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**Environmental conditions for distribution of dominants  
of freshwater molluscs in the Chu river basin**

The first analysis of distribution and abundance of dominants of gastropods in seven habitats of the Chu river basin was performed for the period from 1994 to 2012. Based on comparative analysis of the results of long term external ecological research the environmental conditions affecting its distribution, life cycle, reproduction, development, and population size were defined.

**Keywords:** freshwater mollusks, pulmonate, lifes cycle, morphology of laying of egges, reproduction, development, ecological research.

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**Шу өзенінің бассейнінде кең таралған тұщысу моллюскаларының таралуына  
әсер ететін экологиялық жағдайлар**

Алғаш рет Шу өзенінің бассейнінде кең таралған құрсақаяқты моллюскалардың таралуына 1994 - 2012 жж. талдау жұмыстары жүргізілді. Көпжылдық аутэкологиялық зерттеу нәтижелерінің негізінде моллюскалардың таралуына, тіршілік циклдеріне, көбеюіне, дамуына және популяциялар санына әсер ететін экологиялық факторлар анықталды.

**Түйін сөздер:** тұщысу моллюскалары, өкпелілер, тіршілік циклі, синкапсулаларының морфологиясы, көбею, даму, экологиялық жағдайлар

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**Экологические условия распространения массовых видов пресноводных моллюсков  
в бассейне реки Шу**

Впервые проведен анализ распространения и численности массовых видов брюхоногих моллюсков в 7 биотопах бассейна р. Шу за период с 1994 по 2012 гг. На основании сравнительного анализа результатов многолетних аутэкологических исследований моллюсков определены экологические факторы, влияющие на их распространение, жизненные циклы, размножение, развитие и численность популяции.

**Ключевые слова:** пресноводные моллюски, легочные, жизненный цикл, морфология синкапсул, размножение, развитие, экологические условия.

The first analysis of distribution and abundance of dominants of gastropods in seven habitats of the Chu river basin was performed for the period from 1994 to 2012. Based on comparative analysis of the results of long term external ecological research the environmental conditions affecting its distribution, life cycle, reproduction, development, and population size were defined.

**Materials and methods.** The objects to be investigated are 5 species of mass molluscs of the

Chu river basin, these are the representatives of the family of Lymnaeidae (*Lymnaea stagnalis* L., *L. auricularia* L., *L. truncatula* Mull.), Planorbidae (*Planorbis planorbis* L.), Physidae (*Physa acuta* Drap.).

Collection of material was held in the period from 1994 to 2012. A pulmonate presence was examined in the flood plain of Chu river along 300 km in the vicinity of the following settlements: s. Qyorday, s. Baluan-Sholaќ, s. Kek-Quaynar, s.

Tasetkel, s. Enbekshi, s. Belbasar, s. Zhana turmys, s. Zhanbil, city Chu, s. Telebi, s. Birlik.

Molluscs samples were taken by the method of the pads (Zhadin, 1952) used square frames from 0.1 to 1 m<sup>2</sup> were used; molluscs were collected from the sites either by hand, water net, or a scraper.

At analysis of small samples their pulmonate was measured by ocular micrometer at MBS-1, and for large samples - with a ruler. The total biomass was determined by weighing the sample directly in the sample bottle on the pharmacy scales, after one minute drying of the molluscs on the filter paper.

**Results and discussion.** As a result of the investigations taken place in Chu river basine in the vicinity of the following settlements such as s.Qyorday, s. Baluan-Sholak, s. Kek-Quaynar, s.Tasetkel, s. Enbekshi, s. Belbasar, s. Zhana turmys, s. Zhanbil, city Chu, s. Telebi, s. Birlik, the areas of destrtribution of mass molluscs were defined.

Inhabitation of the molluscs is related to the following biotopes: coastal zone of Chu river, small floodplain lakes, small wetlands, puddles, hollows, and coastal zone of Tasotkel reservoir and irrigation canals.

By type of water the biotopes are static, drained, periodic, ephemeral and temporary water reservoirs.

Hydro-chemical composition of the water and its content of micro elements were determined at the Institute of Soil Science, National Academy of Sciences of the Republic of Kazakhstan and are presented in Table 1 and 2.

The ecological characteristics of biotopes in the settlement of molluscs are presented in Table 3.

The composition of species and abundance of molluscs in given biotopes is different (Table 4).

