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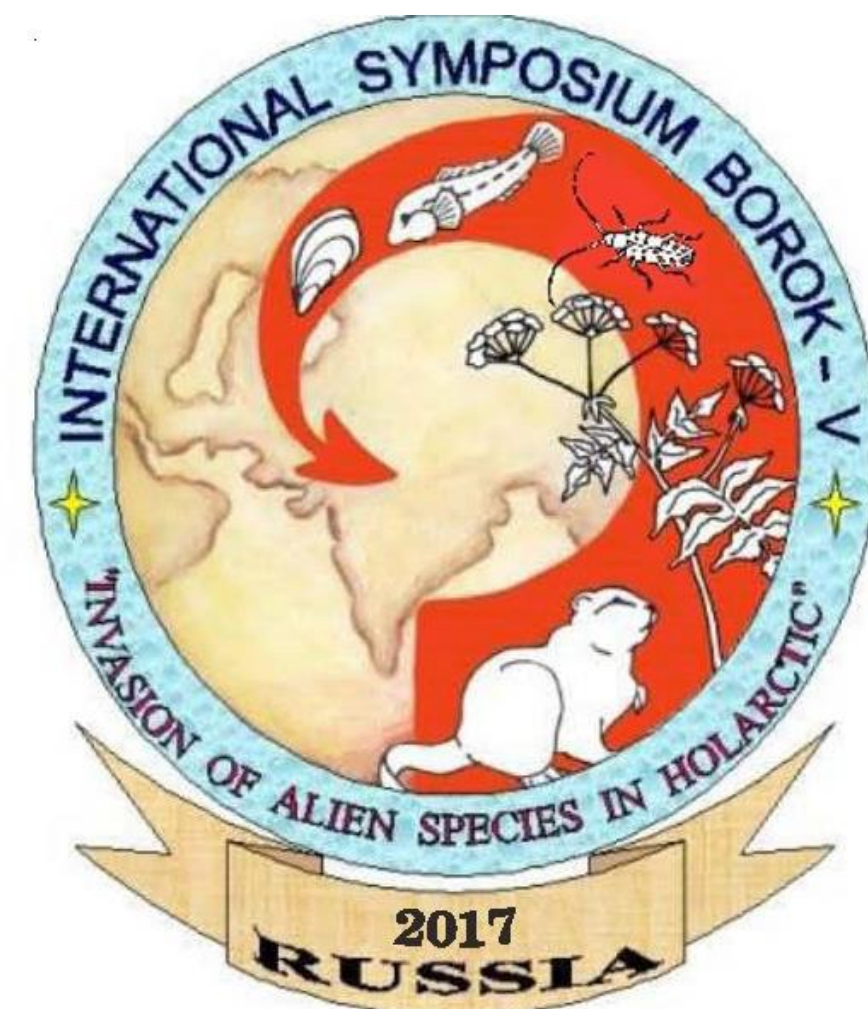
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INVASION OF ALIEN SPECIES IN HOLARCTIC

BOOK OF ABSTRACTS

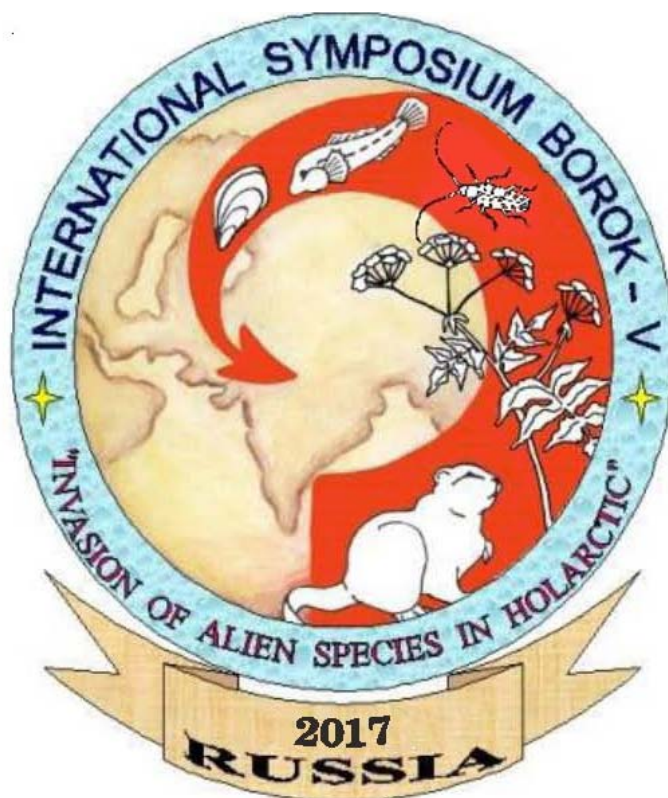


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RUSSIA, UGLICH – BOROK, 25–30 SEPTEMBER, 2017



УДК 574 (211-17)(063)
ББК 28.08(21+71+9)я431
Ч-86

ЧУЖЕРОДНЫЕ ВИДЫ В ГОЛАРКТИКЕ: ТЕЗИСЫ ДОКЛАДОВ V Международного симпозиума (Борок-5) / Ин-т биологии внутр. вод им. И. Д. Папанина РАН, Ин-т проблем экологии и эволюции им. А. Н. Северцова; ред. Ю. Ю. Дгебуадзе [и др.]. – Ярославль: Филигрань, 2017. 162 с.

ISBN 975-5-906682-92-5

The V International Symposium INVASION OF ALIEN SPECIES IN HOLARCTIC: BOOK OF ABSTRACTS / Papanin Institute for Biology of Inland Waters Russian Academy of Sciences, A.N. Severtsov Institute of Ecology and Evolution Russian Academy of Sciences; Ed. Yu. Yu. Dgebuadze [et al.]. – Publisher “Филигрань”, Yaroslavl, 2017. 162 p.

Editors:

Yu. Yu. Dgebuadze, L. I. Tereshchenko, A. V. Krylov

Technical Assistance:

E. N. Pakunova

Texts are printed in the author's edition

Тексты печатаются в авторской редакции

The symposium is held with the financial support of:

Russian Foundation for Basic Research, Project No. 17-04-20303

International Union of Biological Sciences

Ltd Agency «Khimexpert», the Official Distributor of Thermo Fisher Scientific

Симпозиум проводится при финансовой поддержке:

Российского фонда фундаментальных исследований, Проект № 17-04-20303

International Union of Biological Sciences

ООО Агентство Химэксперт, Официальный дистрибьютор Thermo Fisher Scientific

ISBN 975-5-906682-92-5

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INVASIVE SPECIES *HORDEUM JUBATUM* L. IN BASHKORTOSTAN REPUBLIC

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Hordeum jubatum L. – poorly studied biennial or perennial firm bunchgrass, is from North America, included in "The black book of flora of Central Russia" (2010). Natural area covers a northern part of North America and Eastern Siberia. As an alien plant it is known since the end of the 19th century in many countries of Europe, in the European part of Russia, in the Caucasus, in Western Siberia, Central Asia and the Far East (Maevsky, 2006; Lambdon et al., 2008). Outside Russia *Hordeum jubatum* grows as a part of ruderal vegetation in the extensive territory of Central Europe – in Germany, France, Belgium, Holland and other countries (Vinogradova, Mayorov, 2009). In the Republic of Bashkortostan this species is for the first time found in 1984 in Beloretsk (UFA). Extends on roadsides of road highways, in and near settlements, it is naturalized in the disturbed steppes of Trans-Urals and around lakes on saline soils in recent years.

We carry out studying of distribution and biology of *Hordeum jubatum* in Trans-Urals and the Cis-Urals Bashkortostan. For today more than 40 centers of invasion almost in all natural zones of Bashkortostan (fig. 1), except for the Northeast of the republic are found.

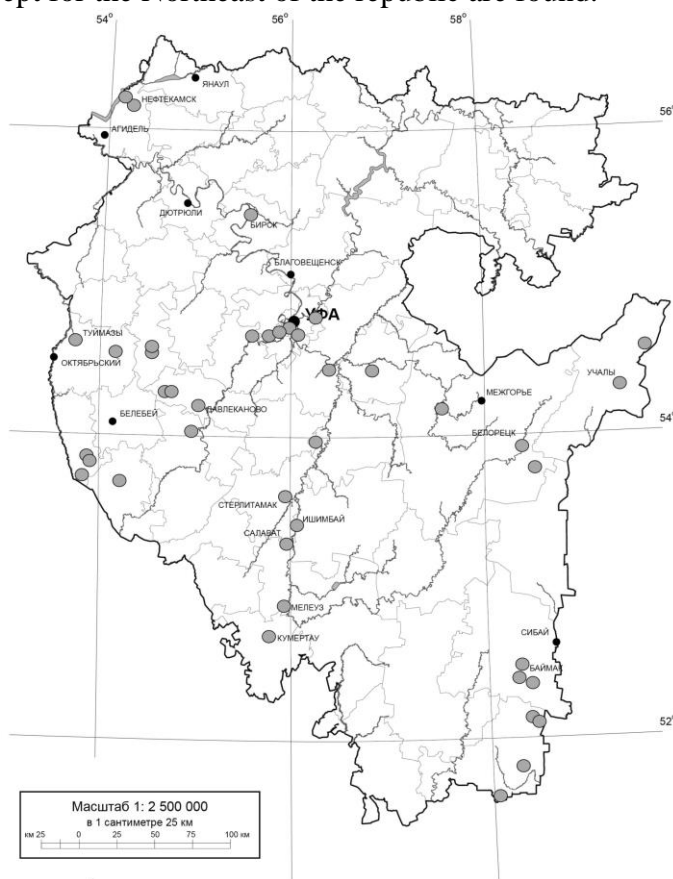


Fig. 1. Distribution of foxtail barley (*Hordeum jubatum*) in the Republic of Bashkortostan.

Hordeum jubatum is a dominant weed plant, at introduction in communities it becomes to dominants with high share – 44.6–61.4%. Density of herbage of invasive species – 9–18 plants on 1 sq.m, biomass – no more than 0.25 kg/sq.m. The species is included in preliminary "Black list" of the Republic of Bashkortostan (Abramova, Golovanov, 2016). Control of an invasion of *Hordeum jubatum* is almost impossible, or is very complicated. *Hordeum jubatum* reduces fodder qualities of haymakings and pastures since after ear formation it isn't eaten by pets. Monitoring of the centers of invasion and strengthening of control of the roadside, especially railway territories which are sources and ways of a drift of this invasive species to the region is necessary.

INVASIVE PLANT SPECIES ON THE KAMCHATKA PENINSULA

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The examination of synanthropic flora of the Kamchatka was only fragmentary, nowadays it requires overall inventory. This paper presents data concerning the communities formed by some alien species: *Heracleum sosnowskyi* Manden., *Impatiens glandulifera* Royle, *Symphytum caucasicum* Bieb., *Lupinus polyphyllus* Lindl., *Reynoutria sachalinensis* (Fr. Schmidt) Nakai, *Tussilago farfara* L., *Vicia cracca* L., *Arctium tomentosum* Mill. They include both species of Russia's invasive plants "Black List" (Vinogradova et al., 2015) and the plants of the temperate zone of Russia.

We started the investigation of Kamchatka settlements in 2012. We observed the territories of Petropavlovsk-Kamchatskiy, Yelizovo, Vilyuchinsk and 9 villages: Paratunka, Apacha, Sosnovka, Esso, Anavgay, Klyuchi, Ivashka, Palana and Ossora. For the investigation of Petropavlovsk-Kamchatskiy territory, we made geobotanical descriptions of synanthropic communities formed by alien species. We preceded the descriptions in accordance with the principles of ecological-floristic classification (Braun-Blanquet, 1964) with the application of the deductive method of Kopečky-Hejny (Kopečky, 1974).

