). TRUDY POL. N.-I. INST. RYBN. KHOZ. I OKEAN., Vol. 2, 1938.

76. FILATOVA, Z. A. (Some New Representatives of Astartidae Inhabiting Far Eastern Seas). TRUDY INST. OKEANOL., Vol. 23, 1957.

77. FILATOVA, Z. A. and ZENKEVICH, L. A. (Quantitative Distribution of Benthic Fauna of the Kara Sea). TRUDY VSES. GIDROBIOL. OB-VA, Vol. VIII, 1957.

78. SHCHEDRINA, Z. G. (Foraminifera of the Soviet Far Eastern Seas). TRUDY PROBL. I TEMAT. SOV. ZIN AN SSSR, Vol. VI, 1956.

79. YAKOVLEVA, A. M. (Loricata of the Soviet Seas). OPREDELITEL' PO FAUNE SSSR, Vol. 45, 1952.

80. DALL, W. H. Diagnoses of New Species of Marine Bivalve Mollusks From the NW Coast of America. PROCES. U. S. NAT. MUSEUM, Vol. 52, 1917.

81. DALL, W. H. Summary of the Marine Shellbearing Mollusks of the NW Coast of America. BULL. OF U. S. NAT. MUSEUM, Vol. 112, 1921.

82. MADSEN, F. J. On the Zoogeography and Origin of the Abyssal Fauna, in View of the Knowledge of the Porcellanasteridae. GALATHEA REP., Vol. 4, 1961.

83. SHELFORD, V. E. and others. Some Marine Biotic Communities of the Pacific Coast of North America. ECOL. MONOGR., Vol. 5, No. 3, 1935.

84. THORSON, G. ZUR JETZIGER LAGE DER MARINEN BODENTIEREN-OKOLOGIE, (The Present Status of the Ecology of Marine Benthos). VERHANDL. DER DEUTSCHEN ZOOLOGISCHEN GESELLSCH. IN WILLHELMSHAVEN, 1951.

85. THORSON, G. Modern Aspects of Marine Level-Bottom Animal Communities. J. MAR. RES, 1955.

86. THORSON, G. Bottom Communities (Sublitoral) or Shallow Shelf). TREATISE ON MARINE ECOLOGY AND PALEOECOLOGY, Vol. 1, ECOLOGY; THE GEOLOGICAL SOCIETY OF AMERICA, MEMOIR 67, Vol. 1, 1957.

87. THORSON, G. Parallel Level-Bottom Communities, Their Temperature Adaptation, and Their balance Between Predators and Food Animals. Perspectives in Marine Biology, 1958.

ooOoo

Security Classification

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author) U. S. Naval Oceanographic Office Washington, D. C. 20390	2a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED
	2b. GROUP

3. REPORT TITLE
"Communities of Benthic Fauna in the Western Bering Sea"
SOOVSHCHESTVA DONNOY FAUNY ZAPADNOY CHASTI BERINGOVA MORYA

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)
Translation from Russian

5. AUTHOR(S) (First name, middle initial, last name)
Z. A. FILATOVA and N. G. BARSANOVA

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
1964	117	87

8a. CONTRACT OR GRANT NO.	9a. ORIGINATOR'S REPORT NUMBER(S)
b. PROJECT NO.	NOO TRANS 459
c.	9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)
d.	

10. DISTRIBUTION STATEMENT
This document has been approved for public release; its distribution is unlimited.

11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
TRUDY INSTITUTA OKEANOLOGII, Vol. LXIX, Pp. 6-97, 1964	U. S. Naval Oceanographic Office Washington, D. C. 20390

13. ABSTRACT

The data on the composition and distribution of the bottom fauna in the western Bering Sea were received in 1950-1952 on board of the r/v "Vityaz". During that period 256 stations were occupied; 173 quantitative samples of the bottom fauna were taken with large ($0.25m^2$) bottom-sampler "Ocean-50" and Petersen grab; 64 samples of bottom fauna were gathered with Sigsbye trawl; 46 of the stations were occupied at the depths exceeding 1000m and 38 of them--at depths exceeding 2000m.

Eighteen communities of the bottom fauna were established in western Bering Sea; 9 of them are located in shallow-water zone (less than 200m), two in bathyal zone (200-2000m) and seven in the abyssal one (more than 2000m).

True oceanic deep-sea species are dominant in the abyssal bottom-fauna communities of the western Bering Sea. Some species living presumably on the slope of the shelf are the leading forms of bathyal communities; a great many arctic-circumpolar, arctic-boreal and north-boreal Pacific species of the bottom fauna take part in the composition of the shallow-water communities of the western Bering Sea.

Author

DD FORM 1 NOV 65 1473 (PAGE 1)

S/N 0101-807-6801

Security Classification

Security Classification

14 KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Animals - Bering Sea.						
Aquatic animals - Bering Sea.						
Marine biology.						

DD FORM 1 NOV 65 1473 (BACK)
(PAGE 2)

Security Classification