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NERITIZATION OF THE PLANKTON FAUNA IN THE MEDITERRANEAN BASIN

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The plankton fauna neritization in the Mediterranean Seas basin is discussed. Neritization is an increase of the neritic species percentage in zooplankton composition from the Mediterranean to the Black and Sea of Azov; It has been shown that the percentage of oceanic species decreases considerably in the Mediterranean Sea, adjacent to Gibraltar strait if compared with the Atlantic region, and the share of neritic – oceanic and neritic species increases correspondingly. Some of these species were observed in the open sea. In the Black Sea, oceanic species are absent. Neritic – oceanic and neritic species, which came there from the Mediterranean Sea, are distributed through out the area. The shallow-water straits between the seas and considerable changes in salinity and temperature regime prevent penetration of oceanic and neritic – oceanic species into each following sea of the Mediterranean basin. Considerable decrease of each sea, increase of the shelf percentage, decrease in the system stability of the circulating currents, separating coastal waters, and these of central regions, facilitate spatial distribution of alien species all over with masses of the seas. The high abundance of neritic species in the Black and Sea of Azov central regions can be possibly explained by a decrease in number of competitors for food and predators (before introduction of Ctenophora *Mnemiopsis leidyi* A. Agassiz*,* 1865) and an increase in food concentration for zooplankton, from the Mediterranean Sea to the Black Sea and Sea of Azov.

Key words: zooplankton, oceanic, neritic-oceanic, neritic and narrow-neritic species, neritization

It is known, that the plankton fauna in the World ocean open regions, occupying 84 % of its surface, and in the shelf zone (16 %) is diverse and form neritic and oceanic complexes, which was shown by E. Haeckel [13] more than one hundred years ago. The oceanic complex is characterized by a great number of usually stenobiotic species, represented by a small number of specimens. The neritic complex consists of a smaller number of mostly euribiotic species. Some of them are numerous in the ocean shelf zone plankton [54]. The boundary between neritic and oceanic species habitats in the ocean approximately coincides with the boundary of the shelf zone. The analysis of the literature on different parts of the World Ocean [3, 22, 55] shows that it corresponds to the outer periphery of the currents, which form intercontinental gyres.

The plankton species can be met in non-characteristic habitats [7, 32, 54]. T. Tokioka [53, 54] selected the group of open-neritic species. K. V. Beklemishev [2, 3] proposed to name these species distant-neritic. T. Tokioka noticed that another extreme of the neritic species are the organisms which inhabit only gulfs and estuaries. A. Fleminger [15] divided copepoda of the Gulf of Mexico into five types and named them facies: estuary, coastal-neritic, slop-neritic, shelf-oceanic and oceanic. N. S. Khromov [22] isolated four groups according to the materials of investigations in the Northern Subtropical Atlantic: neritic, neritic-oceanic, oceanic-neritic and oceanic.

F. Vives [57] divided copepoda into five groups at northwestern Africa, from the Cabo Verde islands to Gibraltar, an ocean region of 500 miles. There are narrow - neritic, neritic, neritic - oceanic, oceanic - neritic and oceanic species.

But to subdivide zooplankton into ecological groups seems to be too difficult. Different authors refer the same species to different groups. It is very difficult to distinguish neritic - oceanic and oceanic - neritic species. Different animal species distribution towards the coast in different ocean regions is the main reason. But, data existing in the world literature allows us to assume that partition, represented in the F. Vives work which can be accepted as the base of zooplankton division into ecological groups by means of neritic - oceanic and oceanic - neritic group unification and naming it, for example, neritic - oceanic [24].

There is the following distribution of these organisms. Narrow - neritic species live, basically, in bays, estuaries and also in the coastal shallow - water zone (depth of 10 – 20 m). Neritic or broad - neritic species are distributed, as a rule, above the shelf to the outer periphery of oceanic circulation. Neritic-oceanic species are represented in communities above shelf and beyond its boundaries. Oceanic species create the base of oceanic macro-circulation communities, in particular, their central regions.