We studied communities with the dominance of invasive plant species and classified them as derivate i.e. replacement communities. The communities belong to 2 classes: the Class of nitrophilic communities of shady habitats *Galio-Urticetea* and the Class of meadow vegetation *Molinio-Arrhenatheretea*.

Weed flora of the Kamchatka was not sufficiently studied. For the first time Komarov (1954) investigate alien flora during his travel along Kamchatka in 1908–1909. Fedorchenko (1971) presented further data of weed flora of the region. In 1973 Ulyanova (1976, 1982) examined weed infestation of Kamchatka's agricultural crops. She noticed that Kamchatka weed flora was rather poor in comparison with other regions of the Far East and the species composition of weed plants was not stable and depended on the introduction of alien plans. She revealed only 75 species. In recent years alien flora and invasive plant species of the region are actively studied (Chernyagina et al. 2012, 2013, 2014; Devyatova et al., 2015, 2016). It is revealed that in Kamchatka weed plant species frequently expand in the areas of thermal springs.

Our research shows that the most of the invasive species concentrated in the Yelizovsky district. This region has the most developed transport system, industry and agriculture. We found most of the species in urban areas of Petropavlovsk-Kamchatsky, Yelizovo and Vilyuchinsk. In Bystrinsky district in Esso and Anavgay villages we found five invasive species. This may be determined by good transport accessibility in comparison with other settlements under study. We observed the spread of a number of invasive species in the villages of North Kamchatka. On the whole, moving to the north of the peninsula we observe that the number of invasive species is reduced, not only due to the lack of transport accessibility, but also due to more severe climatic conditions.

The investigation of synanthropic communities allowed us to reveal introduced species of plants which adapted themselves to the urban habitats, got integrated into them and became the dominants of phytocenoses. The alien species *Heracleum sosnowskyi* Manden., *Impatiens glandulifera* Royle, *Symphytum caucasicum* Bieb., *Lupinus polyphyllus* Lindl., *Tussilago farfara* L., *Vicia cracca* L., *Reynoutria sachalinensis* (Fr. Schmidt) Nakai., *Arctium tomentosum* Mill spread not only across ruderal habitats of the urban areas but also show a tendency of their introduction and naturalization in natural habitats.

INVASIVE SPECIES IN THE AZOV-BLACK SEA BASIN

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The list of invasive species in the Russian part of Azov and Black Seas basin water bodies has been compiled. List includes benthic, planktonic organisms and fish.

It was shown that most abundant group of invasive species belongs to zoobenthos and presents by bivalve mollusks. A number of them form significant biomass both at marine and freshwater ecosystems (f.e. *Mya arenaria*, *Anadara kagoshimensis* (Black and Azov Seas), *Dreissena bugensis* (Lower Don) etc.).

Most stressful for marine water ecosystems is an invasion of euribiotic benthic and planktonic predators (f.e. *Rapana venosa* and *Mnemiopsis leidyi* respectively) with wide food spectrum.

Only few invasive species belong to macrophytobenthos and fish. Last groups characterized by very restricted impact on environment and narrow areal. For example there are only two invasive species of macrophytes that have been reported for coastal zone of the Black Sea and none of them were discovered at Russian part of the sea. The arctoboreal brown algae *Desmarestia viridis* was first recorded in the northwestern part of the Black Sea in 1992 year (Minicheva, Eremenko, 1993). Currently, this species become mass in the Odessa region during the cold period of the year. The second species – *Chorda tomentosa* – is the singular representative of the order Laminariales in the Black sea which first discovered in the area of the Odessa coast in March 2015 year (Minicheva, 2015).

FEATURES OF GONADAL DEVELOPMENT IN DIPLOID AND TRIPLOID PINK SALMON *ONCORHYNCHUS GORBUSCHA* ARTIFICIALLY REARED IN THE WHITE SEA BASIN

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The study aimed at identifying the fish sex in a sample of pink salmon obtained and reared in artificial environments, estimating the effect of triploidization on the gonadal development rate, and evaluating the efficiency of triploidization as a sterilization method in pink salmon. Fish of the White Sea basin were used in experiments. Triploids were generated using heat shock and reared in fresh water for 1.5 years and then in sea cages over the summer. The ploidy was estimated by measuring the mean maximum diameter of erythrocyte nuclei for each fish. In addition to diploids and triploids, fish with an intermediate ploidy were found and assumed to be diploid–triploid mosaics. The gonads were examined histologically at the end of pink salmon spawning in White Sea tributaries, and delayed gonadal development was observed in some of the diploid females reared in experimental conditions. Triploid fish included only males (with or without signs of maturing) and intersexes. Triploids were considered as a means to regulate the size of pink salmon populations and were concluded to be unsuitable for use in pink salmon aquaculture.

The work was supported by the Russian Science Foundation (project no. 16-14-10001).

SECONDARY RANGES OF INVASIVE CONSUMERS OF ASH OVERLAPPED IN EUROPEAN PART OF RUSSIA

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Buprestid beetle *Agrilus planipennis* Fairmaire or EAB and ash dieback disease – ascomycete pathogen *Hymenoscyphus fraxineus* (T. Kowalski) Baral, Queloz, Hosoya or ADB are both important Asian newcomers to Europe. They have no economic value in their native range on aboriginal ash species *Fraxinus chinensis* Roxb. and *F. mandshurica* Rupr. The buprestid is a secondary consumer of weaken and dying trees and fungus is a common saprophage on leaves and twigs. At the end of 20th century the fungus and the beetle were accidentally introduced into Europe and their vivid economic impact became evident first in Poland (ADB – 1992) and than in Moscow (EAB – 2003).

For the moment EAB has damaged up to 80 percent of ash trees in Moscow and suburbs and was found in 11 administrative regions of Western Russia.

According to dendrochronological cross dating of dead ash trees, in Moscow an EAB outbreak took place at 2005–2007 in the northern and central regions of the city and at 2008–2012 in its' southern regions. The last ash trees were killed in these regions at 2013 and at 2014 accordingly. During last 3 years EAB nearly disappeared from the city and from Moscow suburbs although many damaged ashes are still alive and are regenerating successfully. Existing data demonstrated that EAB outbreak collapse was caused in major extent by local polytrophic parasitoids from genus *Spathius* Nees (Hymenoptera: Braconidae) (for sure – *S. polonicus* Niezabitowski, may be few others) who have switched to the new abundant host.

The rapid crash of EAB population at the epicenter of its secondary range in Europe is an outstanding event deserving separate deep investigation. It is a unique example when local biota only during a quarter of a century assimilated populations of the aggressive invader. This good news generates some optimistic expectations about the future of ash species in Europe.

The bad news deals with invasive micopathogen *H. fraxineus* which was found recently nearly everywhere at the eastern border of its secondary range in Europe.

In spite of quick distribution of ash dieback disease in Europe, till recently only limited information on it has been available for the eastern part of natural range of European ash *Fraxinus excelsior* L. In 2014–2016, during 14 000 km trip we explored most eastern corner of *F. excelsior* range in European Russia. The infected samples were collected in 162 plots situated in forest belts along highways, in cities and sometimes in natural forest stands of 23 administrative regions of Western Russia. Samples were taken from *F. excelsior*, as well as from *F. pennsylvanica* Marshall, *F. americana* L. and *F. ornus* L. which were present in the plots. Genetic analysis proved existence of *H. fraxineus* in 86% of the samples. We found no vivid regularities in distribution of fungus activity from Poland and Byelorussia across the region to the river of Volga. The mature trees of *F. excelsior* were the most resistant to the disease comparing to other ash species. Young trees and sprouts were infested more intensively. Their chronic injury took place at least during last 7–8 years.

The closest objectives will be to study pest/pathogen interactions on the newly discovered territory of their overlapping ranges.

The work was supported by the Russian Foundation for Fundamental Research (grant 17-04-01486a).

TRAVELLING BACK IN TIME: SECONDARY RANGE DYNAMICS RECONSTRUCTION OF INVASIVE FOREST INSECTS

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There are few approaches for reconstruction of secondary range expansion of an invasive forest insect pest. We'll present a short overview of existing publications. As our own examples we'll use here two case studies connected with Far Eastern invaders in Russia: four-eyed fir bark beetle *Polygraphus proximus* Bladford (Coleoptera, Curculionidae, Scolytinae) or FFBB and emerald ash borer *Agrilus planipennis* Fairmaire or EAB. Both species were recently included into quarantine list of the Eurasian Economic Union.

The pathways of *P. proximus* westward invasion were traced using molecular methods. The genetic variation of partial mitochondrial sequences of the cytochrome oxidase subunit I and II genes in 22 pest populations all over northern Palaearctic (from Japan to Moscow) was highest at the Far East where we identify 18 haplotypes with the partition into five groups according to the maximum likelihood analysis. The haplotype distribution over initial and secondary parts of *P. proximus* range clearly demonstrates an invasive nature of Siberian and European population of this bark beetle. They have substantially lower genetic variability observed which is typical for the "bottle neck" effect during invasions and allowed us to suggest that introductions into the West and East Siberia regions were independent, since no overlapping in haplotype variants was found.

The direct estimation of time of invasion was made by the method of dendrochronological crossdating. In Krasnoyarsk Kray FFBB' earliest damage occasion, for example, was dated back to 1970ies.

It was shown that EAB invasion to Moscow (officially “registered” at 2003) has started in reality at least at the very beginning of 1990s. Estimated years of dieback of first tree with EAB's exit holes demonstrated rapid movement of invader from Moscow – an epicenter of invasion: Moscow – 1997, Puschino – 2009, Vyazma – 2010, Orel – 2010 and Voronezh – 2006.

Unfortunately, genetic variation of EAB is surprisingly low: few attempts to estimate it found no major difference between EAB population from China, Far East, North America and Moscow.

A total coincidence of EAB invasive activity on North American continent and in Europe (introduction in early 1990s and start of outbreaks after 10-13 years) can be explained, for example, by “appearance” of highly aggressive EAB genotype spreading all over North Eastern Asia. An observation to support it: EAB was always found in Vladivostok, but only in 2004 it attacked and killed all introduced trees of *Fraxinus pennsylvanica* in this city. The stem diameter of these trees was up to 40 sm, so each of them felt itself fine before the “time X”.

I want to acknowledge many colleagues for their valuable input into these mutual studies: D.A. Demidko, V.M. Petko and N.V. Pashenova (Krasnoyarsk), A.G. Blinov and K.V. Kononov (Novosibirsk), S.A. Krivets and I.A. Kerchev (Tomsk), L.G. Seraya (Moscow), G.I. Yurchenko (Khabarovsk).

The work was supported by the Russian Foundation for Basic Research (grants 17-04-01765a and 17-04-01486a).

INITIAL STAGES OF INVASIVE SPECIES DEVELOPMENT *SOLIDAGO CANADENSIS* L.

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Solidago canadensis L. is an alien invasive species, occurring in most ruderal and semi-natural phytocenoses of the Izhevsk. It is included in the “Black book of Udmurt Republic” (2016) and has the second status of aggression. Under favorable conditions *S. canadensis* transforms species composition and structure of natural phytocenoses in precincts of Izhevsk. Therefore it is a dangerous invasive species that poses a threat to native species of urbanized flora.

Currently the question of fight against arising centers of invasive species deserves increasing attention. For the solution of this problem it is necessary to know well the biology of species that extend in a secondary area. It will help to define “tender spots” of species and allow to coordinate the operations against invasive plant species. So that the aim of our research is estimation of the initial stages of development of invasive species *Solidago canadensis* L.

