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ZOOGEOGRAPHICAL CHARACTERISTICS OF THE HELMINTH FAUNA OF MARINE MAMMALS OF THE BOREO-PACIFIC SUB-REGION

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Zoogeographical Characteristics of the Helminth Fauna of Marine Mammals of the Boreo-Pacific Sub-Region.

by A.S. Skryabin.

In the present work we are going to show general Zoogeographical characteristics of helminth fauna of marine mammals of Boreo-Pacific sub-region according to the systematic groups of helminths and their hosts, we also determine some laws of the geographical propagation of helminths of the pinnipedia and cetaceans, studying in particular the questions of amphi-boreal and bi-polar species, concerning amphipacifical propagation of helminths of marine mammals and concerning the possibility of the exchange of helminth fauna between marine mammals of Boreo-Pacific sub-region in present time.

We consider it our duty to express our sincere thanks to professor S.L.Delamure, doctor of biological sciences, for his day to day guidance of present work, and to the head of the expedition to study the Far-Eastern cetaceans in 1955, the senior scientific member of the Institute of Oceanology of USSR Academy of Sciences, S.K.Klumov, candidate of biological sciences, for his great assistance in the collection of helminthological material from marine mammals, and also for the valuable consultations concerning Zoogeography of marine animals.

General Zoogeographical Characteristics of the Helminth Fauna of Marine Mammals of Boreo-Pacific Sub-Region.

Works of S.L.Delamure (1952,1955,1956) give a detailed characteristic of the helminth fauna of marine mammals on global scale. To avoid repetition we have subjected to a more detailed zoogeographical analysis the helminth fauna of pinnipedia and cetaceans only of the Boreo-Pacific sub-region, for which we are in possession of a considerable amount of new data.

As result of the studies of the original material from 302 cetaceans and 10 pinnipedia, caught in the North-Western part of the Pacific Ocean, we have described seven new species of helminths(one of which turned out to be a representative of a new genus Tetragonoporus), namely:

1. Leucasiella subtila n.sp. - trematoda from the bowels of Delphinus orca.

2. Tetragonoporus calyptocephalus n.g.n.sp. - - cestoidea from the liver of a sperm whale.

3. Crassicauda tortilis n.sp. - nematoda from the kidneys of a blue whale.

4. Anisakis pacificus n.sp. - nematoda from the stomach of a sperm whale, delphinus orca and finback whale.

5. Bolbosoma paramuschiri n.sp. - ~~sorapings~~ Echynorhynchae from thw bowels of a blue whale.

6. Corynosoma ventronudum n.sp. - ~~sorapings~~ Echynorhynchae from the bowels of a sea lion.

7. Rhadinorhyndus tenax n.sp. - ~~sorapings~~ Echynorhynchae from the stomach of a fish whale.

The last species is an obligate parasite of fish and only by a stretch may be considered a facultative parasite of ~~кнем~~ the cetaceans. Therefore it was not taken into consideration during our zoogeographical analysis.

Besides the above we have stated for the first time(1955) the presence of following cestoidea in the whales of Boreo-Pacific sub-region: Priapocephalus grandis Nybelin, 1922, Tetrabothrius affinis (Lönnberg, 1891) Lönnberg, 1892 and larvae of cestoidea Tetraphyllidea sp.larva. It is more difficult to solve the problem concerning the belonging to the Boreo-Pacific sub-region of certain species stated near its southern and northern borders. Thus for example: Parafilaroides decorus, P. nanus, P. prolificus, Holocercus invaginatus, H. kirbyi, Dirofilaria immitis and Corynosoma obtuscens priviously were considered to belong to the Tropical region(Delamure, 1955). In connection with closer specification of the habitats (Margolis, 1954) of these species we were convinced, that all of them, if we stick to the lay-out of Ekman - Puzanov (Puzanov, 1938) are registered at the southern border of Boreo-Pacific sub-region, without leaving its limits (San-Francisco, San Diego). Thus, presently we have no basis to consider these species as belonging to Tropical region, especially since such genus as Holocercus and Corynisima in the Boreal region are represented by a larger quantity of species, than in the Tropical one.

We also think, that Uncinaria lucasi, discovered in the region of Pribylov islands, must belong not to the Arctic region (Delamure, 1955), but to the Boreal. Its connection to the Boreo-Pacific sub-region is also confirmed by the fact that in the southern part of the sub-region, as Margolis informs us (Margolis, 1954), near San-Francisco Baylis has discovered another species of this genus - Uncinaria hamiltoni, while no specimens of this genus were found in mammals of the Arctic region.

When analysing the helminth fauna of this sub-region we have taken into consideration also other species about which we had previously no information, or unsufficient information. Thus in the works of Margolis (1954) and of Mar-

golis and Pike (1955) we find for the first time information about occurence within the limits of the Boreo-Pacific sub-region of such species as: Orthoplanchnus fraterculus, Pricetreme zalophi, Diplogonoporus tetrapterus, D. fasciatus, Anisakis physeterys, Uncinaria hamiltoni, Bolbosoma balaenae. In the last work we have also description of two new species of helminths in the material concerning whales, caught near the shores of North America Lecithodesmus spinosus Margolis et Pike, 1955 (trematoda from bile ducts of fish whale's liver) and Crassicauda pacifica Margolis et Pike, 1955 (nematoda from kidneys of a finback whale). In our literature (Mozgovoy, 1953; Delamure, 1955)were no information about nematoda Porrocaecum asarasi (Yamaguti and Arima, 1942), which on the basis of studying original material from ringed seal caught in 1955 in the region of Kuril Islands, was transferred by us into genus Terranova. We have also taken into consideration works by Yamaguti (1951), Hoshina and Sugiura (1956) and several others.

We could not include into helminth fauna of Boreo-Pacific sub-region species Corynosoma hadveni van Cleave (1953) and C. falcatum van Cleave (1953) from the grey or humpnosed seal mentioned in the stated work of Margolis (1954) for the American coast (Island of St.Lawrence and Aleutian Islands), because the host indicated for these scorapings does not appear in the Northern Pacific (Ognev, 1935). Anisakis tridentata, Zolophotrema hepaticum and Mesorchis denticulus are not included in the helminth fauna of the sub-region, because of the lack of exact information about the place of catch of the hosts.

Taken the above into consideration, we have determined that at present time in pinnipedia and cetaceans of the Boreo-Pacific sub-region 92 species of helminths were

recorded, out of these 47 species are endemic. A complete list of all the species of helminths of this sub-region is given in table 1, which is the initial material for the following discussion.

Table 1.

Helminth Fauna of Pinnipedia and Cetaceans of the Boreo-Pacific Sub-Region.

Family, and Species of Helminths	Recorded in the Western Part of the Sub-Region		Recorded in the Eastern Part of the Sub-Region.	
	Pinnipedia	Cetaceans	Pinnipedia	Cetaceans
Campulidae				
Campula folium		(X)		
Campula gondo		(X)		
Campula laevicaecum		(X)		
Lecithodesmus goliath		X		X
Lecithodesmus nipponicus		(X)		
Lecithodesmus spinosus				(X)
Leucasiella mironovi		(X)		
Leucasiella subtila n.sp.		(X)		
Nasitrema spathulatum		(X)		
Odhneriella seymouri		X		X
Orthosplanchnus elongatus		(X)		
Orthosplanchus frateroulus			X	
Oschmarinella sobolevi		(X)		
Zalophotrema curilensis		(X)		
Heterophyidae				
Pricetrema zalophi			(X)	
Rossicotrema venustus			X	

Family and Species of Helminths	Recorded in the Western Part of the Sub-Region		Recorded in the Eastern Part of the Sub-Region	
	Pinnipedia	Cetaceans	Pinnipedia	Cetaceans
Opisthorchidae				
Delphinicola tenuis		(X)		
Phocitrema fusiforme	(X)		(X)	
Notocotylidae				
Ogmogaster plicatus		X		X
Ogmogaster antarcticus		X		
Brauninidae				
Braunina cordiformis				X
Diphyllobothriidae				
Diphyllobothrium krotovi	(X)		(X)	
D. lanceolatum	X		X	
D. fuhrmanni		X		
D. macrocephalus	X			
D.(Diplogonoporus ?)tetrapterus			X	
D.(Diplogonoporus?)fasciatus			X	
Adenocephalus septentrionalis	(X)		(X)	
Diplogonoporus balaenopterae		X		
Tetragonoporus calyptocephalus n.g.n.sp.		(X)		
Hexagonoporus physeteris		(X)		
Pyramicocephalus phocarum	X		X	
Tetraphyllidea sp.larva		X		
Phyllobothriidae				
Phyllobothrium delphini		X		
Tetrabothriidae				
Anophryocephalus ochotensis	(X)			
Priapocephalus grandis		X		
P. minor		X		
Tetrabothrium affinis		X		
Tetrabothrius curilensis		(X)		

Family and Species of Helminths	Recorded in the Western Part of the Sub-Region		Recorded in the Eastern Part of the Sub-Region	
	Pinni-pedia	Cetace-ans	Pinni-pedia	Cetace-ans
Tetrebothriidae (continuation)				
Tetrabothrius ruudi		X		
Trigonocotyle skjabini	(X)			
Trigonocotyle spasskyi		(X)		
Tetrahynchidae gen.sp.larva	X	X		
Anisakidae				
Anisakis typica				X
A. dussumierii		X		
A. ivanizkii		(X)		
A. kükenthalii		X		
A. similis			X	
A. simplex	X	X		X
A. skrjabini		X		
A. physeteris		X		X
A. pacificus n.sp.		(X)		
Contracaecum osculatum	X		X	
C. callotariae	(X)			
Porrocaecum callotariae	(X)			
Terranova decipiens	X	X	X	
Terranova azarasi nov.comb.	(X)			
Ancylostomatidae				
Uncinaria hamiltoni			X	
U. lucasi			(X)	