Studying the allocation and quantitative distribution of organisms belonging to the different ecological zooplankton groups, changing their quantitative ratio depending on distance from the coast and change of conditions in the ocean and inner seas is of definite interest for estimation of their abundance, conditions, boundaries, regularities of their facies formation, and community structure peculiarities of that or another region.

The Mediterranean basin, large inner seas system, stretches from the west to the east for 4000 km and is of great interest. Seas forming the basin (Mediterranean, Black and Sea of Azov) differ greatly by sizes, bathymetrical and hydrological characteristics, and biological conditions.

Plankton fauna neritization in the seas of the Mediterranean basin has been investigated in this work, basically, using Copepoda as an example.

The objectives of the present work are: 1) to show on the base of the literature and our own data analysis, how correlation of different ecological zooplankton groups changes in the Mediterranean basin seas; such process is called neritization of fauna [24]. 2) To reveal the factors of environment, determining degree of the fauna neritization in different water reservoirs of the Mediterranean basin.

Some works, not found earlier and published last years don't change considerably the ideas on the problem discussed [24], but they additionally prove their reliability.

The present publication makes its data and conclusions accessible for English speaking readers, for whom up to the present time they were practically unknown.

The fulfilled analytical review of the literature can be used by the teachers, giving course of the biological oceanography.

Materials and Methods. The numerical data obtained in researches of planktonologists from the different Mediterranean countries, including article authors data, have been used as materials.

Zooplankton samples have been obtained in the different countries using nets of different constructions. These nets were equipped with the sieves of different sizes, mainly from 100 to 300 mkm. Sets of catches were performed, as a rule, in deep-water regions in standard layers to the depth of 100 – 200 and 500 m, in the coastal zone - from the bottom to water surface.

Organisms' abundance has been calculated for $1m^3$ or sometimes $1m^2$. The main task in sample processing was to distinguish zooplankton species composition. Usually, only the Copepoda group was studied, as it had the most mass.

Thus, the lists of the different ecological groups species, given for the regions under consideration, were used for analysis.

Results. Central regions of the Mediterranean Sea, as well as the open part of the oceanic tropics and subtropics are characterized by high species quantity, but low individual abundance. Two hundred species of the plankton animals, including more than 100 species of Copepoda were registered, usually at the full-day station for the layer 0 – 500 m. The animal list considerably increased under the daily observation cycle in the same point, but in another time. In the Ionian Sea, according to the results of two observations in the one point, but in different seasons, 188 species of Copepoda, and in the Sardinian sea 173 species were found [5]. An absolute majority of them were oceanic and neritic - oceanic species. Presence of species belonging to these groups and absence of the neritic species in zooplankton of the Mediterranean Sea deep-water regions was shown in many other works [8, 18, 21, 24, 37, 45, 49, 51].

Zooplankton differs greatly in coastal zones, in particular, in gulfs and bays by species composition and quantity. In the offshore part of the neritic zone, the relatively great species abundance was noticed. Most of the species are neritic - oceanic and partially, oceanic and neritic. Thirty-five species of Calanoida was registered by F. Vives [56] on the Spanish coast to the depth of 60 m during one year. This was considerably less than in the deep-water part of the sea. Neritic and nerititc - oceanic species dominated. Species abundance was not very great in the Barcelona port where the salinity was 36.48 – 36.69 $‰_0$ [58]. During a preannual observation cycle, about eight species of Calanoida were registered. *Podon polyphemoides* (Leuckart, 1859), *Oicopleura dioica* (Fol, 1872), some Medusae, Syphonophora, larvae of Barnacles, Molluscs etc. had the most mass as well as the usual plankton components from the other groups. One hundred and ten species of Copepoda are known in Marseille gulf, 40 species in Marseille port, and 3 to 4 species in lagoons to the west from Marseille [17].

One hundred and twenty-five species of Copepoda were registered in the Neapolitan gulf, according to the results of zooplankton investigations from 1984 to 1990 with a two-week interval. Only some of them were comparatively numerous [36].