The physiologically mature achenes of *S. canadensis* were used as material for research. The achenes were taken as a unit of reproduction because it is difficult to separate seeds from fruits. The collecting material was carried out in localities of Botanical Garden of Udmurt state university in 2014 (56°54'51" N, 53°14'58" E). The study of seed germination was conducted according to standard techniques.

The main constants of achenes under study were identified. The seed production of individuals of this species is very high. For example, average number of achenes at the one anthode is 15.45 ± 0.23 pcs. The pappus is 2 times longer than achene. The average number of fuzz at the pappus is 13.26 ± 0.08 pcs.

During the estimation of influence of light on seed germination of *S. canadensis* it has been found that seeds of this species are light sensitive despite the presence of leather-like pericarp. The period before germination of seeds amounted to 3–4 days at the laboratory conditions (16-hour lighting at +25°C). The period of germination lasted in the range of 19 to 22 days. The germinating energy was 80–85%. The index of field germination is lower than index of laboratory germination. The achenes of *S. canadensis* germinated at the soil for 5–6 days and in the laboratory conditions - for 3–4 days.

The period and storage conditions of seeds can significantly reduce germination index. This factor must be considered to understand how long the diaspores of alien species can preserve vitality in the new territory. Depending on the storage duration of achenes of *S. canadensis* reducing trend of germinating index is observed. For example, the maximal germination is observed after harvest. After 1,5 years of storage there is a decrease in germination approximately by 3 times in comparison with the germination index that is typical for freshly harvested seeds.

Therefore, *S. canadensis* at the initial stages of development has the following features: the seeds of studied species are photosensitive; low temperature has detrimental effect on the process of seed germination; reducing trend of germination is observed at the storage of seeds; the field germination is significantly smaller than laboratory germination.

DISTRIBUTION OF INVASIVE AMPHIPODS IN THE LITTORAL ZONE OF LAKE LADOGA

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At present, four species of alien amphipods are registered in Lake Ladoga. Among them there are two species of Baikal origin (*Gmelinoides fasciatus* (Stebbing), *Micruropus possolskii* (Sowinsky)) and two species of Ponto-Caspian origin (*Pontogammarus robustoides* (Sars), *Chelicorophium curvispinum* (Sars)) (Atlas ..., 2015). *G. fasciatus* invaded in Lake Ladoga in the middle of 1980s from the lakes of the Karelian Isthmus, where it was introduced intentionally in the 1971–1975 with the aim of enhancing food base of fish (Panov, 1996). *M. possolskii* was accidentally introduced into the Baltic Sea basin together with *G. fasciatus* and subsequently penetrated into Lake Ladoga. For the first time, the naturalized population of *M. possolskii* was discovered in the Shchuchiy Bay in 2012 (Barbashova et al., 2013). The appearance in the lake of the Ponto-Caspian amphipods was promoted by the following factors as an intensification of shipping, climatic changes and increased mineralization of water in the Volkhov Bay. *P. robustoides* was found in this bay in 2006 (Kurashov, Barbashova, 2008) and *C. curvispinum* was recorded there later in 2009 (Kurashov et al., 2010).

Studies of benthic communities in the littoral zone of Lake Ladoga were carried out in July – August 2014 to assess the current level of development and the distribution range of invasive amphipods. During the observation period the density of crustaceans ranged from 8 to 25072 ind. m⁻², biomass – from 0.032 to 110.216 g m⁻², which was 0.3–93.5% of the total density and 0.4–85.2% of the biomass of macrozoobenthos. *G. fasciatus* was the most widespread in the lake (the occurrence of 93.8%). Its density varied from 8 to 19360 ind. m⁻², biomass – from 0.032 to 55.792 g m⁻². The maximum quantitative parameters of *G. fasciatus* were noted in the southern part of the lake in the Petrokrepost Bay. In the western part of the lake as well as in the bays and along the open coast, together with *G. fasciatus* *M. possolskii* was also recorded (the occurrence of 15.6%). In different habitats, its density varied from 347 to 1840 ind. m⁻², biomass – from 1.610 to 7.120 g m⁻². In this region, amphipods were the predominant group (22.0–86.5% of the density, 19.9–75.5% of the total biomass of macrobenthos). The biomass of amphipods in equal shares was determined on average by *M. possolskii* (48.5%) and *G. fasciatus* (51.5%). Mass development of *P. robustoides* (the occurrence of 12.5%) was observed in the Volkhov Bay. The density of the population and the biomass of this invader (2576–11240 ind. m⁻², 35.712–82.560 g m⁻²) were high. *C. curvispinum* had similar to *P. robustoides* the distribution in the littoral zone of the lake. Its density varied from 13 to 11640 ind. m⁻² and biomass – from 0.013 to 12.208 g m⁻². Maximum biomass of *P. robustoides* was recorded near the estuary of the Syas River. *C. curvispinum* had its maximum in 4 km from the estuary of the Volkhov River. The greatest diversity of invaders was noted in the Volkhov Bay. Three species were encountered there (*G. fasciatus*, *P. robustoides* and *C. curvispinum*). The species of *P. robustoides* prevailed. Its contribution to the biomass of amphipods was 48.1–99.5%. The share of *C. curvispinum* was 0.02–16.43%, and *G. fasciatus* – 0.28–35.50%.

Thus, *G. fasciatus* was the most widespread on the littoral biotopes; *M. possolskii* was much less common. The habitat of *P. robustoides* and *C. curvispinum* is limited by the boundaries of the Volkhov Bay. Their further immigration is probably hindered by the low mineralization of the waters in the lake. The dominant role of *G. fasciatus* was noted only in those parts of the lake where other species of invasive amphipods had not yet penetrated.

THE ROLE OF INVASIVE SHRUB SPECIES IN ECOSYSTEMS DEFORESTATION IN THE BAIKAL LAKE BASIN

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Degradation of landscapes associated with their deforestation, is currently one of the most widespread in the world, therefore, it is treated as particularly important from a functional point of view to preserve ecological stability of forest regions. The most intensively and in a variety of ways deforestation occurs in the forest-steppe landscapes of the Baikal Lake basin. Instead of the classical scheme of reforestation through derivative forests of aspen or birch, which are typical for Siberia, there has been widespread replacement of coniferous stands with thickets of xerophytic, mesoxerophytic, and mesophytic shrubs: *Amygdalus pedunculata*, *Spiraea aquilegifolia*, *Armeniaca sibirica*, *Betula fusca*, *Salix glauca*, *Dasiphora fruticosa*, and species of the *Caragana* genus (*C. microphylla*, *C. bungei*, *C. spinosa*, and *C. stenophylla*). We interpret these successions as a result of inter-coenotic invasions, when shrub species characteristic of other communities (forest edge, riparian-lowland, steppe and even desert-steppe) introduce into weakened or dead forest communities.

The processes of deforestation and bush successions have regional variants strongly dependent on environmental characteristics and ecological demands of bushes species. Field studies conducted in 2014–2016 in the forest-steppe landscapes of the Baikal Lake basin, has allowed spatially isolate and study the three main factors of deforestation usually facilitating the shrubs invasion.

- 1) *Desiccation of the soil layer with roots* and is fatal implications to forest communities are apparent in the model polygon "Upper Kuitun" in Barguzin valley. A similar phenomenon is recorded in the model polygon "Shamar" in Northern Mongolia where pine forests are replaced with *Armeniaca sibirica*, *Amygdalus pedunculata* and *Caragana microphylla*.
- 2) Deforestation could occur for the opposite reason – *waterlogging the soil layer with roots* that was observed in the model polygon "Nalaikh" to south-east from Ulaanbaatar where serious competitors for larch forest are *Betula fusca* and *Salix glauca*. This process is relevant primarily for mountainous depressions, and can be considered natural, but can be also a result of mining or development of power stations. Both increased significantly in Mongolia in the last 20–25 years.
- 3) Widespread and serious problem in the Baikal Lake basin is *competitive relations between woody and shrubby vegetation* in which a negative role people play (felling, grazing, wild-fires). As a consequence, forests transform into bushes over large territories. In different model polygons, depending on natural conditions, the process is dominated by various species of shrubs: the polygons "Sharyn-Gol" – *Dasiphora fruticosa* and *Spiraea aquilegipholia*, "Salkhit" – *Caragana microphylla*, "Tosontsengel" – *Caragana bungei* and *C. spinosa*. Shrubs not only replace the decaying forests, but also serve as indicators of areas that are potentially suitable for artificial reforestation, as in the case of *Dasiphora fruticosa* or, vice versa, not suitable under succession with *Armeniaca sibirica* и *Caragana spinosa*.

As a general result, the map of distribution of dominant bushes species in forest-steppe landscapes of the Mongolian part of the Baikal Lake basin was composed. According to preliminary calculations, up to 50% of ecotopes in forest-steppe landscapes, which were good for forest trees in the past, now turned into bushlands.

PSEUDORASBORA PARVA (TEMMINCK ET SCHLEGEL, 1846) IN THE SYRDARYA BASIN (IN THE REPUBLIC OF KAZAKHSTAN): CURRENT DISTRIBUTION, BIOLOGICAL AND MORPHOLOGICAL CHARACTERISTIC

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Stone moroko, or pseudorasbora, or topmouth gudgeon *Pseudorasbora parva* (Temminck et Schlegel, 1846) is a short life species and non-commercial fish species. The native range of the species covers water bodies of the Amur basin, the Korean Peninsula and Southern China. During the second half of the XXth century, this species has penetrated to many inland water bodies of Asia, Europe and even North America. Unintentional acclimatization with herbivorous fishes like grass carp *Ctenopharyngodon idella* was considered as the main pathway of the pseudorasbora invasions. Accumulated data allows consider this species as a dangerous invader. Pseudorasbora was discovered for the first time in the Syrdarya basin 1967–1968 (within Kazakhstan) by V.I. Ereischenko (1968). The aim of our research was to study the current state of this species in Kazakhstan part of the Syrdarya basin.

This investigation was carried out during 2002–2016. Syrdarya River from the Shardara water reservoir up to the mouth of the river (Small Aral), the main inflows like the Arys and the Keles rivers as well as many secondary tributaries were observed. Biological features and morphological characteristics were described by routine procedure according to I.F. Pravdin (1966) and J. Holcik (1989). Complete morphological and morphopathological features were investigated for 89 specimens.

In the surveyed area of the Syrdarya basin *Pseudorasbora parva* was found in water bodies that differ significantly by hydrological conditions. This species inhabits the main water arteries as the Syrdarya river with the main tributaries as Arys and Keles rivers as well as small inflows like Karashik, Arystandy, Bogen and Kulan rivers. Stone moroko is an indispensable fish species in large and small water reservoirs of the region. Usually, the pseudorasbora was one of the common but not dominant species in fish communities of all the investigated water bodies. Pseudorasbora was observed as dominant fish species in some local temporary water reservoirs soon after their filling up, and here pseudorasbora can be considered as useful larvivorous species.

Significant variability was revealed for the majority of the investigated parameters like positions and sizes of dorsal, anal, pectoral and abdominal fins, length of the head, snout and body, the number of scales in the lateral line, the number of unbranched rays in dorsal and anal fins, the number of vertebrae. Revealed diversity of the morphology of *Pseudorasbora parva* are due to the peculiarities of the hydrological regime of water bodies.

The maximum size of *Pseudorasbora parva* from the Syrdarya river basin in our catches was 71 mm, which far from the maximum size known for this species from other water bodies of the region. The Fulton condition factor varied widely from 0.36 to 3.06. Morphological pathology revealed insignificant abnormalities in the appearance of the liver and kidneys, but the total IUS (Reshetnikov et al., 1999) corresponded to the zone of relative ecological well-being.