Family and Species of Helminths	Recorded in the Western Part of the Sub-Region		Recorded in the Eastern Part of the Sub-Region	
	Pinnipedia	Cetaceans	Pinnipedia	Cetaceans
Dictyocaulidae				
Ostrongylus circumlitus	X			
Filaroididae				
Parafilaroides decorus			(X)	
P. nanus			(X)	
P. prolificus			(X)	
Pseudaliidae				
Delamurella hyperoodoni		(X)		
Halocercus invaginatus				X
H. kirbyi				(X)
H. dalli		(X)		
H. sunameri		(X)		
Irukanema dalli		(X)		
Otophocaenurus oserskoi		X		
Pseudalius inflexus		X		
Stenurus minor		X		X
S. auditivus		X		
Torynurus convolutus		X		X
Crassicaudidae				
Crassicauda boopis		X		
C. giliakiana		(X)		
C. pacifica				(X)
C. tortilis n.sp.		(X)		
Placentonema gigantissima		(X)		
Filariidae				
Dirofilaria immitis			X	

Family and Species of Helminths	Recorded in the Western Part of the Sub-Region		Recorded in the Eastern Part of the Sub-Region	
	Pinni-pedia	Cetace-ans	Pinni-pedia	Cetace-ans
Polymorphidae				
Bolbosoma balaenae				X
B. turbinella		X		X
B. nipponicum	X	X		
B. bobroboi	(X)			
B. physeteris		(X)		
B. paramushiri n.sp.		(X)		
Corynosoma semerme	X		X	
C. strumosum	X	X	X	
C. obstuscens			(X)	
C. ourilensis		(X)		
C. osmeri	(X)			
C. vemtronudum n.sp.	(X)			

In the present table and in all the following ones by the sign (X) are marked the endemic species of helminths for the Boreo-Pacific sub-region, and by the sign X - species common with Boreo-Atlantic sub-region and with other zoogeographical regions.

ARCTIC

Total 27
Endemic 11

Boreo-Atlantic

Total 70
Endemic 28

Boreo-Pacific

Total 92
Endemic 47

Tropical

Total 13
Endemic 8

Anti-Boreal

Total 38
Endemic 15

Total 20
Endemic 11

ANTARCTIC

Fig. 1. General picture of the relation of helminth fauna with Boreo-Pacific sub-region and with other zoogeographical regions.

We know in the Boreo-Pacific sub-rggion 13 endemic genera (Leucasiella, Nasitrema, Ochsmarinella, Zalophotrema, Pricetrema, Delphinicola, Phocitrema, Tetragonoporus n.g., Hexagonoporus, Delamurella, Otophocaenurus, Irukanema, Placentoneme) and two endemic sub-families (Delphinicolinae and Nasitrematinae).

From the total number of 92 species of Helminths, 10 species are common with the Arctic region, 6 - with Tropical, 15 - with Anti-Boreal, 4 - with Antarctic. We know also 31 species of helminths connecting the helminths fauna of Boreo-Pacific sub-region with the Boreo-Atlantic one (fig. 1). From fig. 1 we also see that helminth fauna of Boreo-Pacific sub-region is considerably richer than the helminth fauna of Boreo-Atlantic sub-region and of any zoogeographic region; this is recorded by G.L.Delamure (1955) and indicated also by all following studies of helminth fauna of marine mammals of this sub-region, and which we have discussed earlier.

Speaking about wealth and originality of helminth fauna of marine mammals of Boreo-Pacific sub-region, we primarily think about the Far Eastern seas and the North-Western part of the Pacific Ocean, where at present time are recorded 78.26 % of all the species known in the sub-region, 80.85 %

of endemic species, and 92.3 % of endemic genera.

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Fig. 2. Occurence of endemic species of trematoda in the Boreo-Pacific sub-region.

1. Campula folium
2. Campula gondo
3. Campula laevivaecum
4. Lecithrodesmus nipponicus
5. Lecithrodesmus spinosus
6. Leucasiella mironovi
7. Leucasiella subtila n.sp.
8. Nasitrema spathulatum
9. Orthosplanchnus elongatus
10. Oschmarinella sobolevi
11. Zalophotrema curilensis
12. Delphinicola tenuis
13. Phocitrema fusiforme
14. Pricetrema zalophi.

Trematoda fauna of Boreo-Pacific sub-region consists of 21 species belonging to 14 genera and who comprise a part of the system of five families. Out of these 14 genera seven are endemic: Leucasiella, Nasitrema, Oschmarinella, Zalophotrema, Pricetrema, Delphinicola, Phocitrema. And out of 21 species - 14 are endemic: Campula folium, C.gondo, C. laevicaecum, Lecithrodesmus nipponicus, L. spinosus, Leucasiella mironovi, L. subtila, Nasitrema spathulatum, Orthosplanchnus elongatus, Oschmarinella sobolevi, Zalophotrema curilensis, Pricetrema zalophi, Delphinicola tenuis, Phocitrema fusiforme (fig. 2). Common with Boreo-Atlantic sub-region are four species: Lecithodesmus goliath, Rossicotrema venustus, Ogmagaster plicatus and Braunina cordiformis. Common with other regions are five species: Orthosplanchus frateroulus, Rossicotrema venustus and Odhneriella seymouri are common with Arctic region /Odhneriella seymouri that earlier was considered as endemic for Boreo- Pacific sub-region was recorded by S.L.Delamure (1956-a) in White Sea white grampus/ ; Ogmogaster antarcticus - with Anti-Boreal and with Antarctica.

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Fig. 3. Occurence of endemic species of cestoidea in the Boreo-Pacific sub-region.

1. Anophryocephalus ochotensis
2. Tetrabothrius curilensis
3. Trigonocotyle skjabini
4. Trigonocotyle spasskyi
5. Diphyllobothium krotovi
6. Adenocephalus septentrionalis
7. Tetragonoporus calyptocephalus n.g.n.sp.
8. Hexagonoporus physeteris.

The cestoidea are represented with 22 species, 11 genera and 3 families. There are 8 endemic species: Diphyllobothrium krotovi, Adenocephalus septentrionalis, Tetragonoporous calyptocephalus n.g.n.sp. Hexagonoporus physeteris, Anophryocephalus ochotensis, Tetrabothrius curilensis, Trigonocotyle skjabini, T.spasskyi (fig.3). In the Boreo-Pacific sub-region are known two very interesting endemic genera of cestoidea: Tetragonoporus n.g. and Hexagonoporus. Besides the above are known larval forms of cestoides: Phyllobothrium delphini, Tetraphyllidea sp. larva and Tetrarhynchidae sp. larva. The first two are recorded in the northern and southern hemisphere, the latter - only in the Boreo-Pacific sub-region. V.A.Dogel (1955) recorded, that osseous fish and cephalopoid mollusks habitating the Far Eastern seas, have an extreme saturation of body-cavities with larvae of shark cestoidea. We have discovered labvae of tetrarhynchidaein the stomach of Balaenoptera borealis Lesson - fish whale, B. acutorostrata Lacep. - small rorqual , Physeter cotodon L. - sperm whale, and of Eumetopias jubatus Schr. - sea lion, caught in the region of Kuril Islands.

Common with the Boreo-Atlantic sub-region are 11 species: Diphyllobothrium lanceolatum, D. macrocephalus,

Diplogonoporus balaenopterae, Diphyllobothrium (Diplogonoporus ?) tetrapterus, Diphyllobothrium (Diplogonoporus?) fasciatus, Pyramicephalus phocarum, Phyllobothrium delphini, Priapocephalus minor, P. grandis, Tetrabothrius affinis and T. ruudi. Species common with Arctic region are Diphyllobothrium lanceolatum and Pyramicocephalus phocarum; with - Tropical - Diphyllobothrium fuhrmanni; with Anti-Boreal and Antarctic - Priapocephalus grandis, Tetrabothrius affinis, T. ruudi, Diplogonoporus balaenopterae and Phyllobothrium delphini. Tetraphyllidae sp. larva discovered by us in a sperm whale in the region of Kuril Islands, were recorded by Markowski (1955) in the same host in the region of South Georgia. The form and size of scolex of pork tapeworms from the northern and the southern hemisphere, permit us to assume, that either they belong to the same species, or to two close species.of cestoidea. Nematoda fauna in Boreo-Pacific sub-region is represented by 8 families, 17 genera and 37 species. 3 endemic genera are known: Delamurella, Irukenema and Placentonema, 18 endemic species: Anisakis ivanizkii, A. pacificus n.sp. Contracaecum collotariae, Porrocaecum collotariae, Terranova azarasi, Uncinaria lucasi, Parafilaroides decorus, P.nanus, P. prolificus, Delamurella hyperoodoni, Holocercus kirbyi, H.dalli, H. sunameri, Irukanema dalli, Crassicauda giliakiana, C. pacifica, C.tortilis, Placentonema gigantissima (fig.4).

Common with the Boreo-Atlantic sub-region are 12 species: Anisakis typica, A. kükenthalii, A. similis, A. simplex, Contracaecum osculatum, Terranova decipiens, Otostrogylus circumlitus, Holocercus invaginatus, Pseudalius inflex, Stenurus minor, Torynurus convolutus, Crassicauda boopis.

13 species are common with other regions, 4 of which are common with Arctic region (Anisakis kükenthalii,

Otophocaenurus oserskoi, Stenurus minor, Otostrongylus circumlitus), three - with Tropical (Anisakis dussumierii, Terranova decipiens and Stenurus auditivus) and six - with Anti-Boreal (Anisakis similis, A.simplex, A. typica, A. skrjabini, A. physetgrys and Uncinaria hamiltoni). Finally: Contracaecum osculatum and Terranova decipiens connect the fauna of nematoda of Boreo-Pacific sub-region with Boreo-Atlantic sub-region and with all regions.

In the Boreo-Pacific sub-region 12 species of Acanthocephalus are known belonging to two genera, including seven endemic species: Bobrosoma physeteris, B. bobrovoi, B.paramuschiri n.sp., Corynosoma curilensis, C.obtuscens, C. osmeri, C.ventronudum n.sp. (fig. 5). Here are four species common with Boreo-Atlantic sub-region (Bolbosoma balaenae, B. turbinella, Corynosoma strumosum, C. semerme), two- with Arctic region (Corynosoma strumosum and C. semerme), one - with Tropical (Bolbosoma nipponicum), two - with Anti-Boreal (Bolbosoma balaenae and B. turbinella).

