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SEASONAL AND SPATIAL DISTRIBUTION OF PHYTOPLANKTON IN ARMENIAN LOTIC ECOSYSTEMS: CASE STUDY OF THE DEBED RIVER

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The phytoplankton dynamics in the Debed River, Armenia, was investigated. Water samples for phytoplankton quantitative and qualitative analyses were collected from 4 sites along the river once per season in April, July and September 2017. The results of the study have revealed the characteristics of the spatiotemporal distribution of phytoplankton community in the Debed River.

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Introduction. Lotic ecosystems are characterized by flowing waters like rivers, streams, creeks, etc [1]. In comparison to lentic fresh waters (lakes and reservoirs), where phytoplankton have been thoroughly studied, the phytoplankton structure and dynamics in lotic systems are poorly understood [2–4]. The spatiotemporal pattern of a community provides information about ecosystem functioning and reflects major environmental changes. The distribution of phytoplankton community is strongly affected with different environmental factors such as climate, water temperature, light intensity, nutrient concentrations, river morphology, discharge, water residence time, precipitation, grazing, competition, parasitism. Unfortunately, there is no general consensus about factors regulating phytoplankton communities in lotic habitats [2]. The present study was aimed at investigating the characteristics of the spatiotemporal distribution of phytoplankton for Armenian lotic ecosystems.

To investigate the phytoplankton dynamics in Armenian lotic habitats, the authors determined the quantitative and qualitative parameters of phytoplankton in the Debed River. The inefficient management of waste and wastewater in the Debed River catchment basin causes river pollution with domestic waste and wastewater as well as mining effluents [5, 6]. Monitoring phytoplankton in the Debed River is, therefore, an important step toward the characterization of phytoplankton structure in a lotic system affected by anthropogenic factors.

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Materials and Methods. Debed is the wateriest river in Armenia. It is a transboundary river and belongs to the Kura River basin. The total length of the Debed River (including the Pambak tributary) is 178 *km*, 152 *km* of which in Armenia and the rest in the territory of Georgia. In the territory of Armenia, the river is located in the northern part of the country, Lori Province [5].

Sampling was done in 4 locations of the Debed River as outlined in Table. Water samples for phytoplankton analysis were taken seasonally with clean polythene bottles in April, July and September 2017 and preserved with 40% formaldehyde solution (1% final concentration) until analysis. During each sampling, water temperature was measured with a digital thermometer (HI98501, «Hanna Instruments»). River velocity was also measured seasonally in April, July and September 2017 with a current meter (LS1206B, «Dalian Zero Instrument Technology»). The hydrological measurements were done at the center of river width. The fixed phytoplankton samples (11) were concentrated by the sedimentation method [7]. The concentrated samples were identified microscopically to the lowest taxonomic level and counted in a Nageotte counting chamber.

Coordinates of sampling sites in the Debed River

Sampling site code	N/Lat	E/Long	River site location
D1	40°59'08.2"	44°39'04.8"	Debed River site located downstream of the confluence of the Pambak and Dzoraget Rivers
D2	41°04'55.2"	44°37'07.2"	Debed River site located at the beginning of Alaverdi Town according to the river flow
D3	41°06'48.5"	44°44'16.2"	Debed River site located downstream of Alaverdi Town
D4	41°12'33.4"	44°54'08.8"	Debed River site located near Armenian-Georgian border

Results and Discussion. Diatom, green, blue-green and euglena algae were registered in the phytoplankton community of the Debed River. Diatoms were the most diverse group in all the investigated river sites during the whole investigation period (Fig. 1). The highest species richness in summer was recorded in river sites D1 and D3, while, in spring and fall, the highest richness was observed in river sites D1 and D4, respectively. The lowest number of species in spring, summer and fall was observed in sites D2, D4 and D1, respectively (Fig. 1).

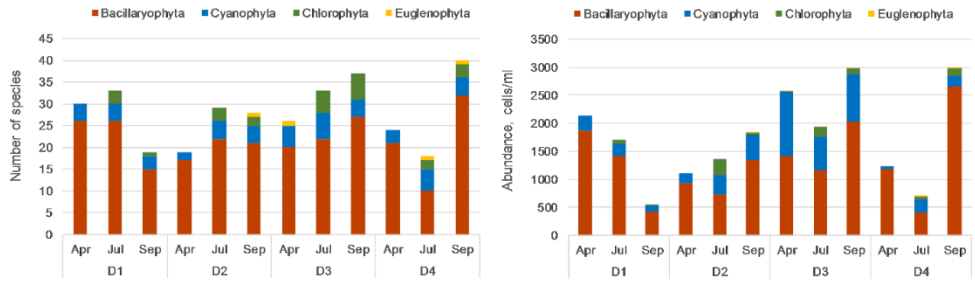

Fig. 1. Quantitative and qualitative parameters of phytoplankton in the Debed River.