The most large-scale changes of the zooplankton composition from oceanic to narrow - neritic were described for the Adriatic Sea. In 1974 – 1976, eight near-latitudinal sections from Otranto strait to the north part of the Adriatic in four seasonal cruises were completed. In the Otranto strait, the oceanic Copepoda species prevailed. There were very few coastal species, and estuarine species were absent. The proportion of oceanic species increased and the proportion of coastal species decreased as we moved forward to the north of the sea. Estuarine species occurred at the third section in southern Italy. Estuarine species were at all five stations at the fifth section, but coastal (neritic) species prevailed. There were very few oceanic species. At the 7^{th} and 8^{th} sections, they were practically absent, and zooplankton consisted of coastal and estuarine species. The species quantity decreased from south to north in the sea. The Copepoda abundance increased 12 times from the Otranto strait to the northern sea part. These changes correspond to the changes of hydrological and bioproductional sea characteristics [20].

According to the investigation results at the Egypt coast in 1966, above the depth of about 110 m, 132 species of Copepoda were discovered [14]. In 1964 – 1965 in the coastal region, in the zone of the Nile influence, 31 species of Copepoda were noticed [50]. Among sea species, only neritic (*Paracalanus parvus* (Claus, 1863), *Temora stylifera* Dana, 1848, *Acartia latisetosa* (Kricz, 1873), etc.) neritic - oceanic (*Calanus minor* Claus, 1863, *Eucalanus attenuatus* Dana, 1848, *Clausocalanus arcuicornis* Dana, 1849, *Acartia clausi* (Giesbr., 1889) and even species, referred by F. Vives [51] to the oceanic

(*Calocalanus plumulosus* (Claus, 1863), *Macrosetella gracilis* (Dana, 1847), *Oncaea minuta* Giesbr., 1892) were found.

Zooplankton of the coastal zone and bays is characterized by less abundance of species. Thirteen species of Copepoda, mainly neritic, were found in the harbor of Abu-Quir near Alexandria above the depth of 15 m before the Nile overflow [13]. *Evadne tergestina* (Claus, 1877), *E. nordmani* (Loven, 1836), *E. spinifera* P.E. Muller, 1867, *Oicopleura spp*., etc were observed in considerable abundance. Plankton abundance decreased during the Nile overflow, when salinity of the upper layer decreased in different places to 3 - 10 ‰. Copepoda species quantity decreased from 13 to 9.

Some peculiarities of coastal zone plankton are known for the other Mediterranean Sea regions [24].

Investigation of zooplankton distribution in the Black Sea actively began in 20^{ties} of the XX century [40]. They were conducted more intensively after the work of V. A. Vodyanitskiy [59], where, in contrast to the existing opinion, the idea about relative life abundance in the central sea part was stated. It was shown that quantity and biomass of zooplankton as a whole and of some its species, in particular, were comparatively high in the coastal regions and in the central part [34].

In 40 – 50^{ties} more high biomass values in the open sea in comparison with the coastal waters were already known. V. A. Vodyanitskiy [60] wrote: "…Black Sea is not depleted in its middle parts; but it should be recognized as abnormally enriched, because, in general, in the deep ponds, relative poorness of the middle layers is expected." (p. 415).

Later, as a result of intensive studies of the Black Sea plankton, problem of zooplankton distribution was considered more precisely [10, 16, 30, 31, 41, 42, 46]. Many authors pointed out the comparative monotony of zooplankton distribution along the sea. Plankton concentration increase was noticed in the regions, which were subject to the strong coastal disposal [north-western sea part] and in the different sea parts as separate spots in the zones of current convergence.

I. Dymov [11] noticed that some neritic species distribute along the section from Varna to the open sea are characterized by their decrease as one moves off shore (*Evadne tergestina, E. spinifera, Penilia avirostris*, Dana, 1849, *Paracalanus parvus*, *Oicopleura dioica*). But, *Acartia clausi* abundance turned out to be the same in the coastal zone and in the open sea.