The results of the study showed that pseudorasbora has great adaptive capabilities that allow it survive in unstable environment conditions and bear serious anthropogenic load. *Pseudorasbora parva* has no commercial significance and is considered an undesirable alien species; therefore the number of populations in reservoirs of the Syrdarya basin should be regulated.

The studies were carried out according to the grant No 2678 / GF 4 of the Ministry of Education and Science of the Republic of Kazakhstan.

ALIEN CYANOBACTERIUM *PLANKTOLYNGBYA BREVICELLULARIS* IN WATER BODIES OF THE NORTH-WEST RUSSIA

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Currently, the filamentous cyanobacterium *Planktolyngbya brevicellularis* Cronb. et Kom., first referenced in research conducted on two lakes in southern Sweden in 1994 [Cronberg, Komarek, 1994], has settled in many fresh water bodies of the Netherlands, Spain, Denmark, Poland, Sweden, and Russia. The complete diagnostic data is not provided in the first cyanobacterium description. Based on phytoplankton samples collected during the vegetation period of the 2000s in the Pskov-Chudskoye Lake and the Narva reservoir, the morphometric characteristics of the cyanobacteria (the width and length of the filaments, the size and shape of the vegetative cells) and the features of reproduction were refined and supplemented.

In reservoirs of the North-West of Russia *Planktolyngbya* appeared in the early 2000s. In eutrophic reservoirs: the Pskov-Chudskoye Lake and the Narva Reservoir, *Planktolyngbya* was discovered in August-October with a biomass of more than 100 mg/m³ in the summer season. (In the same period of 2003 in the hypereutrophic lake Ringsjön (Sweden), the level of development of this cyanobacterium was higher – 130–700 mg/m³). In 2013, the species is also noted in the benthos of the coastal zone of the northern part of the Neva Bay of the Gulf of Finland in the Baltic Sea.

In 2007, *P. brevicellularis* was first detected in the Curonian Lagoon of the Baltic Sea (biomass up to 40 mg/m³) against the background of the dominance of the *Planktothrix agardhii* cyanobacteria. In subsequent years (2008–2016) *Planktolyngbya* was recorded in almost 50% of summer-autumn samples. At the same time, its biomass exceeded 180 mg/m³. A positive correlation was found between the biomasses of *P. brevicellularis* and *P. agardhii* ($R_{\text{Spirmen}} = 0.68$, $p < 0.000$, $n = 87$). The source of invasion of *Planktolyngbya* in the Curonian Lagoon is the water system of the Mazurian Lakes (Poland), where this species periodically dominates, beginning in 1998 [Zębek, 2006].

In all the water bodies under discussion the species has been completely naturalized within the last 15–20 years.

FEATURES OF THE MODERN DISTRIBUTION OF PORGIES (ACTINOPTERYGII: SPARIDAE) IN THE BLACK AND AZOV SEAS

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The objective of the study are to determine the modern state of the species composition, feature of the spread, and registration of the new records of porgies in the Black and Azov Seas and especially near the coast of the Crimea.

The studies were carried out near the coast of the Crimean Peninsula from 1999 up to 2017. Fish were caught by different fishing gear such as gill nets, bottom traps, commercial fixed nets and by underwater hunters. Underwater visual observations and video registration were used to study the patterns of *in situ* behavior and distribution of fish. For the necessary information about porgies from others regions of the Black and Azov Seas the literature sources were analyzed.

The Black Sea is the border of the spread of most thermophilic species of family Sparidae. By the present time in the Black Sea reported 12 species of fish belonging 8 genera of the family Sparidae and only 3 species from 2 genera were registries in the Sea of Azov.

Until the end of XX century *Diplodus annularis* and *Diplodus puntazzo* were the most common in the Black Sea, but *D. puntazzo* prefer to inhabit only the rocky habitats. Other species have been known by the few finds of single specimens, mainly near the coast of Turkey, Bulgaria and Romania. However, in the last two decades a steady increase has seen in the number of registrations of various species of porgies in the coastal zones of the Black Sea's countries. It could indicate climate change, namely an increase in water temperature. According to the latest data, all of 12 species porgies registered in Bulgaria and Turkey, 9 species in Russia, 8 species in Romania, 7 species in Georgia and 5 species in Ukraine.

Near the coast of the Crimean peninsula 9 species of porgies were recorded, of which 4 species first discovered in the past two decades (Boltachev & Karpova, 2014): *Sparus aurata* and *Sarpa salpa* in 1999, *Lithognathus mormyrus* in 2013, *Dentex dentex* in 2014. During these years, *S. aurata* and *S. salpa* at the Black Sea coast of Crimea moved from the category of “very rare species” or “rare species” to the category of “common species” and became the objects of amateur fishery and even the coastal commercial fishery. Over the past three years, increasing the number of registrations of *L. mormyrus* was observed in the coastal zone of the Russia (Crimea, North Caucasus) Georgia and Turkey (Guchmanidze & Boltachev, 2017).

The spread of porgies in the Black Sea and the increasing the number of these thermophilic fish are interesting for us from the perspective of the study of changes in the Black Sea fish fauna as a result of the natural process of “mediterraneanization”. On the other hand, the increasing the number of some species, such as *S. aurata*, may be related to their artificial breeding in cages. In case of damage of cages of fish penetrate to the Black Sea and spread along shores.

In the Sea of Azov only one species *D. annularis* meets in small numbers in summer in the southern part of the sea usually near the coastal zones of Crimea and can be classified as “rare”. Two species *D. puntazzo* and *S. aurata* are known from single finds and belong to the category of “random species”. The low species diversity of Sparidae is obviously connected with the specific of habitat in the Sea of Azov.

INVASIVE PLANT PATHOGENIC MICROMYCETES IN THE CIS-AZOV REGION: HISTORY, DIVERSITY, FEATURES

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The invasions of alien fungal species are an important scientific and economic problem. Nevertheless, movements and pathways of alien fungi invasions remain poorly understood and investigated until nowadays. In this case, it should be noted the extreme inequalities in the studying of various groups of fungi: scientists give great attention to plant pathogens, while saprobic and mycorrhizal fungi usually remain unstudied. In this respect, the study of the distribution and invasion of plant pathogenic fungi, usually obligatorily associated with a certain range of host plants, is a much simpler task, especially by contrast to cryptic saprotrophic fungi on plant debris, aquatic or soil fungi and fungal-like organisms. We have attempted to make this analysis for the obligate phytopathogenic fungi for the Cis-Azov sea region (also known Northern Priazovye), by which we mean the Donetsk region of Ukraine (Donetsk Priazovye) and the southwestern part of the Rostov region of Russia (Don Priazovye).

According to preliminary estimates, the number and percentage of alien species among the obligate plant pathogenic fungi in the Cis-Azov region are relatively high (total 101 species, 29% of all obligate plant pathogen fungal species), including: powdery mildews (*Erysiphales*) – 29 species (28% of all species of the order), rusts (*Pucciniales*) – 22 species (12%), smuts (*Doassansiales*, *Entylomatales*, *Georgiifischeriales*, *Microbotryales*, *Tilletiales*, *Urocystidales*, *Ustilaginales*) – 25 species (31%), downy mildews (*Peronosporales*) – 24 species (18%), *Taphrinales* – 2 species (14%), and *Microstromatales* – 1 species (50%).

The available data indicate that the invasions of alien fungi into the territory of the Cis-Azov region have general features typical for Europe, and most of the phytopathogenic fungi found in the region also were found in many countries of Central and Eastern Europe, from where they spread to the Ukraine and Russia as well as in Cis-Azov region. The analysis of the origin of alien fungi shows that the largest number of fungi come in the Cis-Azov region from North America and East Asia and that their movement in the region were often associated with a spreading of alien plants species as well as with a deep transformation of the primary landscapes (mainly grassland such as steppes, bottomland meadows, salt-marshes, and locate ravine forests) into anthropogenic ones (agrocenoses, grazing lands, artificial forests, urban landscapes, rock dumps, quarries, paddy-fields, artificial water bodies), which have been started in the XIX century and have been continued during the XX century. Therefore, we can distinguish three peaks in the rate of alien fungal species incoming: 1) the first – in 1880–1900s – associated with the rapid development and colonization of the region (the spread of phytopathogens of cultivated plants, for example, *Phytophthora infestans*, *Plasmopara viticola*, *Podosphaera mors-uvae* and some more), 2) the second – in 1950–1960s – associated with the quick expansion of arable lands and steppe afforestation (invaded species of this period were *Blumeriella jaapii*, *Ophiostoma ulmi*, *Cronartium ribicola*, and many more), 3) third – in 1990–2000s – is associated with a fast transition to a market economy and an increase in trade with the many far countries, including the wide-scale importation of new cultivated plant species from Europe, East Asia and North America and associated plant pathogenic fungi (*Dothistroma pini*, *Erysiphe flexuosa*, *Diaporthe helianthi*, and many more).

Basic information shows that the alien plant pathogenic fungi invading rate is still high now. Among the destructive alien species that appear on the territory in the very near future are some pernicious pathogens of arboreal plants, such as *Hymenoscyphus fraxineus* (already known in the neighboring regions of Russia and Ukraine), *Eutypella parasitica*, *Ceratocystis fagacearum*, and many invasive *Phytophthora* species, for example, *P. alni* and *P. ramorum*.

INVASIVE SPECIES IN THE SPECIAL PROTECTED AREAS FLORA OF THE UPPER VOLGA REGION

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Invasions of alien species, which adopted a global scope, pose a serious threat to biological diversity, and exacerbate the ecological problems of the regions. Protected areas provide the core of efforts to safeguard the world's threatened species and represent the fundamental building blocks of most national and international conservation strategies (Dudley, 2008).

The Upper Volga region is one of the industrially developed districts of European Russia. The territory includes Ivanovo, Kostroma, Yaroslavl, Vladimir and Tver' administrative oblast (the area is 203.5 thousand sq. km). The current region flora is rich in alien species, by 2017 there are 820 alien species, 159 of them belong to invasive and potential invasive groups. The Upper Volga system of protected natural areas consists of various types: State nature reserves, national parks, federal-level and local-level sanctuaries (zakaznik), nature monuments. This system has the conservation of regional biological diversity, including genetic heritage. Therefore, alien species introduction and the distribution in protected natural areas are so undesirable.

Studies of the plant invasions in region protected areas are recorded more 70 alien plants. For example, in national Park «Meschera» flora noted 52 species alien species, of which 29 belong to invasive, 12 – potentially invasive, 5 species – transformers; in the nature monuments «Rubskoe Lake» flora noted 46 alien species, in Federal Klazminckiy zakaznik – 27 species, in nature monuments «Ponochor Lake» – 20 species, «Forest near the village Yudinka» – 13 species, «Lake Zabor'ye» – 12 species, «Lake and Swamp Raybo» – 7 species, «Lake and Swamp Tzenskoe» – only 5 species.

The habitats of concentration of alien species are roadside, open places, meadows, vacant lots in settlements. The alien species presence in protected areas reduces this representativeness.

The majority of alien species are North American trees (*Amelanchier spicata*, *Acer negundo*, *Elodea canadensis*, *Fraxinus pennsylvanica*, *Lupinus polyphyllus*, *Physocarpus opulifolius*, *Solidago canadensis*, etc.). Some fruit plants (*Grossularia reclinata*, *Malus domestica*, *Pyrus communis*) were usually found in the forests, forest margins and fields. *Bidens frondosa*, *Echinocystis lobata*, *Hyppophae rhamnoides*, *Impatiens glandulifera*, *Juncus tenuis* are widespread in the riparian habitats. *Palacroloma septentrionalis*, *Conyza canadensis*, *Juncus tenuis*, *Medicago sativa*, *Oenothera rubricaulis* form the large groups along the roads and roadside meadows. Banks slopes of river (Volga, Tesa, Nerl, Uvod, etc.) are covered with big dense groups of herbs (*Arrenatherum elatios*, *Festuca arundinacea*, *Trisetum flavescens*, etc.).