Fig. 4. Occurence of endemic species of nematoda in the Boreo-Pacific sub-region.

1. Anisakis ivanizkii
2. Anisakis pacificus n.sp.
3. Contracaceaumcallotariae
4. Porrocaecum callotariae
5. Terranova azarasi
6. Uncinaria lucasi
7. Delamurella hyperoodoni
8. Halocercus kirbyi
9. Halocercus dalli
10. Halocercus sunameri
11. Irukanema dalli
12. Parafilaroides decorus
13. Parafilaroides nanus
14. Parafilaroides profilicus
15. Crassicauda giliakiana
16. Crassicauda tortilis n.sp.
17. Crassicauda pacifica
18. Placentonema gigantissima

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7 Helminth Fauna of Cetaceans.

62 species of helminths are recorded for the cetaceans of Boreo-Pacific sub-region.

Trematoda fauna of the cetaceans id represented by 17 species, 12 of which are endemic species: Campula folium, C. gondo, C. laevicaecum, Lecithodesmus nipponicus, L. spinosus, Leucasiella mironovi, L. subtila n.sp. Nasitrema spathulatum, Orthosplanchus elongatus, Oschmarinella sobolevi, Zalophotrema curilensis, Delphinicola tenuis, Five endemic genera: Leucasiella, Nasitrema, Oschmarinella, Zalophotrema, Delphinicola. Three species are common with the Boreo-Atlantic sub-region: Lecithodesmus goliath, Ogmogaster plicatus, Braunina cordiformis, one - with Arctic region Odhneriella seymouri, one- with Tropical Braunina cordiformis, with Antarctic - also one,- Ogmogaster antarcticus.

Cestoidea of cetaceans of Boreo-Pacific sub-region are represented by 13 species, 4 of which are endemic: Tetragonoporus calyptocephalus n.g.n.sp., Hexagonoporus physeteris, Tetrabothrius curilensis, Trigonocole spasskyi. Here we know two very original endemic genera: Tetragonoporus and Hexagonoporus. Six species are common with the Boreo-Atlantic subregion: Diplogonoporus balaenoptera, Phyllobothrium delphini, Priapocephalus minor, Priapocephalus grandis, Tetrabothrius affinis and T. ruudi, one- with the Tropical region: Diphyllobothrium fuhrmanni. All species of cestoidea, common with Anti-Boreal and Antarctic regions belong to the cetaceans (Priapocephalus grandis, Tetrabothrius affinis, T.ruudi, Diplogonoporus balaenopterae, Phyllobothrium delphini and Tetraphyillidea sp.larva), the cetaceans have no species common with the Arctic region. Larvae of cestoidea Tetrarhynchidae sp. larva are recorded both in pinnipedia and cetaceans.

Fig. 5. Occurence of endemic species of parasitic worms - Echynorhynchae in the Boreo-Pacific sub-region.

1.Bolbosoma bobrovoi
2. Bolbosoma physeteris
3. Bolbosoma paramuschiri n.sp.
4. Corynosoma osmeri.
5. Corynosoma curilensis
6. Corynosoma ventronudum n.sp.
7. Corynosoma obtuscens

Nematoda fauna consist of 25 species, including 12 endemic species: Anisakis ivanizkii, A. pacificus n.sp., Dalamurella hyperoodoni, Halocercus kirbyi, H. dalli, H. sunameri, Irukanema dalli, Otophocaenurus oserskoi, Crassicauda tortolis n.sp. and Placentonema gigantissima.

Three endemic genera are known: Delamurella, Irukanema and Placentonema.

Nine species are common with Boreo-Atlantic subregion: Anisakis typica, A. kükenthalii, A.simplex, Terranova decipiens, Holocercus invaginatus, Pseudalius inflexus, Stenurus minor, Torynurus convolutus and Crassicauda boopis; two - with the Arctic region: Anisakis kükkenthalii and Stenurus minor; three - with Tropical region: Anisakis dussumierii, Terranova decipiens and Stenurus auditivus; four - Anti-Boreal region: Anisakis simplex, A.typica, A.skrjabini and A.physeteris.

Anisakis simplex and Terranova decipiens are recorded in cetaceans and pinnipedia. The latter species lives in all zoogeographical regions.

The cetaceans were hosts to 8 species of Acanthocephalia. Four endemic ~~xxx~~ species: Bolbosoma physeteris, B.paramuschiri n.sp. Corynosoma curilensis and C. osmeri.

Tree species common with Boreo-Atlantic sub-region: Bolbosoma balaenae, B.turbinella and Corynosoma strumosum; one- with Arctic region: Corynosoma strumosum; one - with the Tropical region: Bolbosoma nipponicum; two - with the Anti-Boreal region: Bolbosoma balaenae and B.turbinella. Bolbosoma nipponicum and Corynosoma strumosum [1] are recorded in pinnipedia and cetaceans.

1) V.A.Dogel (1955) recorded in the Far Eastern seas, that a whole series of parasitic groups habitates, besides their basic hosts, also such groups of hosts that are not habitated in the Atlantic Ocean, thus increasing their "ecological area" of their occurence. C. strumosum may serve as illustration of such example. Definitive hosts of this species are birds, terrestrial mammals, almost all the pinnipedia of the Northern Hemisphere, and also porpoises and white grampus. In the Far Eastern seas this worm was also discovered by us (1956)in the sperm whales.

Helminth Fauna of Pinnipedia.

Helminth fauna of pinnipedia of Boreo-Pacific sub-region is represented by 31 species of helminths.

The trematoda fauna is represented by 4 species, two of which are endemic (Pricetrema zalophi and Phocitrema fusiforme).

There is one endemic genus - Phocitrema. Two species (Orthosplanchnus fraterculus and Rossicotrema venustus) connect the trematoda fauna of the pinnipedia of Boreo-Pacific sub-region with the Arctic region. The latter species is also recorded in the Boreo-Atlantic sub-region.

Pinnipedia of the Boreo-Pacific sub-region have 10

known species of cestoidea, including four endemic species: Diphyllobothrium krotovi, Adenocephalus septentrionalis, Anophryocephalus ochotensis, and Trigonocotyle skrjabini. There are no endemic genera. Common with Boreo-Atlantic sub-region are : Diphyllobothrium lanceolatum, D. macrocephalus, Diphyllobothrium (Diplogonoporus ?) tetrapterus, Diphyllobothrium (Diplogonoporus ?)fasciatus, Pyramicocephalus phocarum; with Arctic region: Diphyllobothrium lanceolatum and Pyramicocephalus phocarum. All the mentioned species of cestoidea habitate only the Northern Hemisphere, they have no common spevies with the Anti-Boreal and Antarctic regions.

The nematoda are represented by 14 species, seven of these are endemic: Contracaecum collotariae, Porrocaecum collotariae, Terranova azarasi, Uncinaria lucasi, Parafilaroides decorus, P. nanus, P. prolificus. Five species are common with the Boreo-Atlantic sub-region: Anisakis similis, A. simplex, Contracaecum osculatum, Terranova decipiens, Otostrongylus circumlitus; one species with the Arctic region - - Otostrogylus circumlitus; three species with the Anti-Boreal region: Anisakis similis, A.simplex and Uncinaria hamiltoni. Contracaecum osculatum and Terranova decipiens connect the nematoda fauna with all the zoogeographical regions. The species Dirofilaria immitis was recorded in pinnipedia in ~~kkw~~ zoological garden (USA), in terrestrial mammals - almost in all tropical and subtropical countries.

In the sub-region seven species of Acanthocephalia are known, four of which are endemic: Bolbosoma bobrovoi, Corynosoma obtuscens, C.osmer, C.ventronudum n.sp. Two species are common with Boreo-Atlantic sub-region and Arctic region: Corynosoma strumosum, C. semerme; one with Tropical region:

Bolbosoma nipponicum. There are no common species with the Anti-Boreal and Antarctic regions.

Laws of Geographic Distribution of Helminths of Marine Mammals of Boreo-Pacific Sub-Region.

When analysing the helminth fauna of marine mammals of Boreo-Pacific sub-region, we, naturally, could not leave without attention the problems of zoogeography and the hosts themselves, who "...serve as biotopes for the parasites" (Dogel, 1947, page 280). However, at present time, there is still no single opinion among the cetologists concerning some questions of zoogeography of the cetaceans and directly contradicting view points are existing. Without going into details of these contradictions, which we are going to treat later individually, we will point out , that according to our opinion only one of these view points is scientifically founded, which accepts the isolated life of the cetacean herds and absence of constant interchange of specimens among them, because first: this point of view is supported by the very latest studies by many cetologists (Tomilin, 1946,1947; Jonsgard, 1955; Laws, 1955; Klumov, 1955[1] and others), secondly it gives key towards explanation of general laws of geographical occurance of helminths of marine mammals that are a part

1) Particularly one should note the opinion of S.K.Klumov (1955), who states, that within each population of whales occur microlocal phenomena, i.e. division of the population into a series of local heards, each of which has its own summer and winter area of habitat, its own historically formed ways of migration, and its own "hunting areas".

of marine fauna (Delamure, 1955, 1956), and thirdly it is confirmed by data of zoogeographical analysis of all new informations that are in our possession concerning helminth fauna of marine mammals.

The opposite opinion that accepts existence of a world heard of whales appears to us to be scientifically unfounded and contradictory to all basic zoogeographical laws of helminth occurence in marine mammals. Now we will discuss these laws.

Amphi-Boreal and Bi-Polar Species of Helmirths of Marine Mammals recorded in the Boreo-Pacific Sub-Region.

