A. Shestak, stud., N. Filimonova, PhD.
Taras Shevchenko National University of Kyiv, Kyiv, Ukraine

EFFECT OF 10 HZ BINAURAL BEAT BRAIN ACTIVITY AND THE EFFECTIVENESS OF A SIMPLE SENSORIMOTOR REACTION AND THE REACTION OF CHOICE FOR MEN AND WOMEN

As a result of researches of 20 persons, aged 18-23 years, it was found that men under the influence of binaural beats 10 Hz, compared with binaural sound when testing a simple sensorimotor reaction was found greater activity in the frontal, central and occipital areas of both hemispheres and right temporal and parietal areas, which may be indicative about activation system imaginative and creative thinking, the need for which was absent for the implementation of a simple sensorimotor reaction. Differences in time as a simple sensorimotor reaction and choice reaction was observed. When testing, choice reaction was detected influence of binaural beats 10 Hz on the brain activity of men. In women under the influence of binaural beats 10 Hz were significantly higher speeds as a simple sensorimotor reaction and choice reaction and significantly smaller spread of latent periods of simple sensorimotor reaction. This was above the hemispheric interaction suppressed irrelevant zone and the high activity of the ascending process of attention that has provided highly specific data processing and high performance tasks compared with binaural sound.

Key words: binaural beats 200 Hz, 10 Hz, brain activity, sensorimotor reaction, selection reaction.

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M. Borysenko, Phd stud., D. Lukashov, DSc.
Taras Shevchenko National University of Kyiv, Kyiv

CHANGE OF ZOOPERIPHYTON COMMUNITIES BY DOWNSTREAM OF KANIV HYDROELECTRIC POWER PLANT IN AUTUMN PERIOD

The results of a study of communities of zooperiphyton from stone embankments of shore protection structures in the downstream of Kaniv hydroelectric in the autumn period has been presented. Inverse relationship between quantitative indexes of zooperiphyton (as density and biomass) its diversity and the distance from the hydroelectric dam was founded.

Key words: periphyton, hydroelectric, downstream.

Cascade of hydropower plants on the Dnieper River has a significant impact on the ecosystem of the river. Although the channel sections in downstream of dams of hydroelectric power plants, transform not so dramatically, compared with sections of reservoirs upstream of hydroelectric power plants, but also undergo significant changes associated with unusual for river ecosystems daily fluctuations in water level and flow velocity and changes in the hydrological and thermal regime of rivers, ice regime and others [1]. River sections of Dnieper reservoirs studied, in particular, on the example of part of Kaniv reservoir within the city of Kyiv [2, 3, 4]. In this case, the impact of hydropower was combined with strong anthropogenic influence of the city. In the present study presented the results related to the river section of Kremenchug reservoir, which is influenced by Kaniv hydroelectric. Influence of the town of Kaniv is much smaller compared to Kyiv. Moreover, much of investigated areas are adjacent to protected areas (Kaniv Nature Reserve). As a marker group to study the effect of hydroelectric on the river ecosystem was chosen zooperiphyton that is a traditional object for hydroecological research because it shows a high sensitivity to a wide range of environmental factors [5]. In addition, the stone embankments of shore protection constructions give a favorable substrate for communities of periphyton, and create similar biotopical conditions at different distances from the hydroelectric dam. It allows estimate marker settings of these communities (such as density, biomass and diversity). In the autumn there is a decrease in water temperature in the Dnieper River and reduction of water level in the tailrace Kaniv hydroelectric [6, 7]. This leads to a complete draining of some shore protection embankments.

Materials and methods. Periphyton samples were taken in October and November 2016 on the stone embankments of shore protection constructions along the right bank of Dnieper River in the area from the town of Kaniv to the village of Pekari (Kaniv district, Cherkasy region.) (Fig. 1). 7 stations were chosed at different distances below the dam hydroelectric. On the stone embankments of shore protection constructions were selected two points (up and downstream), on the stations №3 and №5 – only one. Station №5 was investigated only in October and only one sample was taken, because of the small length of its embankment, and in the fall, due to lower water levels in Dnieper River the embankment was drained between the launchings of hydroelectric.