The last decades *Heracleum sosnowskyi* distribution and invaded in to natural communities is of particular concern. Invasions of some species (*Crataegus monogyna*, *Galega orientalis*, *Linaria canadensis*, *Reynoutria japonica*, *Symphytum uplandicum*, *Zizania latifolia*, etc.) are locally and yet but rarely.

The lists and databases of invasive species should be done for each region protected areas. Control and management alien species in protected areas should be continued.

THE INVASIVE NARROW-CLAWED CRAYFISH (*ASTACUS LEPTODACTYLUS*) IN THE WATER BODIES OF THE SOLOVETSKY ARCHIPELAGO

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The narrow-clawed crayfish (*Astacus leptodactylus*) is one of freshwater invertebrate's species, which are characterized by active spreading outside their native area, namely the Ponto-Caspian basin (Holdich et al., 2009; Kouba et al., 2013). This species successfully colonizes new waterbodies in Europa, displacing other crayfish species, the noble crayfish (*A. astacus*). In spite of widespread, at present there is very little data published on the morphology, ecology, molecular phylogeny, and phylogeography of *A. leptodactylus* (Holdich et al., 2006; Śmietana et al., 2006). The northern boundary of its distribution area is also uncertain (Kouba et al., 2013).

Earlier local sources reported that crayfish, absent in the White Sea region in the past, appeared there several decades ago, however, their specific belonging was not identified. In May 2015, we have collected one individual of crayfish in Lake Bolshoye Krasnoye of the Solovetsky Islands of the White Sea. Genetic analysis based on the sequencing of the about 700-bp mitochondrial DNA fragment containing a part of the cytochrome *c* oxidase subunit I gene showed that it belonged to *A. leptodactylus* (Borovikova et al., 2016). In June 2016 another three specimens of the narrow-clawed crayfish were have captured in the Svyatoye Lake of the Archipelago. These findings are the northernmost for this species.

According to results of molecular genetic analyses, the donor region for *A. leptodactylus* of the Solovetsky Islands is the Caspian Sea basin. The narrow-clawed crayfish has been expanding in the northern and the north-western direction for a long time. Most likely rout of it spreading passed via the Volga basin and the Severnaya Dvina River basin, from the mainstream of the latter to its mouth near Arkhangelsk (Georgi, 1775; Baer, 1837; Birshtejn, Vinogradov, 1934). Probably on the Solovetsky Archipelago the crayfish was introduced by the Solovetsky monastery in the XIX–beginning of the XX century, since at that time this monastery was engaged in the introduction of new species into the Solovetsky lakes. It is known, in Russia and other countries at that time the acclimatization of crayfish was actively kept (Grimm, 1883; Kuchin, 1905).

Thus, the present area of the *A. leptodactylus* extends from Turkey to the Polar circle. Such an extraordinary successful spreading to the northward direction of the Ponto-Caspian fauna representative is not typical and worth an attention. In many respects, the obtained phenomena can be explained by biological traits of this species and its commercial importance. Indeed, the large size of the *A. leptodactylus* and more tolerant of altered water condition make it a highly invasive species and a potential threat to the *A. astacus* (Stucki, 1999; Holdich et al., 2006).

Further molecular genetic studies are required for the better characteristics of the native and non-native *A. leptodactylus* populations and more precise definition of vectors and routs of its invasion.

This study was supported by the Russian Foundation for Basic Research (17-05-00782A), Solovki State Historical, Architectural and Natural Museum-Reserve, and the program “Biodiversity of Natural Systems” (subprogram “Gene Pools of Living Nature and Their Conservation”).

GENETIC POLYMORPHISM OF WHITEFISH *COREGONUS LAVARETUS* IN LAKE SEVAN: 90 YEARS AFTER THE INTRODUCTION

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Population of whitefish (*Coregonus lavaretus*) of Lake Sevan originated in 20th years of the last century after numerous introductions of fecundate eggs of whitefishes from Lake Peipus (*C. l. maraenoides*) and Lake Ladoga (*C. l. ludoga*). At the later time, the morphological and karyological analyses established hybrid origin of this population (Mailyan, 1954; Shaposhnikova, 1971; Bahum, 1989). According to morphological characteristics to the beginning of the XXI century in Lake Sevan comparatively homogenous population has been formed (Pipoyan et al., 2012). The purpose of the present study was to investigate the genetic polymorphism of whitefish from Lake Sevan and to compare with polymorphism of the donor populations.

Materials were collected in the northern part of the lake (so-called Small Sevan) in environs of villages Tsovagyuh and Tsovazard, Armenia in April 2016. As the markers of genetic polymorphism two fragments of mitochondrial DNA (mtDNA) were used. Primarily we performed PCR-RFLP analysis of the fragment including the gene of the subunit 1 of the NADH-dehydrogenase complex (ND1-fragment) for 27 specimens. Five composite haplotypes were revealed; three of them were early described for the donor populations, and two haplotypes were unique for whitefish of Lake Sevan. Interestingly, the samples from Tsovagyuh and Tsovazard were characterized by the different unique haplotypes. However, further studies are needed for accurate definition of this data because the samples size from these localities were different (nineteen and eight specimens consequently).

The sequences of the ND1-fragment and fragment including a part of the gene encoding cytochrome *c* oxidase subunit I (COI) were determined for six *C. lavaretus* from Lake Sevan. For comparison, several specimens from the lakes Peipus and Ladoga and an individual from Siberia (the Laptev Sea, the Buor-Khaya Gulf) were also included in sequencing. The analysis of polymorphism of the ND1-fragment (1929 bp long) has revealed four variants of sequences for whitefish of Lake Sevan, one of them was shared with the whitefish from Lake Ladoga. At the same time, no there were any common haplotypes with the whitefish from Lake Peipus. It is important that the most part of sequence variants of the specimens of Lake Sevan were characterized by two nucleotide substitutions that were not described for individuals from source populations. Although each of these substitutions are synonymous, and do not lead to changes of amino acid sequences in the protein molecule, it is very interesting fact, because it can be reflection of the microevolutional processes into the studied population including produced by anthropogenic press.

Differentiation of the ND1-sequence variants of whitefish of Lake Sevan varied from one to six nucleotide substitutions (values of *p*-distance range from 0.1 to 0.3%, on the average 0.1%). Thus the maximal level of differentiation of whitefish from Lake Sevan are comparable with minimal level of differences of *C. lavaretus* from Siberia and European part of Russia (seven nucleotide substitutions, *p*-distance = 0.4%).

Polymorphism of the COI fragment was not revealed: all specimens from Lake Sevan as well as from donor populations are the carries of the common variant of the sequences.

Thus, on this stage of investigation we can conclude that the whitefish population from Lake Sevan is characterized by intricate pattern of genetic polymorphism. This phenomenon can be resulting of its hybrid origin or/and of strong anthropogenic stress on the Lake Sevan ichthyofauna.

This study was supported by the Russian Science Foundation (16-14-10001).

INVASIVE POPULATIONS OF *NEOGOBIOUS MELANOSTOMUS* (GOBIIDAE, TELEOSTEI) OF THE SOUTH-EASTERN AND EASTERN BALTIC: THE FEATURES OF MORPHOLOGY AND GENETICS IN NEW ENVIRONMENTAL CONDITIONS

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The round goby *Neogobius melanostomus*, one of the most successful Ponto-Caspian invader, was firstly recorded in the Baltic Sea (Gulf of Gdansk) in 1990 (Skóra, Stolarski, 1993) and now is spread through the whole basin (Kotta et al., 2016). The aim of the study was to perform morpho-genetic analysis of the fish in two distinct and spatially separated local populations – in the Southern and Eastern Baltic Sea.

Eight meristic and 44 morphometric (plastic) characters were measured for 107 *N. melanostomus* individuals. The mean values of all meristic characters were typical for the species. However, 5.6% of fish were characterized by lower (less than 30) values of vertebrae number (urostil included). Also, mean number of branched rays in pelvic fin was often below the mean, characteristic for the fish in the native area. We suggest below-average values of the meristic characters may be due to the founder effect. Hypothesis on some morphological features as adaptive phenotypic traits is also possible.

Nucleotide sequence polymorphism of two segments of mitochondrial DNA (mtDNA) was also analyzed. A part of gene encoding the cytochrome *c* oxidase subunit I (COI fragment, 562 bp long) was characterized by low level of polymorphism. Thus, for 23 individuals we obtained only two variants of sequence differing one from another by two nucleotide substitutions (*p*-distance = 0.4%). One of them was widely distributed in European and North American native and non-native populations, and the second was unique for sample from Estonia.

The second mitochondrial segment under consideration was cytochrome *b* gene fragment (cyt *b*, about 960 bp long), comprised of 17 individuals. We revealed moderate level of genetic polymorphism for this fragment of mtDNA: the sequences obtained were combined into the three haplotypes, maximal values of *p*-distance between them was equal to 0.2%, and nucleotide diversity (π) in different samples ranged from 0.0006 to 0.0020.

Low level of mtDNA markers polymorphism from the Baltic Sea in comparison with North American invaders can be explained by different ways. In particular, the number of inoculation events and features of polymorphism of a donor population (-s) as well as bottleneck and founder effect and effect of some ecological factors can contribute to observed level of polymorphism.

The analysis including COI and cyt *b* sequences data from GenBank for other non-native and native round goby demonstrated the *N. melanostomus* of the Baltic Sea are closely related to native populations of north- and/or south-western parts of the Black Sea basin. Comprehensive review of published records let to conclude: ship route around Europe from the Black Sea, through the Sea of Marmara, the Mediterranean, the Atlantic and the North Sea into the Baltic is the most probable for round goby invasion.

The study was funded partially by general budget of the Shirshov Institute of Oceanology RAS, Atlantic Branch (scientific theme № 0149-2016-0005) and by the Russian Foundation for Basic Research (17-05-00782A).

VARIABILITY OF THE GROWTH OF ALIEN FISH (*ALBURNUS ALBURNUS*) IN THE ARTIFICIAL RESERVOIR

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Invasive species penetrating new waters are often found in conditions when their numbers are not controlled by aboriginal community. In this situation we can expect an increasing of the diversity of realized phenotypes, some of them in other conditions could be eliminated.

The growth is one of the most important phenotypic features is the result of a complex interaction of the genotype with the environment (Dgebuadze, 2001). So the analysis of alien species growth is a unique opportunity to study the adaptation process of organisms to the new environment.

In our report we have analyzed the results of the study of linear growth of the bleak *Alburnus alburnus*, which was recently identified in the heated reservoir of Pechora electric power station (Pechora River basin). Age was estimated on the scale samples which were removed from the fish in the area between the dorsal fin and the lateral line. Lengths of fish at previous ages were back-calculated using the linear equation formula.

Bleak in the heated reservoir of Pechora electric power station (PEPS) in comparing with fish of the same age from the Vychegda River and Visinga River (Vychegda river basin) grows about 15–35% faster. Such accelerated growth, apparently, is due to a sufficiently high water temperature and, consequently, longer fish growth period in this man-made pond. In addition, the variability of body length of single-aged fishes increases here. Thus, in the heated reservoir of PEPS the dispersion of body length of the bleak (age 3+) was 3.8–6.0 times higher than fish from the native range (the Vychegda River basin) had. The native populations displayed only slight differences of the body length dispersion.

Back calculations show that the body length at the first annulus of bleak in heated reservoir of PEPS exceeds the size of fish from Vychegda river basin by 30–36%. By the end of the third year of life, this difference is reduced to 15–24%. The variation of the calculated fish body lengths from the reservoir-cooler significantly increases, whereas in samples from the natural range this index varies without a clear regularity.