S.L.Delamure has determined...."that the phenomenon of amphi-boreality, just as the phenomenon of the bi-polarity, until now only known to occur in respect to the freely living species, also occurswith parasite species" (1956, page 623). Our studies of helminth fauna of marine mammals confirmed that this deduction was right and complemented the information concerning the helminths with mentioned propagation type. In the Northern half of the Pacific Ocean, we have recorded for the first time such species of helminths as Priapocephalus grandis, Tetrabothrium affinis and larvae of cestoidea Tetraphyllidea sp. larva.

New information concerning some species of helminths of marine mammals, are found in Markowski's works (1955), who redord in whales of Southern Hemisphere (South Georgis) following cestoidea: Tetrabothrium ruudi, Diplogonoporus balaenoptera, Tetraphyllidea sp. larva; Margolis (1954) and Margolis and Pike (1955) published records of helminths of marine mammals recorded at the American shore of the Pacific Ocean

eto.

When analysing our own data and data taken from literature, we have determined that there are 15 species of helminths with bi-polaric occurence among marine mammals of Boreo-Pacific sub-region: Ogmogaster antarcticus, Tetrabothrius ruudi, T. affinis, Priapocephalus grandis, Diplogonoporus balaenopterae, Phyllobothrium delphini, Tetraphyllidea sp.varva, Anisakis simplex, A.skrjabini, A.physeteris, A.typica, A.similis, Uncinaria hamiltoni, Bolbosoma balaenae, B.turbinella (fig.6).

Nematoda Odontobius ceti Roussel de Vauzeme, 1834, who live as commensals in Balaenoptera physalus L. - finback whale, and B.musculus L. - blue whale, in the gluey film upon the laminae of the whalebone, have also bi-polaric occurence. In the Northern Hemisphere it was for the first time recorded by us in 1955.

Following species have Amphi-Boreal occurence: Lecithodesmus goliath, Ogmogaster plicatus, Priapocephalus minor, Dyphyllobothrium (Diplogonoporus ?) tetrapterus, Diphyllobothrium (Diplogonoporus ?)fasciatus, Holocercus invaginatus, Psuedalius inflexus, Korynurus convolutus, Crassicauda boopis, that are recorded only in the Boreal zone of the Atlantic and Pacific Ocean (fig.7).

Fig. 6a,6b. Bi-polaric occurence of helminths in marine mammals.

1. Ogmogaster antarcticus
2. Tetrabothrium affinis
3. Tetrabothrium ruudi
4. Priapocephalus grandis
5. Diplogonoporus balaenopterae
6. Phyllobothrium delphini
7. Tetraphyllidea sp.larva
8. Anisakis simplex.
9. Anisakis physeteris
10. Anisakis skjabini
11. Anisakis similis
12. Anisakis typica
13. Uncinabia hamiltoni
14. Bolbosoma balaenae
15. Bolbosoma turbinella

Fig. 7a,7b. Amphi-Boreal occurence of helminths of marine mammals.

1. Lecithodesmus goliath
2. Ogmogaster plicatus
3. Tripocephalus minor
4. Diphyllobothrium (Diplogonoporus ?)tetrapterus
5. Diphyllobothrium (Diplogonoporus ?) fasciatus
6. Holocercus invaginatus
7. Pseudalius inflexus
8. Torynurus convolutus
9. Crassicauda boopis.

Many species, who are bi-polaric, have likewise amphi-boreal occurence (Phyllobothrium delphini, Tetrabothrium rudi, T.affinis, Triapocephalus grandis, Diplogonoporus balaenopterae, Anisakis simplex, A.typica, A. similis, Bolbosoma balaenae, B.turbinella).

Considering the parasites of marine animals a part of marine fauna (Delamure, 1955, 1956) we cannot give any other explanation to the causes of their amphi-boreal and bi-polaric occurence, except the one given by L.S.Berg (1918, 1947) for the freely living fauna.

Amphi-Boreality is a result of fauna exchange between Atlantic and Pacific Oceans that once existed. This fauna exchange road, according to the opinion of Berg, might have gone "... along the northern coast of Asia, during times, when the Bering strait, just as to-day, was a sea, and when in the northern Asia it was warmer than now. This took place: a) during the Miocenic, b) during the warm post-glacial period" (1947, page 120). Berg admits, that the fauna exchange could have also taken place along the northern shores of America.

Further L.S.Berg thinks that "...bi-polarity is a result of the glacial period. During glacial period, not only were the Arctic and Temperate zones affected by cold, but also the Tropical zones. At that time many northern forms found their way down to the Equator, and then to the Southern Hemisphere. However, when the glacial period was over and the temperature in the Tropics began to increase, the northern forms that came here, had either to die out, or to remove themselves to the North or to the South. In that manner the interrupted occurence originated." (1947, page 137). It must be assumed, that among the forms that penetrated from one hemosphere into the other, there were beside the definite types, probably, also some intermediate hosts of the presently existing bi-polar helminths. In the post-glacial period there xxx existed no conditions for mass-exchange of marine animals between the Northern and the Southern Hemisphere. The exchange of marine animals between the Atlantic and Pacific Oceans could take place both before the glacial period (in Pleocenic), and during the post-glacial warming up.

However, L.S.Berg points out "... that the post--glacial increase in temperature was not so high, for example in Scandinavia the summer temperature was only 2-2.5 ^{o}C higher than now.

Something completely different occured during the Pliocenic period. At that time the average yearly temperature at the surface within the region of the Bering Strait was 5-10^{o}C higher than to-day. And at that time through the Bering Strait, without any difficulty an exchange could take place of relatively warmth-loving forms of fish, which later might separate into sub-species, species, and sometimes even into genera" (1918, page 1841-1842).

Considering the above, we may assume, that also among the marine mammals of the Boreo-Pacific sub-region there are many species that had connection with the Atlantic Ocean during the Pliocenic period, but did not have it during the post-glacial period. This assumption is supported by the data of the zoogeographical analysis of the helminth fauna of these animals. Thus for example, for the sperm whale (table 2) six species of helminths are known with bi-polaric occurence (Phyllobothrium delphini, Tetraphyllidea sp. larva, Anisakis skrjabini, A. physeteris, A. simplex, Bolbosoma turbinella). These species of helminths, probably, appeared not later than the glacial period. Nine species of helminths (Zalophotrema curilensis, Tetrabothrium curilensis, Tetragonoporus calyptocephalus n.g.n.sp., Hexagonoporus physeteris, Anisakis ivanizkii, A.pacificus n.sp.* Placentonema gigantissima, Bolbosoma physeteris, Corynosoma curilensis) are endemical for the Boreo-Pacific sub-region, and in particular: its western part. One species (Anisakis dussumierii) may also be considered to be endemic for the Northwestern part of the Pacific Ocean. The species Corynosoma strumosum is also common with the Arctic region.

How can it be explained, that within the helminth fauna of the sperm whale there are so many endemic species, and even genera, but there is a complete absence of species, that have just amphi-boreal occurence?

Table 2.

Peculiarities of the Geographical Occurence of the Helminths in various species of Cetaceans.

Species of Hosts	Number of bi-polaric species of helminths	Number of amphi-boreal helm.	Number of endemic species of helminths	Numbr of endem genera of helm.
Sperm whale (Physeter catadon)	6	-	10	3
Berardius bairdii	3	-	3	1
Finback whale (Balaenoptera physalus)	5	4	3	-
Fish whale (B.borealis)	3	2	2	-
Balaenoptera acutorostrata	1	1	2	-

At the present time the basic mass of the sperm whale stays within the belt of 40^{0} Northern and 40^{0} Southern latitude. The very northern limit of its occurence along the western side of the Bering Sea is not further than 62-62^{0}30' of northern latitude, and along the American coast it sometimes reaches the Pribilov Islands (Tomlin, 1957). Probably, during the Ancylus and Litorina period, because of insufficient warming up, the sperm whale, although they did come further north than now, still did not reach the Atlantic Ocean. Of this reason, all the species of helminths, that occured in the sperm whale in the post-glacial period have maintained their separate areas.

However, the amphi-boreal occurence of almost all the species of helminths of the sperm whale, except Tetraphyllidea sp.larva and Anisakis skrjabini, witnesses about a warmer and earlier period, when there was possible an exchange of helminths with the Atlantic Ocean. L.S.Berg is talking exactly about this warm pre-glacial period.

According to A.G.Tomilin (1957), the northern border of the Berardius bairdii is rather close to the border of the sperm whale and ranges approximately from the cape of Navarin (62° - 62°30' N.L.) along the southern border of the shallows of the Bering Sea to the East and South-East Probably, therefore the contents of its helminth fauna, same as for the sperm whale, contains a great number of endemics, and no species that indicate a post-glacial connection with the Atlantic Ocean.

To the finback whale, who even at present time reaches as far north as the Chokotsk Sea (Tomilin, 1957), apparently, the post-glacial warming up was sufficient to come in contact with the Atlantic Ocean. Thus increased the quantity of helminth species with amphi-boreal occurence, and correspondingly the quantity of species with undivided area decreased.

Almost all bipolaric species, except Ogmogaster antarticus, of the helminths of the finback whale have amphi-boreal occurence, this indicates a pre-glacial fauna exchange with the Atlantic Ocean.

Similar picture is presented by the helminth fauna of the fish whale and small rorqual (Balaenoptera acutorostrata).

However, it must be remembered, that in our discussions we take into consideration only the basic causes of the formation of interrupted areas, disregarding any exception. Thus for example, we cannot be completely sure, that in our time, in places where the winter areas of whales from different populations are overlapping, although these populations are not intermixed, because of isolation in time, that no interchange of even some helminths does not take place.(Klumov, 1955).

Moreover, not all species of helminths, who penetrated with their hosts from one hemisphere into another, found there the complete complex of conditions necessary to their various stages of life-cyclus, and the absence of even one of these conditions, as V.A.Dogel (1947) points out, may lead to the absence of the parasite in the given locality. Therefore we are not trying to make any assumptions concerning the time when the various species of helminths appeared, but show only the peculiarities of the occurence of the entire compound of the helminth fauna of the cetaceans, which are most probably connected with their migrations in the past.

Amphipacifical Features in the Occurence of the Helminths of Marine Mammals.