Macroplankton medusae *Aurelia aurita* (L., 1758) inhabited the Northern America shore to the isobath 100 m (Bigelow, 1928). It spread along all the Black Sea [39].

According to Delalo et. al. [9] data, the mass for the Black sea zooplankton species dominated in all seasons of the year in the deep-waters as well as over the shelf. Average zooplankton concentration was the same in the open sea and in the coastal zone, but abundance and biomass were higher in the open sea than in the coastal waters per m^2.

One of us [23] calculated absolute and relative abundance values of the biomass of Copepoda species per m^2 for central and coastal regions, using the literature data and archival cards of sample processing for several years. Analysis of the data obtained showed that abundance of all Copepoda species in both regions was relatively high. Neritic - oceanic specimens of the cool water complex (*Calanus euxinus* Karav., 1894; *Pseudocalanus elongatus* (Boeck, 1872), *Oithona similis* Claus, 1869) were more abundant in the central sea part, than at the Crimean and Caucasus shores in all seasons. Abundance of eurythermal and warm water Copepoda, mainly neritic species (*P. parvus, A. clausi, Oithona nana*, Giesbr., 1892), was nearly equal in the coastal and central regions. The Black Sea eutrophication and pollution increase since 60^{ties} led to the zooplankton habitat change, not only in the northwestern sea part and other coastal regions, but also in the deep-sea zone. Bacterioplankton biomass increased from 1970 to 1980 by 1.5 – 3.0 times in comparison with the

1950 – 1960 [52], phytoplankton biomass - nine times [35]. The zooplankton biomass increased 1.7 – 2.0 times [35], whereas in the northwestern sea part – 3 - 4 times.

Some changes occurred in the zooplankton composition. Organism abundance of many species considerably decreased as a result of sea pollution and predator Ctenophora *Mnemiopsis* intrusion. Some species and especially narrow - neritic were completely absent in the last years in the plankton samples (*O. nana*, *Labidocera brunescens* Czernjavsky, 1868, small form of *A. clausi*, *A. latisetosa* [25]).

The first precise zooplankton study in the Sea of Azov was carried out in five cruises from June to November of 1931. Materials of this study were published considerably later [12]. In this article, the plankton animal list of the Sea of Azov was placed. The data about relative organism abundance in the different sea regions can be found as well. The first quantitative data about zooplankton distribution along the entire sea mass can be found in A.V. Okul [44]. Zooplankton studies in the period before the river flow decrease, a result of an increase of river water consumption by agriculture, gave as a result the review work of G. K. Pitsyk and A. N. Novozhilova [47]. Ninety-seven zooplankton species were marked in this article (without estuary and creek fauna). The main forms were stated and their spatial distribution was characterized. Zooplankton investigations were carried out more intensively and regularly after the Don discharge regulation in 1951 [1, 29, 33, 43]. In these works, the changes of sea plankton fauna composition, abundance distribution of definite species and zooplankton as a whole along the sea mass, seasonal dynamics of biomass as a result of the decrease and seasonal redistribution of the river flow and intensity of water exchange with the Black Sea were shown.

Lack of the data on coastal sea zooplankton is compensated by our investigation, obtained in the region of Mariupol city in 1976 [27]. It follows from these works that the role of the neritic and narrow - neritic species, not only in the coastal, but also even in the central regions in the Sea of Azov, is considerably more important than in the Black Sea. For example, the following narrow - neritic species of Copepoda dwelled in the open part of the Sea of Azov: *Acartia latisetosa*, small form of *A. clausi, L. brunescens*, estuary species of *Calanipeda aquae dulcis* Cricz. 1873, and other ones inhabiting the Black Sea bays and coastal zones.

Discussion. Fauna of the Mediterranean Sea was formed basically at the expense of the aliens from the Atlantic Ocean. But, only some of the species were able to acclimatize themselves in the Mediterranean Sea. As a result, the proportion of the oceanic species decreased in the Mediterranean Sea, including coastal regions in comparison with the Atlantic Ocean. But the proportion of all other species increased (Table 1).