It is possible that enhanced temperature and hydro-chemical background of the heated lake as well as the almost complete absence of predators resulted in increase of the growth variability range of fish.

Indeed in another cyprinid species – verkhovka (*Leucaspis delineatus*) caught in the studied water body an acceleration of growth is observed but the variability of the body length remains practically unchanged. Thus only environmental conditions are unlikely to affect the range of growth variability.

It is obvious that growth of individuals in a population of invasive species is the interaction of the quite limited set of genotypes of individuals starting population and new environmental conditions. Hence, increase of variability of the linear growth perhaps is caused by the reduced gene pool of the limited number of individuals starting population.

CROSS-SPECIES AMPLIFICATION OF MICROSATELLITES LOCI FOR *PONTOGAMMARUS ROBUSTOIDES* G. O. SARS, 1894

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Ponto-Caspian gammarids and mysids were considered valuable fish food during the Soviet times in Latvian inland waters. *Pontogammarus robustoides* made the largest part of fish food. It is known from literature that introduction in Latvian reservoirs was realised with *Pontogammarus robustoides*, *Chaetogammarus warpachowskyi* G.O. Sars, 1987, *Paramysis lacustris* (Czerniavsky, 1882), and *Limnomysis benedeni* Czerniavsky, 1882 (Bodniece 1976), which were obtained from the Kaunas Reservoir (Nemunas) (Mordukhai-Boltovskoi 1979). Abundance of *Pontogammarus robustoides* in the Latvian reservoirs was increasing (Bodniece 1976). Therefore, studying population genetics of invasive and indigenous species might be important for identifying the impact of the invasive species on the native species community.

Microsatellites are successfully used for genetic studies for the monitoring of different Gammarus species. But microsatellites markers for the study of *Pontogammarus robustoides* population are not enough developed. Since the development of specific microsatellites primers requires time and material investments, therefore it may be used for research the primers designed to related species. We tested the developed markers for five related Gammarus species (*Gammarus pulex*, *G. fossarum*, *G. roeselii*, *G. orinos*, *Dikerogammarus villosus*), which showed the applicability of these markers for these species (Danancher et al., 2009; Gergs et al., 2010; Rewicz et al., 2014). The amplification of six microsatellites loci *Dv6*, *Dv11*, *Gam1*, *Gam2*, *Gapu-9* and *Gapu-17*, which gave repeatable and informative responds in testing, were selected for analysis. The size of the scored polymorphic DNA fragments ranged from 125 bp to 462 bp. The number of alleles at each locus and the number of alleles on each microsatellite locus in investigated *Pontogammarus robustoides* population from some Latvian reservoirs are differs.

Therefore these primers for microsatellite loci of nuclear DNA can be used for population genetic study of *Pontogammarus robustoides*.

This study has been supported by the National Research Programme 2014-2017 „EVIDEnT” sub-project “Non-indigenous species distribution and impact on freshwater ecosystems”.

INVASIVE SPECIES SOUTHEAST REGION

A. Brown

United States Fish and Wildlife Service

Invasive species are part of the landscape and are expanding in the Southeast Region. Every Southeastern state has at least one exotic species, either terrestrial or aquatic and most have a multitude of invasive species. Asian Carp, swamp eels, lion fish, northern snakeheads, zebra mussels, hydrilla, Eurasian milfoil, and water hyacinth are just a few of the invasive species that are abundant in the Southeast. In fact, over 150 exotic species occur in the SE. These invasive species severely threaten our nation's natural resources as well as having huge economic impacts. These species contribute to native species extinction, impact ecosystem function and integrity, and ultimately prevent the FWS from achieving our mission: Trust Species Conservation. Working with local, state, Tribal, NGO's and other Federal partners, the U.S. Fish and Wildlife Service is working toward developing innovative detection methods, improving early detection and rapid response protocols, reversing impacts of existing populations, limit intra-state and interstate movement, identify pathways of introduction and wherever possible, eradication.

INVASION OF FUNGI AND FUNGI-LIKE ORGANISMS IN THE STEPPE ZONE OF THE SOUTH OF EUROPEAN RUSSIA

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In the conditions of the steppe zone of the south of European Russia, many alien organisms have actively spread during the last two centuries – purposefully introduced by humans or casually introduced and independently settled in the new areas. Currently, we can read many scientific publications about the invasions of various alien plants and animals, but the invasion of microorganisms, as well as small and unnoticeable cryptic species, often remain mainly unstudied and are often stay undetected even by professional biologists. Fungi are typical examples of alien organism, for which invisible and unnoticeable expansion is typical style of spreading into new territories. Information on alien fungi and the distribution of fungi in the region at general is usually limited mainly to data on plant and animal pathogens because of the relative simplicity of their detection and the economic importance of many fungal pathogens. However, they are often extremely scanty, fragmented and even contradictory, especially in comparison with available data on the areas of plants and animals, including alien ones for any particular area. This is mainly due to the “substrate” feature of the fungal areas – i.e. their “fidelity” to any often specific substrates with certain properties (soil, water, detritus, plants, animals, other fungi); this fact significantly complicates the use of the very term “area” (as territory of distribution of a species) for true fungi and fungal-like organisms and concept of alien species for this group of organism.

The lack of information on fungi often does not allow reliably distinguishing between alien and native fungal species. Another problem in the study of alien fungi is the practical absence of any classification system for alien fungal species by the time and the ways of invasion into any particular territory, by the degree of naturalization and the invasiveness.

Proceeding from the foregoing, we consider it possible to introduce a special term for the alien fungal species (and other fungal-like organism) in any particular area/territory – **xenomycetes**, and to distinguish two large groups of xenomycetes: **pseudoxenomycetes** and **euxenomycetes**. **Pseudoxenomycetes** (false alien fungi) are species or intraspecific fungal taxons, which can grow only on alien plants (usually cultivated by humans without self-reproduction in this territory) or any human-made substrates without natural analogies in the area. This term and the concept are similar to the term “ephemeromycetes” used by some German-speaking mycologists. **Euxenomycetes** (true alien fungi) are fungi, which can grow on indigenous plant species (for particular area/territory), i.e. invaded into the natural ecosystems and able to independent self-reproduction (human activity is not required for their self-reproduction). In general features, the proposed concept of **euxenomycetes** corresponds to the concept of “invasive species”, which modern European biologists usually use – i.e. true invasive species must be invaded into local communities and be harmful for them. Because of the some relativity of the delimitation between **pseudo-** and **euxenomycetes**, we proposes to create also a group of **paraxenomycetes** – obligatorily associated with foreign invasive plant (agriophytes), but not capable to grow native plants or natural substrates.

In addition, we propose to establish and distinguish the groups of fungi by the degree of naturalization: **ephemeromycetes**, **colonomycetes**, **epecomycetes** and **agriomycetes** by analogy with alien plant groups, and the groups by the time of invasion/introduction: **archeomycetes** (alien fungi that appeared before the great geographical discoveries) and **neomycetes** (which came mainly during the last three centuries). The last two terms are also used by German-speaking European mycologists.

THE ADAPTIVE EVOLUTION OF INVASIVE SPECIES III: DE NOVO POPULATION GENOMICS OF THE FISH TAPEWORM *NIPPOTAENIA MOGURNDAE*

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The tapeworm *Nippotaenia mogurndae* (Cestoda: Nippotaeniidae) is co-invasive throughout Russia/Eastern Europe with its specific host, the Amur sleeper (Actinopterygii: Odontobutidae; *Perccottus glenii*). The persistence of *N. mogurndae* requires the acquisition of (potentially) novel intermediate hosts within the invasive range so as to facilitate its transmission to the final host (*P. glenii*). A potential shift in intermediate host underscores the selective pressures placed on the invasive tapeworm in that metabolic pathways of the adult stage are often specialized for their specific hosts. Thus, questions regarding the invasion ecology of *N. mogurndae* focus on the potential for a niche shift with regards to its intermediate host, as well as the genetic underpinnings of specificity in the final host. Both can be appropriately addressed by quantifying the genetic architecture of the tapeworm. To initiate this process, we employed a hybrid approach using Illumina[®] (=short-read) and PacBio[®] (=long-read) technologies that were used in the *de novo* assembly of the nippotaeniid genome. We then compared our assembly to 12 other cestode genomes, so as to determine the extent of divergence found in the genomic architecture of *N. mogurndae*. We then investigated the genomic implications of parasite-host evolution by utilizing whole genome re-sequencing to quantify differences between populations of our study species in its native versus invasive ranges. *Nippotaenia mogurndae* is a close relative of the Cyclophyllidea, a clade that impacts the health of humans and domestic animals. Thus, our assembled genome provides a necessary historic baseline from which the anthropogenic pathogenicity of Cyclophyllidean tapeworms can be compared and contrasted.

FOOD COMPETITION OF THE MOST NUMEROUS ALIEN FISH SPECIES IN THE CHEBOKSARY RESERVOIR

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About 20 invader fish species are registered in the Cheboksary reservoir, currently. Some of them have formed stable settlements in the reservoir and have share the same habitats with each other. So, populations of round goby (*Neogobius melanostomus*) and goby-head (*Neogobius iljini*) are the most common fish species. They live together on certain parts of the reservoir. The both species feed on benthic organism.

Mass pelagic species of fish in the Cheboksary reservoir are tulka (*Clupeonella cultriventris*) and vendace (*Coregonus albula*). This fish species are pelagic and eat mainly of the plankton.

Feeding of these species in the Cheboksary reservoir has not been studied enough. The feeding of competitive relations between these fish has not been studied.

Research was conducted in the Cheboksary reservoir in the summer of 2013–2015. Standard methods were used for nutrition studies. We use the Shorygin's food similarity index for food competition between species. In all about 300 fish all species was considered.

Studies of fish feed have shown that different species of goby caught on the same site prefer different food objects. The round goby feeds mainly on the larvae of Chironomids, while the goby-head prefers amphipod crustaceans. For these fish the feed spectrum overlaps insignificantly. The index of food competition for these species was 11.7%.

Studies of the tulka and the vendace nutrition have shown that the both species prefer to consume Copepods and Cladocera. The species composition in the food spectrum of these fish differs. The tulka mainly feeds of *Bosmina longispina* from the Cladocera and the Calaniformes of the Copepods. In the food spectrum of the vendace, there are *B. longispina* crustaceans, also, but *B. longirostris* occurs in greater numbers. The vendace feeds on Cyclopyformes from Copepods mainly. In addition, in the vendace food specters are not infrequently found benthic and meiobenthos organisms (insect larvae, amphipods, etc.).

The index from food competition for these species was 13.3%.

Between the main invasive fish species living on the same water area, have fixed a low level of the food contention. Their populations harmoniously coexist with each other. The further work is to study feed of the fish competitive relations are required.

IT'S A LONG WAY TO GO: DYNAMICS OF LOCAL POPULATION OF POLYGRAPHUS PROXIMUS BRANDFORD, AN INVASIVE BARK BEETLE

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Cross-dating procedure of Siberian fir dieback in the outbreak area of the four eyed fir bark beetle *Polygraphus proximus* Blandford (Coleoptera: Curculionidae: Scolytinae) at the Southern region of the Krasnoyarsk Kray (Central Siberia, Russia) proved an existence of this Far Eastern invader in the Kray in the early 1970ies. Dendrochronologically determined dates of appr. 200 firs' death provided annual rates of tree mortality at small 0.25 ha sample plot in the dead stand of Siberian fir *Abies sibirica* Ledeb. The forest is in 2 km from the Trans-Siberian railroad – the most possible source of invasive pest.

First signs of *Polygraphus*' infestation were found on trees, which have died in 1976–1988; these trees were obviously weakened and had the lowest radial increment in the habitat.