Diatom algae also prevailed quantitatively in all the investigated sites during the whole study period. The highest abundance in all the investigated seasons was registered in site D3, where blue-green algae also showed high quantitative development (Fig. 1). The dominant composition of diatom algae was represented by the species *Diatoma vulgare, Gomphonema olivaceum, Melosira granulata, Cocconeis placentula, Navicula distans, N. cryptocephala, Fragilaria capucina,* while the species *Phormidium foveolarum, Spirulina sp., Oscillatoria limnetica, Dolichospermum circinalis* prevailed in the composition of blue-green algae. Dominating species in the phytoplankton community were *Navicula gracilis, Fragilaria capucina, Diatoma vulgare* from diatoms and *Spirulina platensis, Aphanothece clathrata* from blue-green algae.

The quantitative and qualitative distribution of phyla in the phytoplankton community in all the investigated seasons and river sites was mainly expressed by phytoplankton parameter decreasing order of diatom–blue-green–green–euglenoid algae, which can be explained by the geological characteristics of the area.

Phytoplankton spatiotemporal dynamics showed a noticeable increase in the quantitative parameters of phytoplankton in river site D3 in all the investigated seasons, then followed by a visible decrease in site D4, particularly in spring and summer (Fig. 1). The investigations of such drivers of phytoplankton dynamics as water temperature and river velocity didn't reveal environmental conditions that can explain this development of phytoplankton in site D3 (Fig. 2). This allows to suppose that the high phytoplankton values in site D3 were conditioned by organic pollution induced by uncontrolled discharges from the domestic activities of Alaverdi Town. A subsequent decrease in the phytoplankton parameters in site D4 is explained by the removal of contaminants (drivers of rapid phytoplankton growth) due to river self-purification processes.

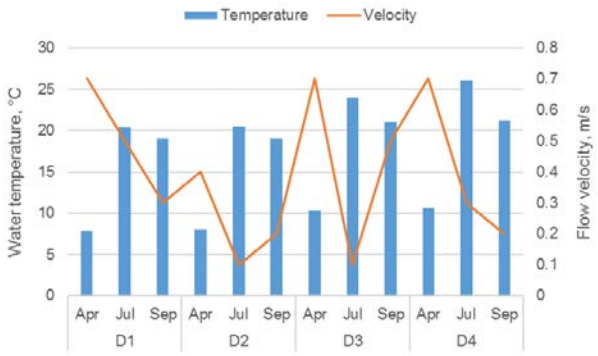

Fig. 2. Hydrophysical and hydrological parameters in the Debed River.

Conclusion. The picture of the quantitative and qualitative development of phytoplankton in the Debed River was mainly maintained along the river in all seasons, showing a decreasing order of phylum parameters as follows: Bacillario-phyta–Cyanophyta–Chlorophyta–Euglenophyta. The quantitative parameters of phytoplankton were noticeably higher in the river sites affected by urban domestic

discharges, however, visible regularities in the seasonal dynamics of phytoplankton were not observed.

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ՀԱՅԱՍՏԱՆԻ ԼՈՌԻԿ ԷԿՈՀԱՄԱԿԱՐԳԵՐՈՒՄ ՖԻՏՈՊԼԱՆԿՏՈՆԻ ՍԵԶՈՆԱՅԻՆ ԵՎ ՏԱՐԱԾԱԿԱՆ ԲԱԾԽՎԱԾՈՒԹՅՈՒՆԸ ԴԵԲԵԴ ԳԵՏԻ ՕՐԻՆԱԿՈՎ

Հետազոտվել է Հայաստանի Դեբեդ գետի ֆիտոպլանկտոնային դինամիկան: Ֆիտոպլանկտոնի քանակական և որակական վերլուծությունների համար ջրանմուշները հավաքվել են գետի երկայնքով 4 դիտակետերից 2017 թ. յուրաքանչյուր սեզոնին 1 անգամ՝ ապրիլ, հուլիս և սեպտեմբեր ամիսներին: Հետազոտության արդյունքները բացահայտել են Դեբեդ գետի ֆիտոպլանկտոնային համակեցության տարածաժամանակային բաշխվածության առանձնահատկությունները:

А. С. МАМЯН, Г. А. ГЕВОРГЯН

СЕЗОННОЕ И ПРОСТРАНСТВЕННОЕ РАСПРЕДЕЛЕНИЕ ФИТОПЛАНКТОНА В ЛОТКОВЫХ ЭКОСИСТЕМАХ АРМЕНИИ НА ПРИМЕРЕ РЕКИ ДЕБЕД

Исследована динамика фитопланктона р. Дебед в Армении. Пробы воды для количественного и качественного анализа фитопланктона были отобраны на 4-х участках вдоль реки один раз за сезон – в апреле, июле и сентябре 2017 г. Результаты исследования выявили особенности пространственно-временного распределения фитопланктонного сообщества р. Дебед.