Table 1 Correlation of percentage of different ecological groups of copepod species in the Atlantic Ocean and Mediterranean basin

Табл. 1 Соотношение количества видов копепод (%) разных экологических групп в Атлантике и морях Средиземноморского бассейна

Regions	Ecological groups (%):				Total number of species
	oceanic	neritic-oceanic	neritic	narrow-neritic	
Atlantic Ocean (near north-west Africa and Gibraltar)*	65	31	3	1	236
Mediterranean Sea (with coastal zone)	42	51	3	2	425
Black Sea (with coastal zone)	0	42	33	25	12
Sea of Azov (with coastal zone)	0	14	43	43	7

*On data of [57].

Bathymetrical (depth of the Gibraltar strait is nearly 300 m) and hydrological (temperature of the water in the Mediterranean Sea is higher, than in the nearby Atlantic region) bars, which prevent penetration of some oceanic species, In particular, deep water and cool water species in the Mediterranean Sea from the Atlantic, are two of the reasons for the relative oceanic species abundance decrease in the Mediterranean Sea.

Comparison of the data on the Mediterranean Sea for the whole investigation period [26] with the data on the Atlantic region, bordering on the Gibraltar strait [57], shows that majority of the oceanic Copepoda species are found in the Mediterranean Sea in smaller species quantities, than in the Atlantic (Table 2).

Table 2. Number of copepod species belonging to different ecological groups in the region of the Atlantic Ocean close to Gibraltar and in the Mediterranean Sea
Таблица 2. Количество видов копепод разных экологических групп в районе Атлантики, прилегающем к Гибралтарскому проливу и в Средиземном море

Genera	Atlantic Ocean near Gibraltar*	Mediterranean Sea
Oceanic		
Gaetanus	12	4
Euchirella	10	5
Pareuchaeta	10	5
Lophothrix	4	1
Scolecithricella	17	10
Metridia	9	5
Euaugaptilus	30	6
Neritic - oceanic and neritic		
Clausocalanus	6	11
Centropages	8	10
Labidocera	4	6
Acartia	6	14
Oithona	9	17
Sapphirina	13	19
Corycaeus	13	24

*On data of [57].

Neritic - oceanic and neritic species do not usually meet barriers on their way to the Mediterranean Sea and find their comfortable conditions for themselves. Many Copepoda genera are more abundant in species number, according to the same F. Vives' data and our data for the Mediterranean Sea species (Table 2). But we can expect, that values for the Atlantic (Table 2) characterize fauna composition in completely, compared to values for the better studied Mediterranean Sea. In this case, differences in abundance of neritic and neritic - oceanic species in the Atlantic and Mediterranean Sea will be smaller and abundance of oceanic species will be higher. Another reason of relatively high neritic - oceanic and neritic species abundance is the increase of the coastal zone proportion in the total sea in comparison with the ocean. This promotes more mass development of neritic - oceanic and neritic species. But, some neritic - oceanic species [22, 57] species, which are usual in the ocean in the coastal part as well as in the off-shore part, are usual in the Mediterranean Sea in great quantities in the coastal zone, In the central regions, they are absent or can be met very seldom [23]. These are Copepods *C. euxinus*, *P. parvus*, *P. elongatus*, *A. clausi*, *Pontella mediterranea* Claus, 1863, *Anomalocera patersoni* Templ, 1837, etc. Some authors consider them neritic and even narrow - neritic species in the Mediterranean Sea. Bathymetrical and hydrological barriers prevent the oceanic species penetration and acclimatizing in the Black Sea because maximal depth of the Bosporus is only 36 m, and water salinity in the Black Sea is two times lower than in the Mediterranean. The above named Copepoda are representative of the Mediterranean Sea neritic zone habitants penetrating into the Black Sea. They are numerous in the offshore regions, as well as in the coastal zone [24]. Other more neritic species are also distributed, excluding *L. brunescens*, a small form of the *A. clausi* and *A. latisetosa*, which inhabited the narrow coastal zone and bays. As a result, there are 42 % of the species with neritic - oceanic Atlantic distribution, 33 % with neritic and 25 % with narrow - neritic affiliation in the Black Sea among Copepoda of the Mediterranean origin. Freshwater and brackishwater species make up 35 % of