In 2002 the local population of *Polygraphus* was high enough to start intensive fir infestation. The beetles quickly colonized all remaining weakened trees. Resistance of these firs was overcome at the year of colonization: there was a lack of any signs of even short period of increment loss in that period.

Finally in 2005–2006 an outbreak foci reached the stage of a "fixed outbreak", when bark-beetle population was able to support its high density during few years by massive attack of healthy firs, weakening them till ready to infest condition. These attacks of each individual tree lasted not longer than 2–3 years and were accompanied by the significant loss of increment before the year of dieback.

At the core area of outbreak all firs were eliminated in 2010–2011.

Nowadays fir stands are damaged to different extent by *P. proximus* on the huge territory of 700 by 700 kilometers in the Southern Siberia. The pest was found also in European part of Russia. At the landscape exposition of Siberian fir at the Main Botanical Garden (Moscow) the beetle with associated ophiostomal fungus *Grosmannia aoshimae* (Ohtaka et Masuya) Masiya et Yamaoka eliminated nearly two thirds of trees and after that attacked collection of firs located near by. Beetles exclusively attacked trees of fir species from the sections Balsamea and Grandis.

By chance, during its way to the West invasive tandem had missed Trans-Baikal territory with incredible territories on the mountains Khamar-Daban covered by forest with *Pinus sibirica* and *A. sibirica*, weakened by anthropogenic stress and bacterial disease. For a moment these forests, located just near Trans-Siberian rail road are at the highest risk of infestation by *P. proximus*.

The work was supported by the Russian Foundation for Basic Research (grant 17-04-01765a).

INVESTIGATION OF INVASIONS OF ALIEN SPECIES, WHICH ARE THE GREATEST DANGER FOR ECOSYSTEMS IN THE EUROPEAN PART OF RUSSIA: PATHWAYS, VECTORS, BIOLOGICAL FEATURES AND METHODS OF CONTROL

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Globalization and intensification of the invasive process on the Earth require the development of rational approaches for solving the problem of environmental safety. This implies risk assessment, prevention and control of invasion of alien species. Taking into account the large scale of the invasive process for solving these tasks, it seems productive to concentrate attention primarily on more dangerous invaders, the so-called target species.

As a result of more than five years studies updated version of the database of invasive species (priority targets) of the European part of Russia was created and submitted for publication on the international global GRIIS portal (www.griis.org), which is developed and supported by the international group of experts on biological invasions (Invasive Species Specialist Group). For each of the target species, all available information on their distribution, life history, main invasive corridors and vectors, impact on native species, ecosystems, human health and economy, as well methods of population control are summarized. Analysis of the current state of Russian fresh waters, the diversity and distribution of fish has been shown that the proportion of alien species in the ichthyofauna of basins most major rivers in Russia reaches 20–30%. Comparative studies of the populations of Black and Caspian Sea sprat *Clupeonella cultriventris*, from reservoirs of the upper reaches of the Volga (invasive range), and in limits of the native range (Caspian, Azov, and Black seas) have been shown that degree of size variability and the asymmetry of sprat length frequency distribution are increasing when large population sizes, deficit of food, and slow growth. It is revealed that the invasion of sea walnut comb jelly *Mnemiopsis leydi* into the Azov and Caspian Seas has so severely damaged the feeding base of the sprat that it not only reduced its numbers and fertility, but also slowed its growth. Data on the distribution, ecology of ruff (*Gymnocephalus cernuus*) another fish target species are generalized. The basic biological characteristics of the ruff, which enabled it to have a wide range and continue to penetrate to many waters are a wide variety of diet and of life history strategies adaptations. New data have been obtained, indicating a catastrophic decrease number of the ancient invader – the black rat (*Rattus rattus*) and the fragmentation of its range in the European part of Russia. A decrease in the genetic diversity of pathogens is shown when they are spread by synanthropic rats of the genus *Rattus* from the native part of their range to the extensive invasive part, and more than 3 time increase in the range of infections associated with rats as a result of their invasions. For the first time, a comparative analysis of the functioning and distribution in the natural populations of three types of meiotic drive (mendelian transmission ratio distortion in females – female meiotic drive, in males - male meiotic drive and haploid spores-haploid spores) (*Mimulus guttatus*, *Mus musculus*, *Podospora anserina*), and factors and mechanisms that limit their invasion was provided. For the first time, a comparative analysis of data on the allelic and genotypic diversity of populations from the invasive and native ranges was made using the example of the Ukrainian and Armenian populations of *Darevskia armeniaca*. The molecular mechanisms of the appearance of new genotypes in the invasive part of the range are shown.

The work was supported by Russian Foundation for Basic Research (grants № 15-29-02550).

THE ADAPTIVE EVOLUTION OF INVASIVE SPECIES I: A GENETIC PARADOX

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Conservation genetic theory predicts that demographic bottlenecks and genetic drift will severely impact small populations and increase their risk of extinction. The same genetic and demographic conditions are often manifested during biological invasions, yet invasive species not only persist but also expand. This creates a paradox for invasion science: How can species establish and thrive despite low genetic diversity and small population size? One explanation is that multiple (cryptic, undocumented) introductions actually occurred during the invasion, followed by extensive gene flow among these founding populations. This would effectively convert genetic variation among distinct populations within the native range into admixed variation within a single alien population. We evaluated this hypothesis for Amur sleeper (*Perccottus glenii*; Odontobutidae), initially introduced into Russia ~100 years ago, then followed by multiple potential re-introductions from the Far East, such that its range extends across western Eurasia and Eastern Europe. To do so, we first assayed mitochondrial (mt) DNA variation across three populations: two invasive (Western Russia: Moscow and Volga River) and a third representing two closely aligned native populations in the Far East (Khanka Lake/Sivakovka). We compared these data with an earlier mtDNA evaluation of 19 Chinese populations, so as to gain insights into the phylogeographic history of our study populations. To understand contemporary diversity, we also derived genome-wide single nucleotide polymorphisms (SNPs), using double digest restriction-site associated DNA sequencing (ddRAD-seq). An opportunity to evaluate demography and co-evolution of a second species was also possible, in that Amur sleeper is the unique final host for a tapeworm (*Nippotaenia mogurndae*). We first sequenced the entire genome of this tapeworm then assembled it using a variety of genomic algorithms. We then employed whole genome re-sequencing to identify the genomic differences between populations in western and eastern Russia. Here, we were interested in the manner by which the invasion process impacted levels of genomic variability in tapeworm and fish. We were also interested in reconstructing the successful trajectories of these co-invaders by evaluating native and invasive populations, as separated by ~9000 km. We outline this process herein and explain the various analyses as an introduction to subsequent presentations that interpret the results for each species.

THE ADAPTIVE EVOLUTION OF INVASIVE SPECIES II: AMUR SLEEPER (*PERCCOTTUS GLENII*) IN WESTERN RUSSIA

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The Amur sleeper (Actinopterygii: Odontobutidae; *Perccottus glenii*) was first introduced into Russia at St. Petersburg (1916), then Moscow Province (1948), followed by more than 13 additional Eurasian introductions. Secondary translocations may also have been important in promoting its current distribution. Most of these were documented anecdotally, in that Amur sleeper was most often transported accidentally within shipments of commercial fishes. This, in turn, may have provided additional genetic variability within the introduced range. This ambiguity in the invasion history of Amur sleeper can best be deciphered by employing high-resolution molecular genomic approaches. These, in turn, can help identify demographic, historic and selective processes that have shaped its distribution, as well as identifying potential gene flow that may have occurred if distinct clades were involved in sequential introductions. Our initial focus was on populations of Amur sleeper separated by ~9000 km: Two of these were within the invaded range of western Russia (Moscow Province and Volga River), whereas a third was from the native part of the range, as represented by two closely aligned Far Eastern populations (Khanka Lake and Sivakovka). We first employed mitochondrial (mt) DNA to evaluate the historic similarities of these study clades, and to gauge their relationships with previously published data on 19 populations from the Liaohe and Amur river basins of China. Both western and eastern populations clustered separately from those in China, suggesting the historical affinities of the study populations were further to the north and east in the native range. We then derived 10,000 genome-wide single nucleotide polymorphisms (SNPs) for our study populations using double digest restriction-site associated DNA sequencing (ddRAD-seq). These data indicated that populations from western Russia had levels of genetic variability significantly lower than those found in the Far East. Bottlenecks and subsequent genetic drift are thus apparent within the genetic architecture of these western populations. We then discuss the paradox of genetic variability and the manner by which it contributes to the invasion success of Amur sleeper.

INFLUENCE OF *ZIZANIA LATIFOLIA* (GRISEB) STAPF INVASIONS ON MICROCLIMATIC CHARACTERISTICS OF THE WETLAND ECOSYSTEMS OF THE DNIESTER DELTA

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So far, the adaptation mechanisms of phyto-invasive species in Aboriginal communities have been poorly studied. This had a significant impact on the development of issues of limiting their development. The authors covered the issues of microclimatic changes in environmental conditions in communities transformed by phytointvasions, examined their influence, and suggested measures for restoring the factor balance. To assess the influence of invasive species on the microclimatic characteristics of the wetland ecosystems, a comparative analysis of changes in the microclimatic characteristics of aborigines (for example *Phragmitetum communis* (Gams, 1927) Schmale, 1939) and invasive species (*Zizanietum* Akhtiamov, 1987) cenoses located in the coastal areas of the Dniester (National Natural Park Nizhnednestrovsky). Lotus-1 was used to measure microclimatic parameters.

The results showed that the spread of *Zizania latifolia* (Griseb) Stapf. in the wellhead area of the Dniester is also caused by changes in microclimatic characteristics. It is revealed that the vertical dynamics of air temperature depends on the type of cenosis, reflecting its structure and productivity. It was found that the cenoses of *Z. latifolia*, which are in unfavorable natural conditions, are characterized by large (at 2–5°C) values of air temperature in substages in comparison with optimal conditions of existence. In this way they differ from the indigenous groups, for which a relatively high dynamics of the vertical temperature gradient is revealed. It is established that the values of the vertical temperature gradient are higher in the cenoses formed by the invasive species and range from 3.5–4.0°C/2m (in favorable ecological conditions of existence) to 13.0°C/2m (in adverse ecological conditions of existence). It is shown that the average relative air humidity of the first substage of the *Zizanietum* cenoses is characterized by a more than 2-fold increase in values compared to a similar substage of indigenous communities. The revealed difference is caused by ecological conditions of existence of *Z. latifolia*. Populations of the species displaced indigenous communities from flooded areas. The second factor is the high density of the *Z. latifolia* leaf blade, which leads to a decrease in the convection processes between the substages and the main mechanism of moisture transmission becomes the diffusion process. Formed "cushion" of relatively cold and moist air, in invasive cenoses weakly interacts with warmer air of the second substage and leads to the formation of a layer of more dry air on it. The patterns of changes in microclimatic parameters are revealed. It is established that the main regulatory factors of microclimatic conditions are the density of phytomass and the area of the leaf blade. It is shown that the cenoses of *Z. latifolia* form such ecological conditions that lead to the disappearance of most species from their grass stand, including wide ecological amplitude.

ADVENTIVE SPECIES OF ARTHROPODS IN AGRO-ECOSYSTEMS OF KRASNODAR TERRITORY

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Increased anthropogenic impact on Earth's biosphere in XX century affected the properties of different ecosystems. Agro-ecosystems have worsened the phytosanitary state of crops due to frequent outbreaks of breeding of many species of arthropod pests. Their mass reproduction is provoked by all factors of the chemical-technological farming systems (Novozhilov, Pavljushin, 2010), which, together with anthropogenic processes, contribute to change of the geographic ranges of many species. This phenomenon is currently posing a threat of "biological contamination" of biocoenoses and agrobiocoenoses. According to the EPPO materials, for the period from 1995 to 2004 in 29 European countries 8889 adventive species have been registered, which migrated from other areas (Roques, Auger-Rozenberg, 2006). On the territory of Russia in its European part more than 150 allied species are already registered (Orlova, 2004).