The comparison of the species composition and abundance of molluscs showed the peculiarities of settlement in each biotope.

*In the coastal zone of Chu river* in the growing season the following species were found: *Lymnaea stagnalis*, *L. auricularia*, *Planorbis planorbis*, *Physa acuta*, numerically the smallest set was defined for *L. stagnalis* L. (3-4 examples/m<sup>2</sup>), and the average value was set for *Lymnaea auricularia* L. (38 examples/m<sup>2</sup>); high quantity was set for *Planorbis planorbis* L. (75 examples/m<sup>2</sup>) and *Physa acuta* D. (82 examples/m<sup>2</sup>) (Fig. 1).

A comparative analysis of the species composition of molluscs at coastal zone of Chu river showed that the species composition of molluscs remained constant throughout the years of the study period. However the abundance of molluscs varied which can be explained by the features of environmental factors affecting populations in different years of the study. In addition, the dynamics of the number of species was identified during the vegetation season, related to the stages of the life cycle (Fig. 2).

The floodplain water reservoirs in the Valley of Chu river consist of small lakes, wetlands, oxbow, puddles, having temporary (during the flood) or constant relationship with the river. Usually these water reservoirs are shallow, well-warmed, with a muddy bottom and abundant coastal and aquatic vegetation. The floodplain reservoirs are rich in molluscs, both qualitatively and quantitatively.

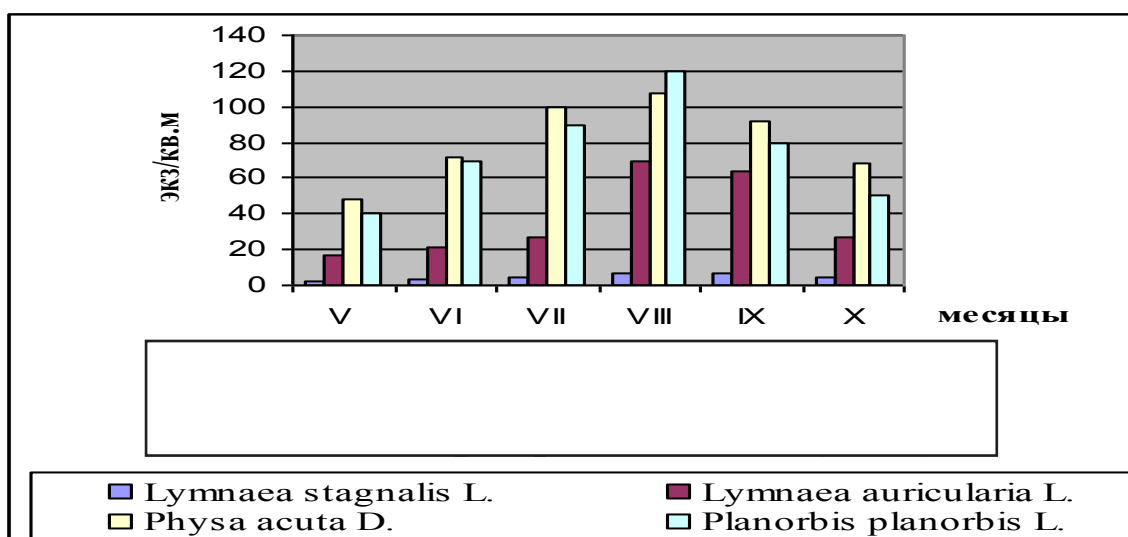


Figure 1 - Dynamic of molluscs abundance in vegetation period Biotope: coastal zone (1994)

**Table 1** - Hydro-chemical composition of water

№	Biotopes	Total alkalinity in $\text{HCO}_3$	Cl	$\text{SO}_4$	Ca	Mg	Sum of anion- cation ions	Na	K	pH	Sum of salts
1.	Coastal zone of Chu river	0,185 3,032	0,025 0,704	0,24 4,96	0,066 3,3	0,033 2,71	3,74 8,7	0,0014 0,036	0,061 2,65	7,21	0,61
2.	Small wetlands	0,190 3,114	0,068 1,915	0,96 19,97	0,10 8,22	0,10 8,22	5,03 25,0	0,0022 0,056	0,27 11,72	8,15	1,69
3.	Puddles	0,161 2,639	0,085 2,394	1,06 22,07	0,096 7,89	0,096 7,89	5,03 27,1	0,0044 0,113	0,33 14,3	8,66	1,83