zooplankton in the coastal regions, estuaries and bays [28]. Thus the multispecies complex of the narrow - neritic species was formed in the coastal regions and especially in the northwestern sea part. It was already noted that inhabitants of the open sea consist of the neritic and neritic - oceanic species, which inhabit mainly the coastal zone, in bays and estuaries of the Mediterranean Sea. A high abundance of the neritic species in the offshore part of the Black Sea is explained by a greater occupancy of the shelf and the fact that offshore sea area is smaller than that of the Mediterranean Sea. Interruption by winds of the current circulation system, which surrounds the central Black Sea, provides intensive intrusion of the coastal water with its inhabitants [6].

Shallow water, considerable salinity decrease, and temperature alteration of the Sea of Azov in comparison with Black Sea are the significant barriers for many species and groups of Mediterranean plankton, which is usual in the Black Sea [38]. Sea Copepoda species abundance is two times smaller in the Sea of Azov than in the Black Sea. Among six species of Copepoda known in the Sea of Azov, *A. clausi* is represented by large and small forms, which are considered as different taxonomical units in Table 1 (as in the Black Sea). But, only large *A. clausi*, if its distribution is considered in the Atlantic [57], can be referred to neritic - oceanic species. As a result, the abundance correlation of species, which are referred to the different ecological groups in the Sea of Azov, is changing greatly in favor of neritic, and, in particular, narrow-neritic species. Three species that are narrow-neritic in the Black Sea (small *A. clausi*, *A. latisetosa* and *L. brunescens*) are widely distributed all along the entire Sea of Azov. It can be referred also to some brackish water species, which are widely distributed in the Sea of Azov, for example, Copepoda *C.aquae dulcis*, which inhabits the Black Sea, but only in the coastal zone, mainly near the river issues. Narrow-neritic species, numerous in the coastal part of the Sea of Azov [27], are also a considerable element of its fauna in the open sea part. Salinity lower than in the Black Sea, smaller sea areas, more often and strong destructions of the cyclonic current, surrounding the central part of the sea, promote distribution of the neritic and even narrow - neritic species all along the Sea of Azov.

Taking all this into consideration, we make a conclusion that increase of the plankton fauna neriticity grows from the Atlantic to the Sea of Azov and open sea regions is determined by several abiotic factors. Some of them limit the intrusion of the oceanic species into the Mediterranean basin; others promote the distribution of the neritic species all along each sea basin. Current facilitates relatively proportional distribution of the plankton organisms in such small seas as Black and Sea of Azov. Graphic evidence of it is the horizontal distribution of the larvae of the bottom animals, which are abundant in the central sea regions [48].

Abundant level of the neritic species, which intruded into the open sea, is determined substantially by biotic factors. A decrease in number of species, competitors for food and increase of food concentration from the Mediterranean Sea to the Black and Sea of Azov is evidently the main factor.

Conclusions. **1**.We call a consistent increase of the neritic species proportion in the seas of the Mediterranean basin and their spread to the central regions, the neritization of the sea fauna and, in particular, of their offshore zone. **2.** The species abundance is decreasing and correlation of the organisms' number is changing in favour of neritic. In other words, the reduction and reconstruction of the community take place at all stages of fauna neritization from Mediterranean Sea to Sea of Azov. Species ecological group abundance is decreasing from four (oceanic, neritic - oceanic, neritic, narrow - neritic), in the Atlantic and Mediterranean Seas to three (excluding oceanic) in the Black Sea and to two (neritic and narrow-neritic) in the Sea of Azov.