Fig. 1. The stations where samples were taken

Samples were taken by flushing of periphyton from the stones taken out of the water from a depth of 0.5 m in the evening (before evening launching of the hydroelectric). Collected organisms were fixed with formalin. Primary processing of samples was carried out with Bogorov counting chamber and a stereo microscope MBS-9 (2×10). Linear parameters of representatives of zooperiphyton measured with an eyepiece reticle. Determining the biomass of organisms was performed using a torsion weighing scale VT-500 or by method of biomass calculation on the basis of the linear dimensions (for larvae of Chironomidae – according to Balushkina [8]). The density and the biomass of periphyton communities were counted on 1 m^2 of stone surface. To assess the diversity of taxonomic groups used the Shannon index [9]. Mathematical processing was performed by standard statistical methods. Because the studied relations were different from linear, was used Spearman's rank correlation coefficient [10].

Results and discussion.

The main taxonomic groups of aquatic invertebrates found in periphyton of downstream of Kaniv hydroelectric were: representatives of phylum Mollusca: class Bivalvia (*Dreissena polymorpha* and some individuals of *D. bugensis*), class Gastropoda (mainly *Theodoxux fluviatilis*), representatives of phylum Annelida: class Oligochaeta, phylum Arthropoda: class Insecta (Chironomidae larvae and Trichoptera larvae). Only by separate individuals were presented leeches (phylum Annelida, class Hirudinea), including *Piscicola geometra*; crustaceans (phylum Arthropoda, class Crustacea), springtails (class Entognatha, subclass Collembola), larvae of dragonflies (class Insecta, order Odonata).

The dominant groups in number were: *Dreissena* (at stations № 2, 6, 7 at the up points, at station № 4 – at the down point and at station № 3, at these points, their part in total number was 29,7-76,2 %), Oligochaeta (at stations № 1 and № 4 – at the up points, at stations № 2, 6 and 7 – at the down points, where their part in total number was 33,6-66,2 %), Chironomidae (at station № 5 at the up point where their part in total number was 62.5 % and station № 1 – at the down point, where their part in total number was 31.7 %). In biomass dominated *Dreissena* (at all stations except the station № 5, where *Dreissena* was absent, its part in the total biomass was 57,6-99,4 %). In conditions of station № 5 the main part of biomass was made by chironomid larvae and gastropods (33.3 % for both).

The total density of zooperiphyton communities in the study area varied over a considerable range. The difference between its maximum and minimum value was 3 orders of magnitude (Table. 1). Its lowest value (69.0 ind./m^2) noted on the station № 5. Considering only stations that in the study period were not undergo draining, the minimum is the density at the up point of the station № 4 (421.7 ind./m^2). The highest density (15899.5 ind./m^2) was recorded at the station №1 (up point).

Table **1. The average density of communities of zooperiphyton (ind./m^2) on a stone embankment in the downstream of Kaniv hydroelectric**

Station	1	1	2	2	3	4	4	5	6	6	7	7
Distance to the dam, km	3,46	3,46	4,12	4,12	5,12	5,77	5,77	6,48	7,24	7,24	7,72	7,72
Point	up	down	up	down		up	down	up	up	down	up	down
Oligochaeta	8492,7	2095,2	2809,1	2276,6	3706,6	180,7	367,5	8,6	358,0	1451,6	818,5	1468,1
Theodoxus fluviatilis		261,9	227,8	21,3	-	-	-	-	71,6	20,2	249,1	-
Dreissena	1588,3	2000,0	3145,3	1148,9	4362,9	150,6	971,1	-	1837,7	1371,0	5017,8	387,8
Trichoptera	1458,7	2261,9	2472,9	255,3	193,1	90,4	52,5	-	23,9	201,6	1174,4	83,1
Chironomidae	4311,2	3190,5	1800,4	1531,9	1583,0	-	367,5	43,1	119,3	1209,7	1245,6	249,3
Piscicola geometra	-	-	54,2	-	-	-	-	-	-	-	-	-
Girudinea (other)	-	-	21,7	42,6	-	-	-	-	-	-	-	-
Gastropoda (other)	16,2	190,5	32,5	276,6	77,2	-	-	8,6	-	60,5	106,8	27,7
Gammaridae	32,4	-	32,5	-	-	-	-	-	-	-	71,2	-
Asellus aquaticus	-	-	-	21,3	-	-	-	-	-	-	-	-
Acari	-	-	-	-	-	-	26,2	-	-	-	35,6	-
Collembola	-	-	-	-	-	-	-	8,6	-	-	-	-
Odonata	-	71,4	-	21,3	-	-	-	-	-	-	-	-
Diptera (other)	-	-	10,8	-	-	-	-	-	-	-	-	-
Total density, ind./m^2	15899,5 ±1589,0	10071,4 ±1007,1	10607,4 ±1060,7	5595,7 ±559,6	9922,8 ±992,3	421,7 ±42,2	1784,8 ±178,5	69,0 ±6,9	2410,5 ±241,1	4314,5 ±431,5	8718,9 ±871,9	2216,1 ±221,6
Number of taxonomic groups	6	7	10	9	5	3	5	4	5	6	8	5
Shannon index	0,5	0,67	0,66	0,62	0,49	0,46	0,5	0,47	0,34	0,57	0,57	0,43