**Table 2** - Water. Content of micro elements in mg/l

№	Biotopes	Zn mg/l	Cu mg/l	Pb mg/l	Cd mg/l	Mn mg/l
1.	Coastal zone of Chu river	0,016	0,009	0,01	0,0025	0,015
2.	Small wetlands	0,020	0,009	0,01	0,0025	0,01
3.	Puddles	0,036	0,01	0,01	0,0025	0,084

**Table 3** - Ecological characteristic of molluscs' settlement

№	Biotopes	Type of water reservoir	Characteristics
1.	Coastal zone at Chu river	Static water reservoir	Shallow water zone. Localization of malacofauna is limited by coast flats with reduced watercourse or dense thickets of macrophytes in the backwaters. The presence of low-energy flow in areas of the vegetation has a favorable influence on the oxygen regime and creates the conditions for introduction oxyphilic species.
2.	Small floodplain lakes	Drained water reservoirs	Reservoirs having significantly larger dimensions. In lakes molluscs inhabit open coastal shallows, exposed to weak surf, with sandy-muddy bottoms, thickets of macrophytes in areas with very low mobility of the water masses, extensive shallows, where billow is weakened in spring time, and in summer is almost completely void. Because of the fairly dense thickets of reeds.
3.	Small wetlands	Periodic water reservoir	Small wetlands. Flooding period is quite long.
4.	Puddles	Ephemeral water reservoir	Deepening with melt, flood or rain water.
5.	Hollows	Ephemeral water reservoir	Deepening made in soft ground by the hooves of cattle, with the melt, flood or rain water that forms in the areas with low permeability of the upper soil horizons.
6.	Coastal zone of Tasotkel reservoir	Static water reservoirs	Shallow water zone. Open coastal flats with sand or gravel and silt muddy bottoms. Localization of malacofauna is limited in the areas with bush of macrophytes.
7.	Irrigation canals	Temporary water reservoirs	The channel walls of drainage and irrigation systems are characterized by a thin layer of water. These reservoirs are of extremely high saturation of water with oxygen, with irregular inflow and, as a consequence, the possibility of temporary desiccation.

**Table 4** - Species composition and abundance of molluscs in biotopes

№	Biotopes	Lymnaea stagnalis	Lymnaea auricularia	Lymnaea truncatula	Physa acuta	Planorbis planorbis
1.	Biotopes	*	**	0	***	***
2.	Coastal zone at Chu river	*	**	0	***	***
3.	Small floodplain lakes	**	***	**	0	***
4.	Small wetlands	0	0	***	*	*
5.	Puddles	0	0	***	0	**
6.	Hollows	***	***	**	***	***
7.	Coastal zone of Tasotkel reservoir	0	**	**	**	**

Remark: 0 - absent not present; \* - low abundance; \*\* - middle abundance; \*\*\* - high abundance