3. A consistent decrease of the oceanic and neritic-oceanic species abundance from the Mediterranean Sea to the Sea of Azov, and on the other hand, extending the neritic and narrow - neritic species into the offshore regions determines a considerable reduction of differences between coastal fauna and the offshore sea. The differences in the Sea of Azov in compliance with a regular increase of environmental neritization in the offshore zone from Mediterranean Sea to the Sea of Azov are feebly marked. **4**. The distribution of neritic species in the Mediterranean basing seas and in their offshore regions in particular is determined mainly by the abiotic factors (depth of straits, size of the sea, shelf part, stability of rim currents, temperature, water salinity). Abundance of the neritic organisms is determined mainly by the biotic factors (abundance of food, predators and competitors in feeding). **5.** Thus, fauna neritization in the seas of Mediterranean basin lies in the fact, that some neritic - oceanic species are distributed in the Mediterranean Sea in its open part from the coastal zone. Neritic species joined them in the Black Sea. Neritic and narrow - neritic species are distributed in the open part of the Sea of Azov because oceanic and neritic - oceanic species did not reach the Sea of Azov at all.

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Неритизація планктонної фауни у Середземноморському басейну. О. В. Ковальов, М. Г. Маццоккі, А. Е. Кідейш, В. А. Скрябін. Обмірковується проблема неритизації планктонної фауни в морях Середземноморського басейну. Мається на увазі збільшення проценту неритичних видів у складі зоопланктону від Середземного моря до Чорного та Азовського. Показано, що у Середземному морі частка океанічних видів значно зменшується у порівнянні з районом Атлантики, який прилягає до Гібралтарської протоки, а частка неритично-океанічних та неритичних видів відповідно збільшується. Деякі з цих видів відзначені у відкритій частині моря. У Чорному морі океанічні види відсутні. Неритично-океанічні та неритичні види, які уселилися туди із Середземного моря, поширені по усій акваторії моря. Мілководність проток між морями і суттєві зміни солоності то температурного режиму перешкоджають проникненню океанічних і неритично-океанічних видів у кожне наступне море Середземного басейну. Просторовому розподілу видів, яки уселилися, сприяє значне зменшення кожного наступного моря, збільшення частки шельфу, зменшення стабільності систем циркуляційного плину, який розділяє води прибережжя та центральних районів. Велика кількість неритичних видів у центральних районах Чорного й Азовського

морів пояснюється, напевно, зменшенням кількості конкурентів за їжу і хижаків (до з'явлення *M. leidyi* A. Agassiz, 1865) і збільшенням концентрації їжі для зоопланктону від Середземного моря до Чорного і Азовського.

Ключові слова: зоопланктон, океанічні, некритично-океанічні, неритичні, вузько неритичні види, неритизація

Неритизация планктонной фауны в Средиземноморском бассейне. А. В. Ковалев, М. Г. Маццокки, А. Э. Кидейш, В. А. Скрябин. Обсуждается проблема неритизации планктонной фауны в морях средиземноморского бассейна. Имеется в виду увеличение процента неритических видов в составе зоопланктона от Средиземного моря к Черному и Азовскому. Показано, что в Средиземном море доля океанических видов значительно уменьшается по сравнению с районом Атлантики, прилегающим к Гибралтарскому проливу, а доля неритическо-океанических и неритических видов соответственно увеличивается. Некоторые из этих видов отмечены в открытой части моря. В Черном море океанические виды отсутствуют. Неритическо-океанические и неритические виды, вселившиеся туда из Средиземного моря, распространены по всей акватории моря. Мелководность проливов между морями и существенные изменения солености и температурного режима препятствуют проникновению океанических и неритическо-океанических видов в каждое последующее море Средиземноморского бассейна. Пространственному распределению вселившихся видов содействует значительное уменьшение каждого следующего моря, увеличение доли шельфа, уменьшение стабильности систем циркуляционных течений, разделяющих воды прибрежья и центральных районов. Высокое обилие неритических видов в центральных районах Черного и Азовского морей объясняется, вероятно, уменьшением количества конкурентов за пищу и хищников (до появления *M. leidyi* A. Agassiz, 1865) и увеличением концентрации пищи для зоопланктона от Средиземного моря к Черному и Азовскому.

Ключевые слова: зоопланктон, океанические, неритическо-океанические, неритические, узко неритические виды; неритизация.