A.P.Adriashev (1939) points out that in the marine fauna both of the Asiatic and American shores, besides considerable differences, there are also many common and close forms that appear in the Boreal and Sub-Tropical waters of the northern part of the Pacific Ocean, but are absent in the Tropical zone and have a separated area in the north. Such species Adriashev called Amphi-Pacific.

Being in possession of a vaste quantity of data concerning helmithological studies of marine mammals, caught at Asiatic and North-American shores of the Pacific Ocean, we decided to determine if there appears any Amphi-Pacific features in the helminth occurence of the mentioned animals.

Data analysis of table 1, shows that from 92 species of helminths of marine mammals known for the Boreo-Pacific sub-region, 18 species are common for Asiatic and American shores. Among these first and foremost must be pointed out:

Odhneriella seymouri, Dyphyllobothrium lanceolatum, Pyramicocephalus phocarum, Contracaecum osculatorum, Terranova decipiens, Stenurus minor, Corynosoma semerme and C.strumosum, who are connecting the helminth fauna of the Boreo-Pacific sub-region with the Arctic region and in the north have closed areas. Species: Phocitrema fusiforme, Diphyllobothrium krotovi, Adenocephalus septentrionalis are not recorded in the Arctic region, but are wide-spread along the northern limit of the Boreo-Pacific sub-region. It is difficult to say anything definite concerning their areas, because they are to a certain degree transitory from solid occurence to interrupted Amphi-Pacific (fig. 2,3).

But there are species that occur on both sides of the Ocean and have interrupted areas in the north. To such Amphi-Pacific species belong: Lecithodesmus goliath, Ogmogaster plicatus, Phyllobothrium delphini, Anisakis simplex, A. physeteris, Torynurus convolutus and Bolbosoma turbinella (fig. 8).

Taking into consideration, that all, now separated, in systematical relation similar faunae, once represented one single unit (Zenkevich, 1956), we may consider, that helminths of marine mammals, just as their hosts (both definitive and intermediate), that presently have Amphi-Pacific occurence, in the past possessed closed areas in the North.

A.P.Andriashev (1939) considered that the most energetic fauna exchange was carried out in the Pleocenic and Inter-glacial periods, but did not exclude the possibility of exchange also in the warm Post-glacial period. But owing to the following cooling down, all the warmth-loving beings were pushed southward and dyied out in the northern parts of the Ocean, thus interrupted areas appeared in the North.

Waters of their former areas were filled by more northern species. Thus, among the previously mentioned species of helminths of the marine mammals, we observe all stages from the closed occurence to a completely interrupted Amphi-Pacific.

It is interesting to note, that almost all species of helminths, that have a well-expressed Amphi-Pacific area are at the same time also Amphi-Boreal species (fig. 6,7), this points towards the historical interconnection between these two phenomenons, and the oneness of their origin.

As a result of the disrupture of the original unified area, appears a territorial relative isolation of individual helminth populations, who under influence of various physico-geographical and ecological conditions, through medium of their hosts, begin to separate themselves from their initial forms. The process of separation among the parasites is uncomparably faster, than among their hosts. Thus, V.A.Dogel considers that: "Processes which flow slowly, - over a period of centuries and millenia, - and widely, - over a space of huge territories, when free living organisma are concerned, in case of parasites are condensed both in time and space" (1947, page 10). Isolation increased the divergence, precipitated the process of species-formation, provoked the formation of interruptions between related species descending from common ancestor. Thus it is not accidental, that the greatest number of species of helminths common to both shores of the Ocean occur in the northern part of the sub-region, where species still are preserved with closed or interrupted area, but that has been interrupted in more recent time, while when approaching the southern border of the sub-region the endemism of the helminth fauna

increases as a result of its greater disconnection (fig. 2,3,4,5).

When analyzing the occurence of freely living marine organisms in the northern half of the Pacific Ocean, A.P. Andriyashev (1939) also recorded, that the number of species and even genera common for both shores decreases, the further we go to the south, and the differences appear more and more clear, especially if we compare the fauna of the Japaneese Sea and the coast of Oregon, where not only the species and genera are different, but also sub-families and families.

Similar laws were determined for the occurence of many freely living forms (fish, mollusks, ascidia etc) habitating in the Atlantic Ocean (Bobrinsky, Zenkevich, Bierstein, 1946).

Among the endemic species of the helminths of the sub-region, as it might be expected, there is not a single species, that has a clearly defined Amphi-Pacific area.

We may see from everything said above, that side by side with the amphi-boreal and bi-polaric phenomena of the occurence of the helminths of the marine mammals, just as of the occurence of the freely living organisms, we find Amphi-Pacific phenomena and that the formation of all the types of the interrupted areas of the freely living and parasite animals took place as result of identical causes.

Exchange Possibility of Helminth Fauna between the Marine Mammals of the Boreo-Pacific Sub-Region in Our Time.

When we speak about relative isolation of individual populations of helminths, first and foremost, we think about the isolated existence of their hosts living in various regions of the interrupted area and who do not have any exchange of individuals. Here, naturally, are not exoluded the

rare occasions of passing over by individual animals (Klumov, 1955). At first sight it might appear rather doubtful, that marine mammals in general and cetaceans in particular, to whom no natural barriers are existing in the Ocean, and who are able to carry out long migrations, may be, even to some degree, isolated from other parts of their immense area. Taking into consideration the assumptions, expressed particularly by M.M.Sleptzov (1955), and old informations concerning rare founds of harpoons in the dead bodies of whales, although as A.G.Tomilin (1957) points out the trustworthiness of these cases is doubtful, and also the fact that the parasite Panella antarctica was found in the whales of the Northern Hemisphere(this parasite, just as many other parasites of the marine mammals has, probably, a bi-polaric occurence), - some researchers consider the whales to be cosmopolitans, who freely migrate within the limits of the World Ocean. Thus,for example, B.A.Zenkovich (1952) writes about mass-migrations of whales from the seas of the Antarctica to the northern part of the Pacific Ocean. M.M. Sleptzov (1955) generally repudiates the possibility of local herds of whales, claiming that that a whale herd in the northern half of the Pacific Ocean is not isolated from other herds situated in the southern half of the Pacific Ocean, and that because of the constant migration there occurs a periodical, or systematical mixture of these herds; he even disagrees with the opinion of Kellogg (1929) about the presence in these waters of two local herds: the American and the Asiatic herd.

But if there is one single world herd of whales, then we have right to expect, that also the helminth fauna of this world herd should be, if not completely identical, then

at least sufficiently identical for every species of whale within any part of its huge area. However, in reality we see a different picture. We observe basical differences in the helminth fauna of the marine mammals living not only in different zoogeographical regions and sub-regions (Delamure, 1955), but even within the limits of a single sub-region, or a part of this sub-region. Returning to the analysis of table 1, we see that out of 92 species of helminths of the marina mammals, known for the Boreo-Pacific sub-region, in the Far-Eastern seas and in the north-western part of the Pacific Ocean - 72 species are recorded (16 species of trematoda, 20 - cestoidea, 26 - nematoda, 10 - acanthocephalia), at the American shore 38 species are recorded (9 - trematoda, 7 - cestoidea, 17 - nematoda, 5 - acanthocephalia), but species common for both sides of the Ocean we find only 18 (4 - trematoda, 5 - cestoidea, 6 - nematoda, 3 - acanthocephalia). Already these general numbers show sufficiently clearly how great is the difference in the helminth fauna of the marine mammals living in these parts of the sub-region.

What are the few species that link the helminth fauna of the two sides of the Ocean? To them belong species of helminths that are common with the Arctic region (Odhneriella seymouri, Diphyllobothrium lanceolatum, Pyramicocephalus phocarum, Corynosoma semerme and C. strumosum), species that are found within the only road of exchange of fauna both between the two coasts of the Boreo-Pacific sub-region, and between the Pacific and Atlantic Oceans. But this road goes through the Arctic region and at present time is only accessible to a very limited number of basically arctic animals,

who are hosts (definitive or transitory) of the mentioned helminths. Almost all these species are typical parasites of the pinnipedia, except Ordhneriella seymouri - a parasite of white grampus andCorynosoma strumosum, which is found in pinnipedia, cetaceans and other animals. Phocitrema fusiforme, Diphyllobothrium krotovi, and Adenocephalus septentrionalis are also parasites of the pinnipedia and live near the northern border of the sub-region, and, probably, also outside this sub-region, where still is a certain possibility of contact between the faunae of the two coasts, but where this contact has been interrupted, this interruption only occured at a late date. The species with Amphi-Pacific and Amphi-Boreal occurence (Lecithodesmus goliath, Ogmogaster plicatus, Phyllobothrium delphini, Anisakis simplex, Anisakis physeterys, Torynurus convolutus and Bolbosoma turbinella) can still less indicate any constant exchange of helminth fauna between the two parts of the sub-region, because if we accept this possibility, we must also accept the possibility of a not less regular exchange of helminth fauna with the Atlantic Ocean, around enormous territories of land, through passages presently impassable for the majority of the host of the above-stated helminths. On the contrary all the Amphi-Pacific species are parasites of the cetaceans and only Anisakis simplex is sometimes found in the pinnipedia. The geographical occurence of Contracaecum osculatum and Terranova decipiens cannot be taken into consideration, when studying this problem, because these two species habitate in all the zoogeographical regions of the World Ocean. Consequently not one of these 18 species may indicate a close contact

between its hosts within the limits of the Boreo-Pacific sub-region, and we do not have to mention, that all these species comprise only 18.5% of the total number of species known in the sub-region. On the other hand, the presence in each of the part of the sub-region of a great number of endemic species and even genera, on the contrary indicates a long period of mutual isolation. 12 genera and 47 species (table 3) are endemic for the sub-region, 10 genera and 35 species are endemic for the western part of the sub-region, 1 genus and 9 species are endemic for the eastern part, and only 1 genus and 3 species are recorded on both sides of the Ocean.

Table 3.

Occurence of Endemic Genera of Helminths of Marine Mammals of the Boreo-Pacific Sub-Region.