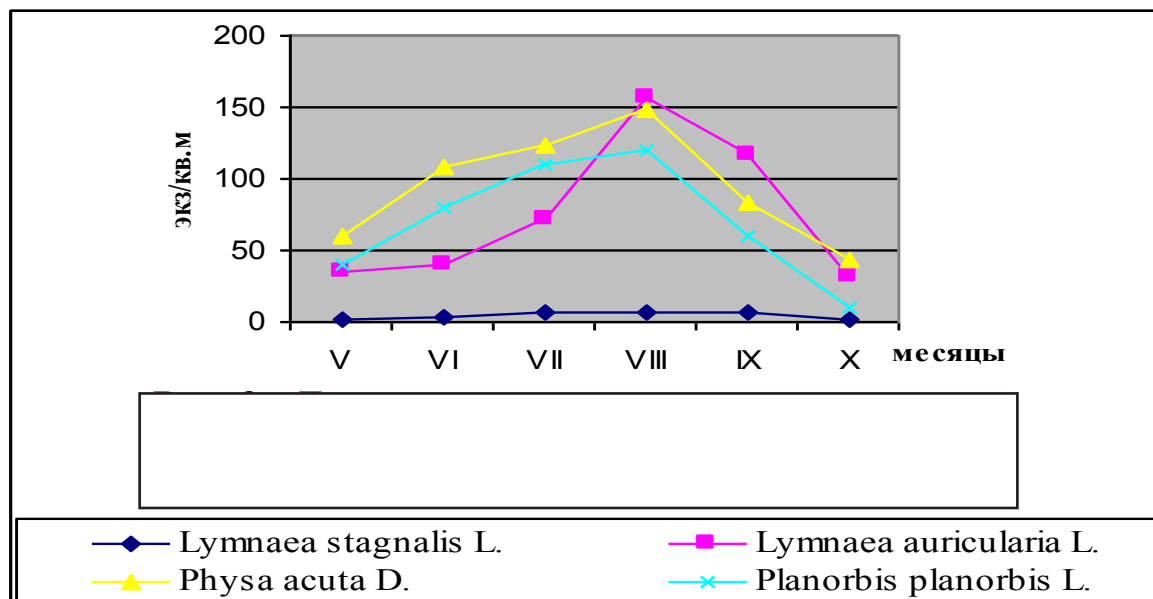


Figure 2 - Dynamics of molluscs abundance in vegetation period at the coastal zone of Chu river (2006)

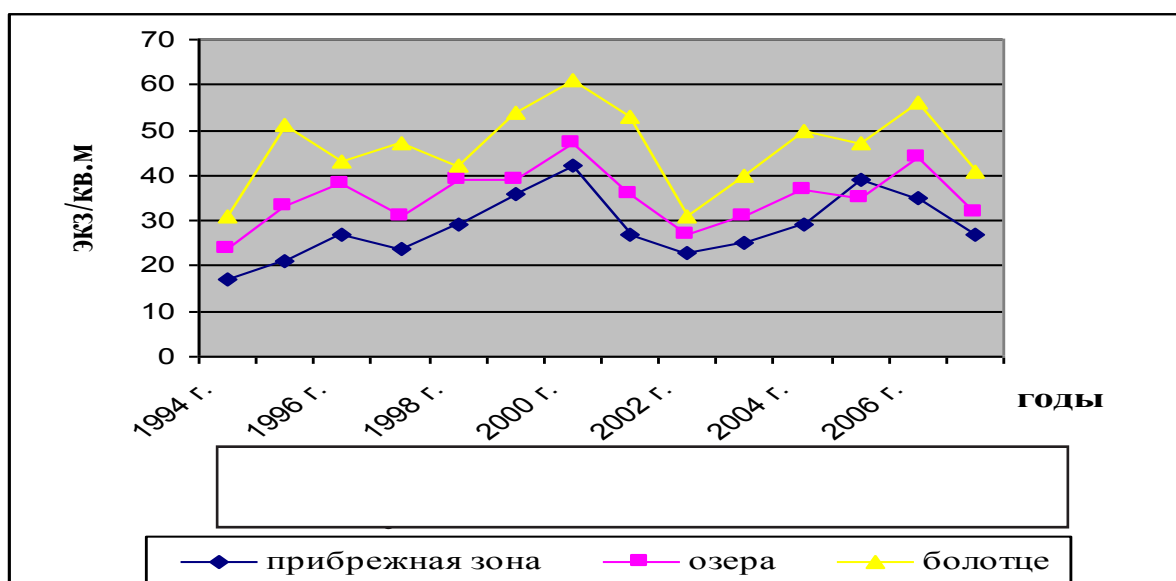


Figure 3 - Dynamics of molluscs abundance in Lymnaea auricularia in May

Here nine species of molluscs were identified and their number per unit area is large and ranges from 70-130 examples per 1 m<sup>2</sup>. The most usual and widespread in these reservoirs are *Lymnaea stagnalis*, *L. auricularia*, *L. truncatula*, *Planorbis planorbis*, *Physa acuta*. The rare found ones are *Lymnaea palustris*, *Succinea sarsi*.

In small floodplain lakes during the vegetation period the found species were *Lymnaea stagnalis*, *L. auricularia*, *Planorbis planorbis*, *Physa acuta*,

numerically the smallest set was defined for *L. stagnalis* L. (7 examples/m<sup>2</sup>), and the average value was set for *Lymnaea auricularia* L. (86 examples/m<sup>2</sup>); and high quantity was set for *Planorbis planorbis* L. (118 examples/m<sup>2</sup>) and *Physa acuta* (126 examples/m<sup>2</sup>).