In general, it was detected the tendency to reduce the total density of communities with increasing distance from the hydroelectric dam, but this correlation was not statistically significant. However, this dependence was found for the density of separate groups of aquatic invertebrates: chironomids larvae (r_s=-0,67, p<0,05, Fig. 2) and oligochaetes (r_s =-0,59, p<0,05).

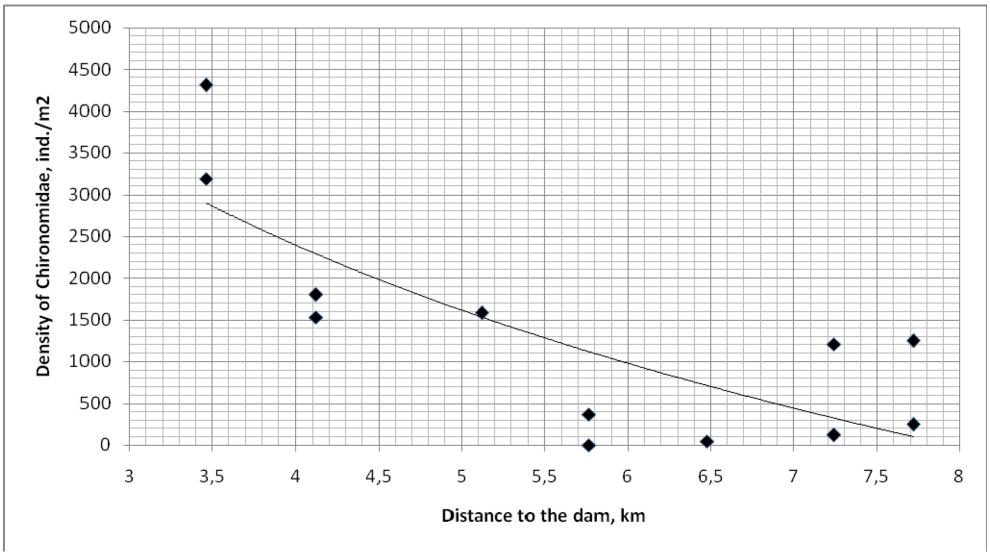

Fig. 2. The relationship between Chironomidae larvae density and distance from hydroelectric dam.

Biomass of communities varied in even wider range, the difference between the extreme values reached 6 orders of magnitude (Table. 2). The minimum value was also found at station number 5 (0.003 g/m^2), which was undergoing drying. Among the other stations, the lowest value of total biomass (2.47 g/m^2) was found on the station № 4 (up point). Maximum biomass (158.99 g/m^2) was found at the station № 2 (up point).