Helminth Genera	Recorded in the western part of the subregion		Recorded in the eastern part of the sub-region	
	Pinni-pedia	Cetace-ans	Pinni-pedia	Cetace-ans
Leucasiella		(X)		
Nasitrema		(X)		
Oschmarinella		(X)		
Zalophotrema		(X)		
Braicetrema			(X)	
Delphinicola	(X)		(X)	
Phocitrema		(X)		
Tetragonoporus n.g.		(X)		

(Cont)	Pinni pedia	Cetac.	Pinni pedia	Cetaceans
Hexagonoporus		(X)		
Delamurella		(X)		
Irukanema		(X)		
Placentonema		(X)		

The only endemic genus connecting the helminth fauna of the two coasts belongs to the pinnipedia, while there are no common endemic genera found for the cetaceans.

What concerns the question of presence in the northern half of the Pacific Ocean of Asiatic and American local whale herds, table 4 gives an exhaustive answer to it.

Table 4.

Occurence of the Endemic Species of Helminths of Cetaceans in the Boreo-Pacific sub-region.

Helminth Species	Recorded in Westn part of sub-reg.	Recorded in Eastn part of sub-reg.
Campula folium	(X)	
Campula gondo	(X)	
Campula laevicaecum	(X)	
Lecithodesmus nipponicus	(X)	
Lecithodesmus spinosus		(X)
Leucasiella mironovi	(X)	
Leucasiella subtila n.sp.	(X)	

	West	East
Nasitrema spathulatum	(X)	
Orthospåanchus elongatus	(X)	
Oschmarinella sobolevi	(X)	
Zalophotrema curilensis	(X)	
Delphinicola tenuis	(X)	
Tetragonoporus calypthocephalus n.g.n.sp.	(X)	
Hexagonoporus physeteris	(X)	
Tetrabothrius curilensis	(X)	
Trigonocotyle spasskyi	(X)	
Anisakis ivanizkii	(X)	
Anisakis pacificus n.sp.	(X)	
Delamurella hyperoodoni	(X)	
Halocercus kirbyi		(X)
Halocercus dalli	(X)	
Halocercus sunameri	(X)	
Irukanema dalli	(X)	
Crassicauda giliakiana	(X)	
Crassicauda pacifica		(X)
Crassicauda tortillis n.sp.	(X)	
Placentonema gigantissima	(X)	
Bolbosoma physeteris	(X)	
Bolbosoma paramuschiri n.sp.	(X)	
Corynosoma curilensis	(X)	

The analysis of the table leaves no doubt, that we are confronted with helminth fauna of two local herds of whales existing already for a very long time isolated from each other, and who are not interexchanging specimens.

This is confirmed by presence in each herd of its own endemic helminth fauna, by complete absence within them af common endemic species of helminths, and also by an unusual richness and originallity of helminth fauna of the Asiatic herd faced by an uncomparable poverty of helminth fauna of the American herd. In the western part of the sub-region 27 species of helminths are endemic (11 species of trematoda, 4 cestoidea, 9 nematoda and 3 echinorynchae), in the eastern part - only 3 endemic species (1 trematoda and 2 nematoda).

A different relation is observed for the helminths of the pinnipedia (table 5), - in the western part of the sub-region are recorded 8 endemic species of helminths of the pinnipedia (2 cestoidea, 3 nematoda and 3 echinorynchae), in the eastern part - 6 species (1 trematoda, 2 cestoidea, 1 nematoda, and 2 echinorynchae); 3 species (1 trematoda, and 2 cestoidea) are common for both parts of the sub-region.

Thus, the helminth fauna of the pinnipedia habitating the Asiatic and the American shores of the Pacific Ocean, show more similarities, than the helminth fauna of the cetaceans of the same parts of the Ocean. We get a completely different picture, than what we could have expected proceeding from the migration ability of these animals. This may be explained only by the closer connection of the pinnipedia with the Arctic region, through which a small exchange of helminth fauna is still possible along the two shores of the Pacific Ocean, while within the limits of the sub-region proper such an exchange is not possible. By the mobility of animals and their ability to carry out migration, we cannot explain the general laws of the geographical occurence of the living nature, because these laws are expressed also for the little-mobile animals and even plants. Particularly, Phyllobothrium delphini and Tetraphyllidea sp.larva have bi-polaric occurence, naturally, independently of their reserve of hosts -

- the cetaceans, because the latter, after all, only represent a subsidiary and blind way to spread these helminths. By the way, we may remark, that the cetaceans of the Northern and Southern Hemisperes have a considerably greater amount of common species of helminths, than the pinnipedia ~~have~~ (Delamure, 1955). This is explained, primarily, not by the ability of the cetaceans to migrate from one hemisphere into another, but, as L.S.Berg (1947) points out, because/ ~~by~~/the phenomenon of bi-polarity appears only among the forms of the moderate, and not Arctic zone, because the decrease in temperature in the Tropics was not big enough to permit the habitants of the polar regions to cross the Equator. Naturally, among the animals that succeeded to cross the Equator during the glacial period, there were less pinnipedia than cetaceans.

Table 5.

Occurence of the Endemic Species of Helminths of Pinnipedia of the Boreo-Pacific Sub-Region.

Helminth Species	Recorded in Westn part of sub-reg.	Recorded in Eastn part of sub-reg.
Pricetrema zalophi		(X)
Phocitrema fusiforme	(X)	(X)
Diphyllobothrium krotovi	(X)	(X)
Adenocephalus septentrionalis	(X(	(X)
Anophyoocephalus ochotensis	(X)	
Contracaecum callotariae	(X)	
Trigonocotyle skrjabini	(X)	

(Cont.)	Westn	Eastern
Porrocaecum callotariae	(X)	
Terranova azarasi nov. comb.	(X)	
Uncinaria lucasi		(X)
Parafilaroides decorus		(X)
Parafilaroides nanus		(X)
Parafilaroides prolificus		(X)
Bolbosoma bobrovoi	(X)	
Corynosoma obtuscens		(X)
Corynosoma osmeri	(X)	
Corynosoma ventronudum n.sp.	(X)	

In order to clarify the mentioned question in greater detail, we comsider it necessary to carry out a careful analysis of helminth fauna by their hosts, taking in consideration the peculiarities of occurence of each of them individually. We must, however, point out, that this is still impossible to be made in regards to all the species of marine mammals, because to our regret, we are not in possession of corresponding comparative data of their helminth fauna.

Sperm whale - Physeter catodon Linn. 1758. About the question of occurence and migration of the sperm whale within the limits of the Boreo-Pacific region, there are contradictory opinions. M.M.Sleptzov is of the opinion that "... migrations of the whales have no barriers", and thus the mixing of the American and the Asiatic herd of the sperm whales is possible "... both in the North, and in the South" (1955, page 65). He thinks that there is a Pacific Ocean herd of the sperm whales, which, however, is not isolated

from the sperm whale herds of the Southern Hemisphere.

The analysis of the helminth fauna of the sperm whales confirms the opinion of the majority of the cetologists concerning the presence in the northern half of the Pacific Ocean of at least two local herds: an Asiatic herd and an American herd, which at present time do not mix in the North, and still less in the South.

The helminth fauna of the Asiatic herd of the sperm whales distinguishes itself by extraordinary richness, originality and independence(table 6). It contains 9 endemic species of helminths (Zalophotrema curilensis, Tetrabothrium curilensis, Tetragonoporus calyphhocephalus n.gn.sp., Hexagonoporus physeteris, Anisakis ivanizkii, Anisakis pacificus, n.sp., Placentonema gigantissima, Bolbosoma physeteris, Corynosoms curilensis) and three very interesting endemic genera (Tetragonoporus, Hexagonoporus, Placentonema).

The helminth fauna of the sperm whales of the American herd, on the contrary, strikes by its poverty. It is represented only by three wide-spread species; no endemic species were recorded. It is possible, that the helminth fauna of the American herd is less studied, than the Asiatic herd, but to ascribe all the differences in helminth fauna of these herds exclusively to the lack of study of one of them would be unfounded.

Utilizing the data of studies through many years of the helminth fauna of the cetaceans, we have noted that not a single endemic helminth species of the sub-region has Amphi-Pacific occurence. Considering this to be a rule, we have right to expect, that also during future studies, such species, probably, will not be found. Further we have determined, that all Amphi-Pacific species also have Amphi-Boreal

occurence. This gives us reason to assume, that during future studies of the sperm whales of the eastern part of the sub-region, first we will discover the already known Amphφ-Boreal species, and also some circum-polaric and bi--polaric ones. Simultaneously, there is the possibility to discover also new endemic species. As an example, we may take the work of Margolis and Pike (1955), in which they give a list of helminths that are recorded for the first time along the North-American coast. Of 8 species, stated in this work, 6 species were known previously as Amphi-Boreal, and now, consequently, are known also as Amphi-Pacific (Lecithodesmus goliath, Ogmogaster plicatus, Phyllobothrium delphini, Anisakis simplex, A.physeteris and Bolbosoma turbinella), and the other two species are described as new endemic species of the North American coast (Lecithodesmus spinosus and Crassicauda pacifica). Disregarding the fact, that there are $2\frac{1}{2}$ times as many endemic species in the sub-region, as there are Amphi-Boreal ones, not one of them was discovered on the opposite side of the Ocean. The probability of discovering endemic genera is still less probable. Similar picture is obtained through the results of studying the helminth fauna of marine mammals of the region of the Kuril Islands. Consequently, through further study of the helminth fauna of the sperm whales of the Asiatic and the American herds, we can only expect such data, that will once more confirm the locality of these herds.