In the wetlands at the vegetation period the following species were found: *Lymnaea stagnalis*, *L. auricularia*, *L. truncatula*, *Planorbis planorbis*, *Physa acuta*, numerically the smallest set was defined

for *L. stagnalis* L. (7 examples/m<sup>2</sup>), the average value was set for *L. truncatula* L. (30 examples/m<sup>2</sup>); and high quantity was set for *Lymnaea auricularia* L. (98 examples/m<sup>2</sup>) and *Planorbis planorbis* L. (103 examples/m<sup>2</sup>). *Physa acuta* Drap. doesn't occur.

*In the hollows* at the vegetation period the following species were found: *Lymnaea truncatula*, *Planorbis planorbis*, *Physa acuta*, numerically the smallest set was defined for *Physa acuta* Drap. (27 examples/m<sup>2</sup>) and *Planorbis planorbis* (30 examples/m<sup>2</sup>); high quantity was for *Lymnaea truncatula* (152 examples/m<sup>2</sup>).

*In the puddles* at the vegetation period the following species were found: *Lymnaea truncatula* and *Planorbis planorbis*, an average quantity was defined for *Planorbis planorbis* L. (90 examples/m<sup>2</sup>), high quantity was for *L. truncatula* (121 examples/m<sup>2</sup>).

*In the coastal zone of Tasotkel reservoir* at the vegetation period, the following types of mass mollusks were defined: *Lymnaea stagnalis* L., *L. auricularia* L., *L. truncatula* Mull., *Planorbis planorbis* L., *Physa acuta* Drap., numerically the smallest set was defined for *Lymnaea stagnalis* L. (9 examples/m<sup>2</sup>), and the average value was set for *Physa acuta* Drap. and *L. auricularia* L. (78 examples/m<sup>2</sup>), high quantity was set for *Planorbis planorbis* L. (142 examples/m<sup>2</sup>).

*In the irrigation canals* at the vegetation period, the following types of mass mollusks were found: *L. auricularia* L., *L. truncatula* Mull., *Planorbis planorbis* L., *Physa acuta* Drap., an average quantity was set for *Physa acuta* Drap. and *L. auricularia* L. (15 examples/m<sup>2</sup>), high quantity was set for *L. truncatula* Mull. and *Planorbis planorbis* L. (38 examples/m<sup>2</sup>).

A comparative analysis of the species composition of molluscs showed the followings:

1) the specific structure of molluscs at the coastal zone Chu river and Tasotkel reservoir is the same, but differ in quantity;

2) the species composition of the wetlands is characterized by the absence of *Physa acuta* Drap.;

3) the irrigation canals are characterized by the species composition of coastal zone of Chu river and availability of *L. truncatula* Mull.

A comparative analysis of the abundance of molluscs on biotopes showed that for *L. stagnalis* L. numerically the smallest value was defined at the coastal zone of Shu river (4 examples/m<sup>2</sup>), an average value - in small lakes (6 examples/m<sup>2</sup>) and

wetlands (7 examples/m<sup>2</sup>), and high quantity - at coastal Tasotkel reservoir (9 examples/m<sup>2</sup>); for *L. auricularia* L. numerically the smallest value was defined for the coastal zone of Chu river (37 examples/m<sup>2</sup>), the average value - in small lakes (86 examples/m<sup>2</sup>) and wetlands (7 examples/m<sup>2</sup>), high quantity in the wetlands and at coastal zone of Tasotkel reservoir (98 examples/m<sup>2</sup>); for *L. truncatula* Mull. numerically the smallest value was defined in irrigation channels (85 examples/m<sup>2</sup>), and the average value - in the puddles (120 examples/m<sup>2</sup>), high quantity - in the hollows (145 examples/m<sup>2</sup>); for *Planorbis planorbis* L. numerically the smallest quantity was defined at the coastal zone of Chu river (75 examples/m<sup>2</sup>), and the average quantity - in the puddles (90 examples/m<sup>2</sup>), high quantity - in the wetlands and at the coastal zone of Tasotkel reservoir (103 examples/m<sup>2</sup>); *Physa acuta* Drap. is a typical specie only for the coastal zone Chu river as well as Tasotkel reservoir (82 and 78 examples/m<sup>2</sup>).

A comparative analysis of the statistical mean value on the number of species of molluscs during 14 years maintained relatively constant for the following types of species: the smallest numerically set value was defined for *L. stagnalis* L. (3-4 examples/m<sup>2</sup>), and the average value - for *Physa acuta* Drap. and *L. auricularia* (84 examples/m<sup>2</sup>); and high value - for *Planorbis planorbis* L. (142 examples/m<sup>2</sup>).