Table **2. The average biomass of communities of zooperiphyton (g/m^2) on a stone embankment in the downstream of Kaniv hydroelectric**

Station	**1**	**1**	**2**	**2**	**3**	**4**	**4**	**5**	**6**	**6**	**7**	**7**
Distance to the dam, km	3,46	3,46	4,12	4,12	5,12	5,77	5,77	6,48	7,24	7,24	7,72	7,72
Point	up	down	up	down		up	down	up	up	down	up	down
Oligochaeta	1,05	0,17	0,17	0,20	0,15	0,02	0,03	0,0004	0,02	0,11	0,06	0,13
Theodoxus fluviatilis		21,69	2,36	0,11	-	-	-	-	0,31	-	2,35	-
Dreissena	76,69	74,45	148,37	53,26	132,01	2,68	23,18	-	81,81	33,02	124,48	16,07
Trichoptera	0,76	0,86	1,26	0,17	0,17	0,04	0,02	-	0,01	0,09	0,56	0,06
Chironomidae	1,10	0,57	0,85	0,30	0,46	-	0,14	0,001	0,03	0,18	0,31	0,03
Piscicola geometra	-	-	0,30	-	-	-	-	-	-	-	-	-
Girudinea (other)	-	-	0,02	0,01	-	-	-	-	-	-	-	-
Gastropoda (other)	0,001	0,12	5,59	21,49	0,01	-	-	0,001	0,01	23,91	0,01	0,06
Gammaridae	0,05	-	0,07	-	-	-	-	-	-	-	0,14	-
Asellus aquaticus	-	-	-	0,13	-	-	-	-	-	-	-	-
Acari	-	-	-	-	-	-	0,0001	-	-	-	0,001	-
Collembola	-	-	-	-	-	-	-	0,0005	-	-	-	-
Odonata	-	1,71	-	0,81	-	-	-	-	-	-	-	-
Diptera (other)	-	-	0,001	-	-	-	-	-	-	-	-	-
Total biomass, g/m^2	79,66 ±7,97	99,57 ±9,96	158,99 ±15,90	76,46 ±7,65	132,80 ±13,28	2,74 ±0,27	23,38 ±2,34	0,003± 0,0003	82,19 ±8,22	57,32 ±5,73	127,92 ±12,79	16,33 ±1,63
Biomass of soft periphyton, g/m^2	2,97± 0,30	3,31± 0,33	2,67± 0,27	1,61± 0,16	0,79± 0,08	0,06± 0,01	0,20± 0,02	0,002± 0,0002	0,05± 0,01	0,38± 0,04	1,07± 0,01	0,21± 0,02

Quantitative indexes of *Dreissena* settlements in periphyton didn't show statistically significant depending on the location relative hydroelectric dam. Due to the dominance of *Dreissena* in periphyton biomass for almost all investigated points, the total biomass depending on the distance from the dam also wasn't detected. However, analysis of soft periphyton biomass (excluding molluscs) showed a clear dependence on the distance below the dam (r_s=-0,63, p<0,05 %, Fig. 3). This correlation was also detected for biomass of chironomid larvae (r_s=-0,61, p<0,05 %) and for biomass of oligochaetes (r_s=-0,65, p<0,05 %).