Only two common species of helminths were discovered for these herds of sperm whale : - Phyllobothrium delphini and Anisakis simplex. Both species have a wide circle of hosts and occur in the Temperate zones of the Northern and Southern Hemospheres. In solving the problem of the locality

of the mentioned herds of the sperm whales, these species naturally cannot play any role. Thus, we may speak quite definetely about the absence of the exchange of the helminth fauna between the sperm whales of the American and the Asiatic herds, in our days. But we have a reason to assume, that also in the warmer post-glacial period (Ancylus and Litorina period), there was no exchange of the helminth fauna between the sperm whales of the Atlantic and the Pacific Oceans, and also between the sperm whales of the Asiatic and American herds. Such exchange might have taken place considerably earlier, probably, before the Glacial period. We are not going to deal with the details of this question, since we have treated it previously. Exchange of helminth fauna with the sperm whales of the Southern Hemisphere could only take place during the Glacial period. At present time (Tomilin, 1957) two sub-species of the sperm whale are noted: the northern sperm whale - Physeter catodon catodon L. 1758, and the northern sperm whale - Physeter catodon australis Mac-Leay, 1851, betwwen which two there are some morphological variations (Ivanova, 1955) and very considerable differences in their helminth fauna (Delamure, 1955). The absence of comparative data concerning the sperm whales of the northern halves of the Atlantic and the Pacific Oceans, forces us to consider the entire northern population still as one (typical) sub-species Physeter catodon catodon L. 1758, (Tomilin, 1957). However, the sperm whales of these two, as Tomilin says "... basically isolated regions" (1957) page 416, footnote) have very material differences in the helminth fauna (Delamure, 1955).

Table 6.

Helminth Fauna of Sperm Whales Habitating in the Eastern and Western Parts of the Boreo-Pacific Sub-Region.

Helminth Species	Recorded in Westn part of sub-reg.	Recorded in Eastn part of sub-reg.
Zalophotrema curilensis	(X)	
Tetrabothrius curilensis	(X)	
Trigonocotyle sp.	X	
Drigonoporus sp.	X	
Trigonoporus calyptocephalus n.g.n.sp.	(X)	
Hexagonoporus physeteris	(X)	
Phyllobothrium delphini	X	X
Tetraphyllidea sp.larva	X	
Tetrarhynchidae sp. larva	X	
Anisakis skrjabini	X	
Anisakis physeteris		X
Anisakis dussumieri	X	
Anisakis ivanizkii	(X)	
Anisakis simplex	X	X
Anisakis pacificus n.sp.	(X)	
Placentonema gigantissima	(X)	
Bolbosoma physeteris	(X)	
Bolbosoma turbinella	X	
Corynosoma curilensis	(X)	
Corynosoma strumosum	X	

Basing ourselves upon observations and interrogations, which confirm arrival of same sperm whales during the course of two - three years in a row into the same region of waters around the Kuril Islands, S.K.Klumov (1955) expresses his assumption, that in the north-western part of the Pacific Ocean we deal with two local herds, one of these herds during the summer period occupies the territory from the middle part of the Hokaido Island to the northern point of the Urup Island, the other herd spreads from the Boussole Strait and to the Comandore Islands, entering into the southern part of the Bering Sea.

Utilizing our own data of the helminthological studies of the sperm whales of the region of the Kuril Islands, also the data of N.M.Gubanov (1951,1952) and other information from literature, we tried to compare the helminth fauna of the sperm whales from these presupposed herds. It was discovered, that sperm whales caught south of the Urup Island did not contain species endemic for the north-western part of the Pacific Ocean - Tetragonoporus capytocephalus n.g.n.sp and larvae of Tetraphyllidea sp.larva, and in sperm whales caught north of the Boussole Strait, we did not find such species as: Zalophotrema curilensis, Tetrabothrium curilensis, Hexagonoporus physeteris, Corynosoma curilensis, Trigonocotyle sp. and Diplogonoporus sp. First four species are also endemical for the western part of the sub-region. Such difference in the helminth fauna of the sperm whales living in immediate proximity to each other, cannot be considered to be accidental, and if this phenomenon will be confirmed by further data, then the hypothesis of S.K.Klumov (1955) about existence of two local herds of sperm whales in the northwestern part of the Pacific Ocean, may be considered proved. The presence of comparatively large number of common species of helminths in these herds of sperm whales

is explained, first: by the fact that their migration roads pass through the same territories, secondly: by the immediate proximity of their habitats, which permits ~~xxxx~~ to a certain degree some exchange of helminth fauna through media of intermediate hosts.

Killer whale - Orcinus orca (Linneus), 1758. In the northern half of the Pacific Ocean the killer whales occur from the Chukotsk Peninsula and Alaska to the Equatorial waters, however, the migrations of the killer whales are still not investigated (Tomilin, 1957).

Table 7.

Helminth Fauna of the Killer Whales in the Eastern and Western parts of Boreo-Pacific sub-region.

Helminth Species	Recorded in the Western part of the sub-region	Recorded in the Eastern part of the sub-region
Leucasiella subtila n.sp.	(X)	
Trigonocotyle spasskyi	(X)	
Anisakis simplex	X	
Anisakis pacificus n.sp.	(X)	
Anisakis sp.		X
Bolbosoma physeteris	(X)	

In the Far-Eastern seas and in the north-western part of the Pacific Ocean five species are recorded (table 7) of the helminths of the killer whale, four of which are endemic (Leucasiella subtila n.sp., Trigonocotyle spasskyi,

Anisakis pacificus n.sp. Bolbosoma ohyseteris). Trematoda Leucasiella subtila n.sp. from the bowels of the killer whale and L. mironovi from the bowels of white grampus are only recorded in the western part of the sub-region, therefore we may consider the genus Leucasiella endemic for the Asiatic coast. Only one nematoda is known on the North-American coast - Anisakis sp. (Margolis, 1954; Margolis and Pike, 1955).

Naturally, the list of the helminths of the eastern part of the sub-region cannot be limited by only one and to boot undetermined species. Thus we have right to consider it as a result of unsatisfactory study of the helminth fauna of the killer whales of the American coast. However, as we have noted before, the probability to find endemic species, and still more - endemic genera, that have Amphi-Pacific occurence, is negligible, moreover that the species Anisakis pacificus and Bolobosoma physeteris in the western sub-region are recorded both for the sperm whales and the killer whales, while in the eastern part they are not discovered for either of them. No signs of exchange of the helminth fauna between the killer whales of these shores has been discovered.

White-winged porpoide - Phocaenoides dalli (True), 1885. Occurs only in the northern half of the Pacific Ocean from Japan (province of Rikuzen, north-western part of Nipon) and California (Santa-Cruz) to the Seas of Okhotsk and Bering inclusively (Tomilin, 1957).

The helminth fauna of this animal is extremely little studied. At the American shore only one species of nematoda is recorded - Holocercus kirby, which is endemic in the Boreo-Pacific sub-region; at the Asiatic shore - Halocercus dalli? Irukanema dalli, Anisakis sp.larva. However, even

these few data indicate not a similarity of helminth fauna, but a distinction.

Finback whale - Balaenoptera physalus (Linn.) 1858. According to B.A.Zenkovich (1936)in the northern half of the Pacific Ocean live two isolated herds of the finback whale: the North-American and the Asiatic herds. A.G.Tomilin (1957) is of the same opinion, however, he considers this division to be conditional, because at present time there is almost no proof of the isolation of these herds. A.G.Tomilin, just as B.A.Zenkovich, assumes that in the Chukotsk Sea, Bering Strait and in the northern part of the Bering Sea, the American herd of the finback whales mixes with the Asiatic herd, and he admits the possibility of the finback whales entry to the waters of Kamchatka also from the North American side and not only from the South. M.M.Sleptzov (1955) considers the opinion of B.A.Zenkovich concerning the division of the Pacific herd into American and Asiatic still insufficiently founded.

One of the weighty arguments for the division of these herds of whales is their difference in the helminth fauna (table 8).

Helminth fauna of the Asiatic herd of finback whales is considerably richer than the helminth fauna of the American herd. It is represented by 10 species, while the American helminth fauna by only three. Only one endemic species is know in each of the helminth faunae. The only species (Ogmogaster plicatus), which connects the helminth fauna of these herds of finback whales, has Amphi-Pacific and Amphi-Boreal occurence and thus cannot serve as proof of the inter-mixture neither of the Asiatic whales with the American, nor of the Pacific ones with the Atlantic ones. Probably, the locality of both herds is maintained even during their reproaching

in the Bering Strait.

The exchange of helminth fauna between these herds, just as between the finback whales of the Antlantiv and the Pacific Oceans, as we have pointed out previously, occured for the last time, probably, during the warm post-glacial period. The exchange of helminth fauna with the whales of the Southern Hemisphere could only take place during the glacial period.

At the present time (Tomilin, 1957) we discern two geographical races of finback whales: the northern one - Balaenoptera physalus physalus Linn., 1758 (typical area - Spitzbergen region) and the southern - Balaenoptera physalus quoyi Fisher, 1830 (typival area - Southern Falkland Islands). The difference between the Atlantic and the Pacific finback whales is expressed considerably less.

Fish whale - Balaenoptera borealis Lesson, 1828. The difference in size gives basis for division into two geographical races of fish whales: the northern one - Balaenoptera borealis borealis Lesson, 1928 and the southern - Balaenoptera borealis schlegi Flower, 1864. The fish whale makes regular migrations in the northern part of the Pacific Ocean and occurs most frequently during the summers in the waters of Japan and Korea, seldom at Kamchatka and still more seldom near Chukotka. At the Pacific shores of the North America the fish whale lives from Alaska down to the Mexico (Tomilin, 1957). M.M.Sleptzov (1955) thinks, that owing to their ability of the fish whales to feed upon fish and plankton, they are capable to carry out long journeys from one hemisphere into the other, from the Atlantic Ocean into the Pacific etc.

However, the helminth fauna of these whales differs even within the confines of one single sub-region (table 9).

Table 9.

Helminth Fauna of Fish Whales Living in the Eastern and Western Parts of the Boreo-Pacific Sub-Region.