A data comparison for 14 years showed that the years 1999, 2000, 2005 and 2006, differed by higher values on abundance parameters for the studied species, as compared with other years. This is explained by the release of a large number of wintering species in the month of May, for *Lymnaea stagnalis* L. these data are compiled by (6-7 examples/m<sup>2</sup>); for *L. auricularia* L. (39-42 examples/m<sup>2</sup>) in *L. truncatula* (49 examples/m<sup>2</sup>), for *Physa acuta* Drap. (78 examples/m<sup>2</sup>); for *Planorbis planorbis* L. (96 examples/m<sup>2</sup>) (Fig. 3, Fig. 4).

General pattern on dynamics of molluscs' abundance in the vegetation period shows a high peak from July to September, due to increase in number of appearance of juvenile molluscs of their first and second generation.

The years 1995, 1996, 1997, 2001, 2004 differed by the average density of species, due to the abundance of wintering species in May, and which was amounted as follows: for *Lymnaea stagnalis* L. (3 examples/m<sup>2</sup>); for *L. auricularia* L. (24 examples/



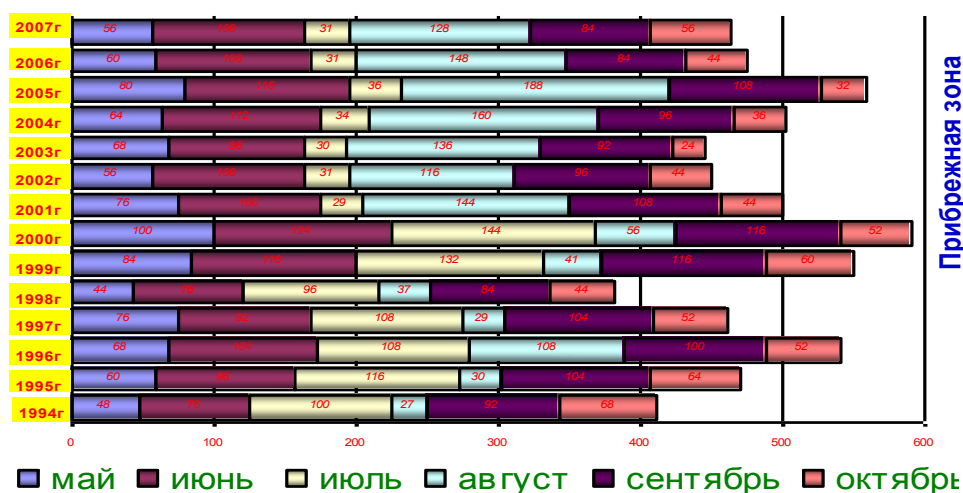


Figure. 4 - Dynamics on abundance of *Physa acuta* Drap. at vegetation period

m<sup>2</sup>); for *Physa acuta* Drap. (60 examples/m<sup>2</sup>); for *Planorbis planorbis* L. (48 examples/m<sup>2</sup>).

The Low density of the studied species differed for years 1994, 1998, 2002, 2003, 2007, due to the abundance of the wintering species in the month in May which was amounted as follows: for *L. stagnalis* L. (2 examples/m<sup>2</sup>); for *L. auricularia* L. (17 examples/m<sup>2</sup>); for *Physa acuta* Drap. (48 examples/m<sup>2</sup>); for *Planorbis planorbis* L. (40 examples/m<sup>2</sup>). The number of over-wintering molluscs plays a significant role in the total number of molluscs at the vegetation period, since they build up the bulk of future mature species in molluscs with two-year and one-year life cycle. The abundance of molluscs for the remaining months of the vegetation

period are directly dependent on the number of molluscs in the month of May, and this is confirmed by the research data and graphics based on them.

A comparative analysis of the characteristics on distribution, reproduction and development, ratio in dimension- age of populations, the number of mass species of aquatic molluscs in the Basin of Chu river showed that environmental factors determining their dynamics are the water flow, regimen temperature, depth, substrate, salinity of water, active response of the environment, phytocenosis in the area of inhabitation. The dynamics of abundance of dominantes molluscs in the vegetation period depends on the relations to the life cycle, as well as on the environmental conditions specific to each year.

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