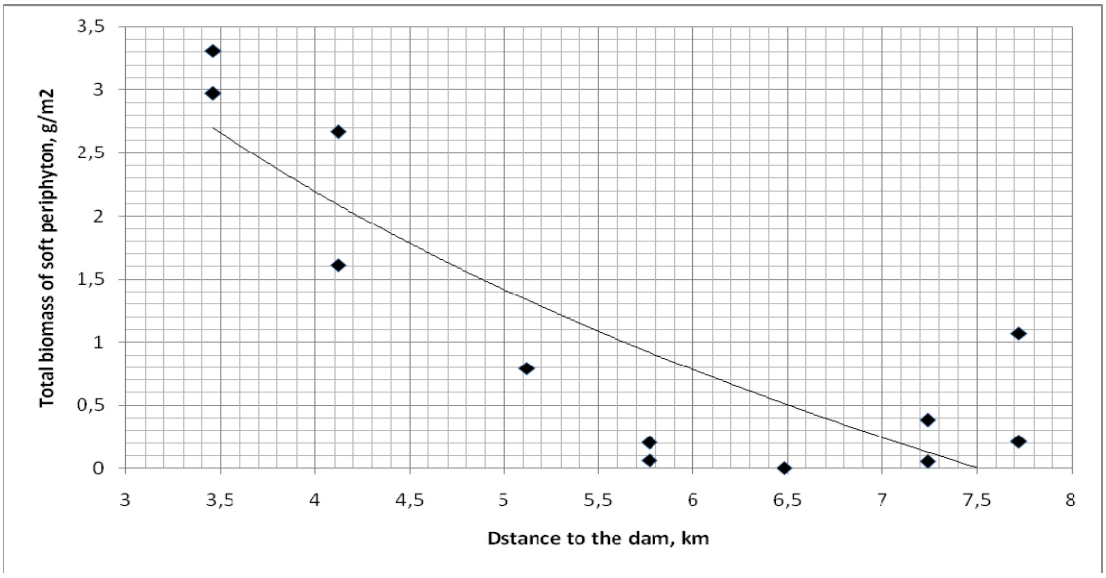

Fig. 3. The relationship between the total biomass of periphyton excluding molluscs and distance from hydroelectric dam

To characterize the structural and functional organization of the communities was used quantitative assessment of taxonomic diversity of zooperiphyton communities using Shannon index. Found that taxonomic diversity of the communities also decreases with increasing the distance from the hydroelectric dam, but the relationship are weak and not statistically significant.

Thus, the dependence of quantitative indexes of development and structural and functional organization of communities of periphyton on stone shore protecting structures, in the riverbed of the Dnieper River on the distance from the downstream of Kaniv Hydroelectric Power Plant was detected. This can be explained more rheophilic conditions of upper (closer to the dam) parts of riverbed. According to other researchers flow rate has a positive effect on density, biomass and diversity of communities of zooperiphyton [11, 12]. However, when flow rate is great (over 2 m/s) conditions are unfavorable [13]. In the downstream of Kaniv hydroelectric the flow rate reaches 1.0-1.5 m/s [14]. It should be noted that for communities of phytoepiphyton is typical inverse relationship: when the flow rate increases the density, biomass and diversity of communities – are falling [3].

It is well known that *Dreissena* forms specific biocenoses in which it is an ecosystem engineer that determines the conditions for the existence of other species in periphyton [13]. But our research has found no statistically significant dependence between biomass or density of *Dreissena* and the distance from the dam. Simultaneously, the density of other taxonomic groups of periphyton positively correlated with biomass of *Dreissena* (for the overall density r_s=0,81, p<0,01). On the other hand, we know that *Dreissena* can inhibit the development of other organisms in communities of periphyton [15]. But we have not found a solid surface coating of substrate by *Dreissena* settlements. Thus, we can assume that settlements of attached clam occupy only part of the area of the substrate and it leads to increase habitat diversity. Meaningful correlation between the biomass of *Dreissena* and the taxonomic diversity of communities of periphyton was not found.

The impact of fluctuations in water levels most clearly appeared in the station № 5, where in October we were able to take only one sample, and in November the embankment was completely drained. This periodic draining significantly reduces density (by 1-3 orders of magnitude compared with other stations) and biomass (by 4-6 orders of magnitude) of organisms of zooperiphyton. Including precisely on this station was not found *Dreissena*.

Conclusions:

In the communities of zooperiphyton in the downstream of Kaniv hydroelectric were detected representatives of 8 classes of aquatic organisms. The major groups were molluscs, oligochaetes and insects (chironomid and caddisfly larvae). The largest part of the total biomass of the communities of periphyton is made by bivalves (*Dreissena*) which are the ecosystem engineer species.

The density and biomass of representatives of zooperiphyton at the investigated area in the autumn period exhibit a negative correlation with distance from hydroelectric dam. It is probably due to more rheophilic conditions in the points closer to the dam.

Periodical (every day) draining of some embankments of shore protection structures in the study period of year has a catastrophic effect on communities of periphyton.