Species of Helminth Fauna	Recorded in the Western part of the sub-region	Recorded in the Eastern part of the sub-region
Lecithodesmus goliath	X	X
Lecithodesmus spinosus		(X)
Ogmagaster plicatus	X	X
Diplogonoporus balaenopterae	X	
Diphyllobothrium sp.larva	X	
Tetrarhynchidae sp.larva	X	
Anisakis simplex		X
Bolbosoma turbinella	X	X
Bolbosoma nipponicum	X	

The helminth fauna of the fish whales of the eastern part of the sub-region is represented with a smaller number of species, but among them there is one endemic species (Lecithodesmus spinosus). Among the helminth fauna of the western part of the sub-region there is no endemic species, but there are such typical species of helminths as Bolbosoma nipponicum and cestoidea larvae Tetrarhynchidae sp. larva, that occur widely in the marine mammals of the north-western part of the Pacific Ocean only. Three Amphi-Pacific species connecting the helminth fauna of these shores of the Ocean, as one should have expected, have also an Amphi-Boreal occurrence.

Minke whale - Balaenoptera acutorostrata Lacepede,

1804. Two faintly expressed sub-species are discerned (Tomilin, 1957): the North-Atlantic one - Balaenoptera acutorostrata acutorostrata Lacepede, 1804, and the North-Pacific - Balaenoptera acutorostrata davidsoni Scammon, 1874. In the northern half of the Pacific Ocean the minke whale occurs from the Sea of Chukotsk and the Bering Strait to the Koreo-Chinese coast and Mexico (Tomilin, 1957). The helminth fauna of the minke whale is still only little studied, especially near the American shore.

Besides one endemic species Anisakis pacificus n.sp., the most characteristic for the Asiatic coast are cestoidea larvae Tetrarhinchidae sp.larva and the echinorhynchus Bolbosoma nipponicum. (table 10).

Table 10.

Helminth Fauna of Minke Whale Living in the Eastern and Western Parts of the Boreo-Pacific Sub-Region.

Helminth species	Recorded in western part of sub-region	Recorded in eastern part of sub-region
Lecithodesmus goliath	X	X
Tetrarhinchidae sp.larva	X	
Anisakis simplex	X	
Anisakis pacificus	(X)	
Bolbosoma nipponicum	X	

Exchange of helminth fauna with the Atlantic Ocean and the Southern Hemisphere of the fish whale and the minke whale occured, probably, during the same periods of time, as it occured in the case of the finback whale.

What concern the helminth of the pinnipedia, the data available are considerably fewer, however, will still find it suitable to state them in the present work.

Sea Lion - Eumetopias jubatus Schreber. According to S.I.Ognev (1935) the geographical region of its occurrence covers the Seas of Bering, Okhotsk and Japan, reaching in the North up to 66°, and in the South - 37° (along the western shore of the Hondo Island in Japan). Along the American coast the sea lions are spread from the Pribilov Islands, Islands of St.Paul, St.George and St.Mathew (61°) in the North, and in the South down to the Monterey Bay and the Island of Farallones and Año Nuevo (37°40').

Table 11.

Helminth Fauna of the Sea Lions Living in the Eastern and Western Parts of the Boreo-Pacific Sub-Region.

Helminth species	Recorded in the western part of the sub-region	Recorded in the eastern part of the sub-region
Anophryocephalus ochotensis	(X)	
Diphyllobothrium (Diplogonoporus ?) fasciatus		X
Pyramicocephalus phocarum	X	
Tetrarhynhhidae gen.sp.larva	X	
Anisakis simplex	X	
Anisakis similis		X
Contracaecum osculatum	X	X
Terranova decipiens		X
Uncinaria hamiltoni		X
Parafilaroides nanus		(X)

Parafilaroides prolificus		(X)
Bolbosoma bobrovoi	(X)	
Corynosoma strumosum	X	
Corynosoma ventronudum n.sp.	(X)	

We know five endemic species of helminths in the sea lion (table 11), three of these (Anophryocephalus ochotensis, Bolbosoma bobrovoi, Corynosoma ventronudum n.sp.) are endemic for the Asiatic coast and two (Parafilaroides nanus, P.prolificus) - for the North-American. Contracaecum osculatum, which connects the helminth fauna of these shores, as already mentioned, occurs in all zoogeographical regions.

The stated facts show the absence of exchange of helminth fauna among the sea lions living in the mentioned parts of the sub-region.

We see a different picture, when analyzing the helminth fauna of the bearded seal - Erignatus barbatus Pall.,who has a circum-polar occurrence. Within the limits of the Boreo-Pacific sub-region it has six species of helminths recorded (table 12), among which there is not a single endemic species. They are all connecting the Boreo-Pacific sub-region with the Arctic region.

Table 12.

Helminth Fauna of the Bearded Seals Living in the Eastern and Western Parts of the Boreo-Pacific Sub-Region.

Helminth species	Recorded in the western part of the subregion	Recorded in the western part of the sub-region.
Orthoplanchus fraterculus		X
Diphyllobothrium lanceolatum	X	X
Pyramicocephalus phocarum	X	

Terranova decipiens	X
Contracaecum osculatum	X
Corynosoma strumosum	X

We cannot speak about substantial difference in the helminth fauna of the bearded seal living near the American and the Asiatic coasts, because all the species of the helminths, except Orthosplanchus fraterculus are recorded in all other marine mammals in the both parts of the sub-rehion, consequently there is a possibility to discover them even in the bearded seal. In the present case we may assume the presence of some exchange of helminth fauna among the bearded seals living near these shores, even though their migration and has local character according to N.A.Bobrinsky, B.A.Kusnetzov and A.P.Kuzyakin (1944). Such exchange of helminth fauna may take place through a long chain of definite and intermediate hosts, and through the Arctic region.

Conclusion.

1. On the basis of the results of the study of helminthological material from 302 cetaceans amd 10 pinnipedia, and of the analysis of literature sources, including the ones that appeared after S.L.Delamure (1955) had published his monography, - we record at present time in the marine mammals of the Boreo-Pacific sub-region - 92 species of helminths, 47 of which are endemic. Helminth fauna of the Boreo-Pacific sub-region is considerably richer in the helminth fauna than the Boreo-Atlamtic sub-region and than any of the zoogeographical regions.

2. At present time we know in the helminth fauna of the marine mammals of the Boreo-Pacific sub-region - 15 species of helminths that have bi-polar occurrence and 10 species of these have Amphi-Boreal occurrence. 9 species are known, that have only Amphi-Boreal occurrence.

The nematoda Odontobius ceti Roussel de Vauzeme, 1834, who live as commensals of the finback whale in the sticky film of the laminae of the whalebone, also have a Bi-polar occurrence.

3. The analysis of own data and the ones in the literature permits us to determine, that together with the phenomena of Amphi-Boreality and Bi-Polarity in the occurrence of the helminths of the marine mammals, just as in the occurrence of freely living animals, a phenomena of Amphi-Pacificity is observed. Among the helminth fauna of marine mammals of the Boreo-Pacific sub-region we know 7 species of helminths with Amphi-Pacific occurrence.

Almost all the species of helminths who/have a clearly defined Amphi-Pacific area, have likewise an Amphi-Pacific occurrence, which indicates the origin of these two types of interrupted areas from same causes.

All the known species of the Amphi-Pacific species of helminths known at present time are parasites of the cetaceans and only one species is recorded both for the pinnipedia and the cetaceans. helminth species, that have a closed area in the North, on the contrary, are in the vast majority of cases parasites of the pinnipedia.

4. Helminth fauna of the marine mammals living in the Far Eastern seas and in the North-Western part of the Pacific Ocean, materially differ from the helminth fauna

of animals living near the North-American coast. Out of 92 species of the helminths of the marine mammals, known for the Boreo-Pacific sub-region, only 18 species live on both sides of the Ocean. Here the greatest number of species of the helminths, common for both sides of the Ocean, same as for the free-living animals (Andriashev, 1939), is in the northern part of the sub-region, while the closer to the southern border of the sub-region, the greater the endemism of the helminth fauna, as a result of the greater disconnection.

5. The helminth fauna of the pinnipedia living at the Asiatic and American shores of the Pacific Ocean, show more points of mutual similarity, than the helminth fauna of the cetaceans of the same sides of the Ocean. This is explained by a greater connection of the pinnipedia with the Arctic region, through which an insignificant exchange of helminth fauna is still possible between the two coasts of the Pacific Ocean, while within the limits of the sub-region such exchange does not occur neither for pinnipedia, nor for the cetaceans. The presence of a great quantity of endemic species and even genera of helminths for each of the parts of the sub-region, indicates the prolonged period of the relative isolation of their hosts.

6. A comparative analysis of the helminth fauna of the cetaceans of the Boreo-Pacific sub-region indicates presence in the northern half of the Pacific Ocean of, at least, two local herds of whales: an Asiatic and an American herd, who do not exchange helminth fauna at present time.

7. On the basis of the peculiarities of the geographical occurrence of the helminths and their hosts, we have

determined, that among the cetaceans living near the Asiatic and American coasts of the Pacific Ocean, there are many species, who did not exchange helminth fauna neither among themselves, nor with the whales of the Atlantic Ocean even in the warmer period of the post-glacial period. To such species of whales belong, probably; sperm whale, Berardius bairdii, and, possibly, some other species, whose helminth fauna contains many endemic species, and even genera, but they have no species with only Amphi-Boreal and Amphi-Pacific occurrence.

Following the thesis of L.S.Berg (1918, 1947), we consider that the exchange of helminth fauna between the sperm whales of the Atlantic and the Pacific Oceans took place in a warmer Pre-Glacial period (during the Pliocene), which is indicated by the Amphi-Boreal occurrence of almost all the Bi-Polaric species, who participate in the helminth fauna of the above-mentioned animals.

To the finback whale, who even in present time penetrates as far north as to the Chukotsk Sea (Tomilin, 1957), the Post-Glacial warming up was, obviously, enough to have contact with the Atlantic Ocean. As the result of this the number of species of helminths with Amphi-Boreal occurrence increased and the number of species with un-interrupted occurrence decreased correspondingly. Similar picture is presented by the helminth fauna of the fish whale and the minke whale.

8. The difference in the helminth fauna of the sperm whales living North of the Boussole Strait and South of the Urup Island, confirms the thesis of S.K.Klumov (1955) concerning the division of the Asiatic herd of the sperm whales into two local herds.

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