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М. Борисенко, асп., Д. Лукашов, д-р біол. наук
Київський національний університет імені Тараса Шевченко, Київ, Україна

ЗМІНИ ЗООПЕРИФІТОНОВИХ УГРУПУВАНЬ У НИЖНЬОМУ Б'ЄФІ КАНІВСЬКОЇ ГІДРОЕЛЕКТРОСТАНЦІЇ В ОСІННІЙ ПЕРІОД

Наведено результати дослідження угруповань зооперифітону кам'яних підсипок берегоукріплювальних споруд у нижньому б'єфі Канівської ГЕС у осінній період. Виявлено зворотну залежність між кількісними показниками зооперифітону (такими як щільність і біомаса), його різноманіттям і відстанню від греблі ГЕС.

Ключові слова: перифітон, гідроелектростанція, нижній б'єф.

М. Борисенко, асп., Д. Лукашов, д-р биол. наук
Киевский национальный университет имени Тараса Шевченко, Киев, Украина

ИЗМЕНЕНИЕ ЗООПЕРИФИТОНОВЫХ СООБЩЕСТВ В НИЖНЕМ БЬЕФЕ КАНЕВСКОЙ ГИДРОЭЛЕКТРОСТАНЦИИ В ОСЕННИЙ ПЕРИОД

Представлены результаты изучения сообществ зооперифитона каменных подсыпок берегоукрепляющих сооружений в нижнем бьефе Каневской ГЭС в осенний период. Обнаружена обратная зависимость между количественными показателями зооперифитона (такими как плотность и биомасса), его разнообразием и расстоянием от плотины ГЭС.

Ключевые слова: перифитон, гидроэлектростанция, нижний бьеф.

УДК 1963/58.009

О. Шевчик, асп., В. Соломаха, д-р біол. наук, проф.
Київський національний університет імені Тараса Шевченка, Київ

ДО ПОШИРЕННЯ *CRATAEGUS UCRAINICA (ROSACEAE)* В ЗАПЛАВІ Р. ДНІПРО (О. ШЕЛЕСТІВ, КАНІВСЬКИЙ ПРИРОДНИЧИЙ ЗАПОВІДНИК)

Уперше підтверджено зростання Crataegus ucrainica A. Pojark. у заплаві р. Дніпро. Місцезнаходження двох генеративних особин глоду українського виявлене на о. Шелестів у межах Канівського ПЗ (Черкаська обл.). Відображено еколого-ценотичні особливості поширення виду. Виявлене місцезростання глоду українського певною мірою пов'язане з попередньою сучасною знахідкою популяції цього виду в дельті р. Рось [1] у зв'язку із близькістю та розташуванням о. Шелестів у заплаві р. Дніпро напроти цієї ділянки. Зазначено необхідність збереження нових локалітетів цього рідкісного виду, занесеного до "Міжнародного Червоного списку".

Ключові слова: Crataegus ucrainica, рідкісний вид, охорона, заплава р. Дніпро, о. Шелестів, Канівський ПЗ.

Вступ. Після опису виду *Crataegus ucrainica* [2] та наведення його у флорі України у вигляді окремих особин, виявлених у природі й долучених до гербарних колекцій [3], і виходячи з екологічної й ценотичної специфіки виду та стабільності морфологічних ознак, цей вид був віднесений до списку видів, що мають міжнародний статус охорони [4].

Зацікавленість дослідників до глоду українського зросла після виявлення перших двох досить великих ценопопуляцій його в лісових масивах м. Києва в 1974 р. (с. Биківня та Червоний хутір) [5]. Автори акцентували основну увагу на екологічній специфіці цього виду. Вони ж у межах Середнього Придніпров'я та особисто Любченко В. М. на території Лівобережного Лісостепу в ті самі роки виявили нові знахідки, які підтверджені гербарними зборами.

Опрацювання цих гербарних матеріалів та експедиційні дослідження дозволили нам відшукати й описати досить велику ценопопуляцію глоду українського в гирлі р. Рось [1] і впорядкувати наявні та власні матеріали, зібрані з території Лівобережного Лісостепу [6].

З метою розробки комплексу природоохоронних заходів відносно глоду українського актуальним є пошук нових популяцій цього виду в межах його природного ареалу. Вирішуючи це завдання, ми найперші наші дослідження спрямували на пошуки *C. ucrainica* в околицях Канівського природного заповідника, де раніше в гирлі р. Росі було виявлено найбільшу із сучасних відомих