It is known that the species-invaders, after the completion of the acclimatization period, enter the phase of the outbreak "productivity population explosion" that in conditions of agrobiocoenoses results in serious damage to crop production. A number of species which annually inflict damage to agricultural production is already known: the Colorado potato beetle (*Leptinotarsa decemlineata* Say), the American White Butterfly (*Hyphantria cunea* Drury), the potato moth (*Phthorimaea operculella* Zeller), the Oriental fruit moth (*Grapholitha molesta* Busck), the San Jose scale (*Diaspidiotus perniciosus* (Comstock)), greenhouse whitefly (*Trialeurodes vaporariorum* Westwood), black Apple aphid (*Eriosoma lanigerum* Jerry Hausman), phylloxera (*Viteus vitifolii* Fitch).

A number of new species were revealed in the recent years in agro-ecosystems that settled and formed extensive secondary ranges, namely: bug-plane lacemaker *Corythucha ciliate* (Say) (Hemiptera: Tingidae) (North America); Strawberry aphid small root *Aphis forbesi* Weed (Hemiptera: Aphididae) (North America); Rice yellow moth *Chilo suppressalis* Walker (Lepidoptera: Pyralidae) (South-East); the East species, Japanese grapevine leafhopper *Arboridia kakogawana* (Matsumura) (Hemiptera: Cicadellidae) (Japan, Korea, Primorsky Krai of Russia); the Indian wax scale *Ceroplastes ceriferus* f. (Hemiptera: Coccidae) (India); green tree bug (*Palomena prasina* L.) (Hemiptera: Pentatomidae) and a number of other species.

Soon emergence of new dangerous arthropods in southern Russia is expected. One of such dangerous quarantine pest is the Western corn beetle *Diabrotica virgifera virgifera* Le Conte, which was discovered on the territory of crossing Matveev Kurgan in Rostov Region by the staff of Rostov Reference Center of Federal Service for Veterinary and Phytosanitary Surveillance.

The danger of many invasive species revealed in agro-ecosystems is caused by their widespread environmental plasticity which allows them to be embedded in agrobiocoenoses of Russia and gradually move from the category of dominant pests to superdominant harmful ones of, such as the Colorado potato beetle, for example.

This work was supported by grant from RFBR and administration of Krasnodar Territory r_a 16-44-230780.

THE INVASIVE ROUTES OF *NEOGOBIOUS MELANOSTOMUS* (GOBIIDAE, TELEOSTEI): FROM THE PONTO-CASPIAN BASIN TO THE BALTIC SEA

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Invasive populations of round goby (*Neogobius melanostomus*) in Europe currently are in a focus of study. Further records, marking the distribution of invader and new data on traits of morphology and ecology of *N. melanostomus* in new donor areas are publishing regularly. However, many aspects of *N. melanostomus* invasive history in the Baltic Sea, concerning exact donor area, source populations, number of inoculations, introduction vector and most probable pathway remain unresolved till now. Analysis of these items is given basing at comprehensive literary review and own records and genetic data.

The source region of round goby invasive Baltic populations, without any contradiction, is closely related to populations from the Black Sea basin. However, exact location of donor population (populations) is stayed not defined till now (Dillon, Stepien, 2001; Szybkowska, 2003; Brown, Stepien, 2008; Björklund, Almqvist, 2010). Our data on two mitochondrial genes' polymorphism, namely cytochrome *c* oxidase subunit I (*coI*) and cytochrome *b* (*cyt b*) let to prove the origin of South-Eastern Baltic (historically the first Baltic location of this goby) and Eastern Baltic (considered as secondary dispersion of primary invasive population) *N. melanostomus* from population, inhabiting the northern and/or south-western parts of the Black Sea basin.

As the most probable vector of the *N. melanostomus* invasion in the Baltic Sea, ballast water transport is accepted (review: Kotta et al., 2016) and three routes are considered as theoretically possible (Sapota, 2004). The version of round goby introduction to the Baltic Sea through European canal waterways should be rejected basing at analysis of records chronology. The first records of this species in middle and upper sections of the Danube and Rhine rivers and basins were dated by the end of 1990th–early 2000th (Roche et al., 2013). The invasive population of round goby in the Baltic Sea had existed about 10–15 years to the moment. In case the species was transported by vessels through European rivers and canals, such time breakup should not be detected.

Later was supposed (Sapota, 2004) a pathway northward through the Volga basin is the most probable. The finding of the *N. melanostomus* in the Moskva River (Sokolov et al., 1989) was quoted as one of the arguments of its invasion into the Baltic Sea through the Volga-Baltic Waterway. It should be noted, however, the Moskva River is not one of the main streams of this water system. In the Upper Volga reservoirs and other parts of the main stream of the Volga-Baltic Waterway any prominent populations of round goby are not detected till now. And, even more important, analysis of the *coI* and *cyt b* genes' fragment polymorphism (our data) correspond well with Brown & Stepien data (2008), proving that the Caspian Sea basin is inhabited by other phylogenetic lineage of the *N. melanostomus*.

The Dnieper-Bug Waterway ending in the Vistula River also could not be regarded as possible route of *N. melanostomus* introduction in the Baltic basin by vessels as supposed (Skóra, Stolarski, 1996; Sapota, 2004), because not all parts of this waterway are passable for ships (The Dnieper-Bug Canal – the history of business <http://www.dneprobug.by/history.html>).

Thus, review of existing records let to assume with confidence *N. melanostomus* introduction in the Baltic through shipping ballast, and a way around Europe, from the Black Sea through the Sea of Marmara, the Mediterranean, the Atlantic and the North Sea (the third way) as the most (or the only) possible rout. More detailed study of morphological and genetic polymorphism of *N. melanostomus* from the upper reach of the Dnieper, Dniester, Western Dvina, Don, Moskva, Volga rivers and their basins as well as populations of native area are required for strict description of round goby invasion history.

The study was funded partially by budget theme 0149-2016-0005 of the Shirshov Institute of Oceanology RAS, Atlantic Branch and RFBR grant 17-05-00782A.

ON THE POPULATION STATUS, DISTRIBUTION AND ECOLOGICAL TRAITS OF POLYCHAETES OF MARENZELLERIA GENUS IN THE SOUTH-EASTERN BALTIC SEA

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Since the 1980-s, the representatives of the polychaete genus *Marenzelleria* colonized all of the Baltic Sea. It was shown with DNA markers, the existence of three close relative *Marenzelleria* species in the Baltic Sea: *M. neglecta*, *M. arctia* and *M. viridis*. *M. neglecta* and *M. arctia* both were found in the South-Eastern Baltic Sea (SEB). The native geographic range of *M. neglecta* is Western Atlantic, *M. arctia* – the Arctic-Pacific region. Both species belong to the arctic-boreal region, *M. neglecta* – originated from west-atlantic sub-region, *M. arctia* – arctic-shelf sub-region. At basis of own data 1998–2016, it was shown that the Vistula Lagoon is inhabited by *M. neglecta* only, in the marine off-shore waters only *M. arctia* is present. Both species are well established during several decades.

M. neglecta is timed to the shallow eutrophic waters, silty sediments and low and fluctuating salinity (1.5–7.7‰), it is found from zero (in rooted macrophytes) up to 5 m water depth. The maximum numbers and biomass were marked in coastal habitats.

M. arctia occurs to the depths of 80 m, salinity from 7.0 to 10–12‰. Numbers and biomass of species are maximal in the coastal shallow waters at depths of 10–15 m, deeper than 50 m abundance of *M. arctia* is drastically drops. The species frequency of occurrence is decreasing with depth, below 30-meter depth – from 80 to 40%. Average biomass, according to 2001–2014 data, amounted to only 1.2 g/m². Local maxima of biomass confined to the sandy deposits.

Thus, in the South-Eastern Baltic Sea two closely related species of the genus *Marenzelleria* occur, both were introduced to the Baltic Sea at the end of the 20 century. The population of these invasive species, however, are dwelling as allopatric, and do not overlap spatially. *M. neglecta* is connected with the lagoon habitats, *M. arctia* with open sea ones. Despite the possibility of larvae exchange between the lagoon and the sea, the above described habitat preferences is persisted for over 15 years. This indicates the different ecological requirements of the species and the most likely, in our view, is the salinity limitation in regard of *M. arctia* larval development.

THE FAUNISTIC COMPLEX OF INVASIVE SPECIES AS A BASIS OF THE MACROZOOBENTHOS STRUCTURE OF THE SARATOV AND VOLGOGRAD RESERVOIRS

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Planned introduction of new species aiming at the reconstruction of the ground fauna, occasional introduction which accompanied this process and self-dissemination of the macro-invertebrates resulted in drastic changes of the ground fauna at that section of the Lower Volga which is regulated by the dams (Belyavskaya, 1968; Nechvalenko, 1973; Dzyuban, 1978, Filinova, 1981, 2003, and others).

During the period after the planned introduction (in the 60s of the previous century) of the invertebrates and up to the early 2000 y.y. in the reservoirs under study maximum quantity of the introduced species were registered. Out of them the highest numbers of species were representatives of Crustacean of Ponto-Caspian origin. The vast majority of the introduced species have first been registered in the open section of the reservoirs. In these sections the species made significant part of quantity and biomass of macro zoo benthos (Filinova, 2013–2015). The recent studies carried in the shallow-water section of the Volgograd Reservoir reveal that the invasive species are more and more frequently being registered in the bays and drowned flood-lands.

At the present moment in the reservoirs of the Lower Volga the invasive species form the basis of the structure of the quantitative rates of macro zoo benthos. The set of the species non indigenous in overall quantity makes about 90%, in overall biomass – more than 99%. Such a high rate is a result of wide dissemination of *Dreissena*. At all the parts of the reservoirs under study *Dreissena* make about 99% quantity and biomass of the summary rates of malacofauna in general.

Domination of introducers is also revealed when analyzing the structure of the quantitative rates of growth of soft macro zoo benthos. In the Saratov and Volgograd Reservoirs within the 5 year period the species nonindigenous made from 25 to 45% of summary rates of quantity and biomass of the given group of invertebrates. Among them the share of the Polihaeta – *Hypania invalida* Hrab (which used to dominate for a long period of time) was from 18 to 30% of these rates. The rates under study varied on parts different according to the morphometric and hydrological characteristics.

It has been found out that in two Reservoirs under study correspondence of species non indigenous and indigenous in quantity and biomass is identical though the absolute summary rates of these parameters. A high concentration of the species non indigenous domination in the ground systems of the open part of the Reservoirs has been revealed.

Within the 5 year period in the Reservoirs of the Lower Volga compared to the previous 5 year period a change of species dominating in the systematic group of higher Crustacean has taken place. A reduction in the number of noticed species non indigenous as well as general reduction in the diversity of species of ground fauna has been marked. At the same time the share of species non indigenous in the general rates of quantity and biomass of the ground fauna (including soft zoobenthos) is not decreasing.

THE ROLE OF ALIEN SPECIES IN PREDATORY FISH FORAGING IN THE RYBINSK RESERVOIR IN 1948–2012

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The study of predatory fish foraging in the Rybinsk reservoir in the period from 1948 to 2012 has shown that the majority of ichthyophages (zander, burbot, pike and adult perch) feed on 16–18 fish species while Volga zander feeds on seven. The main food objects for all predators were three native fish species (perch, ruffe, roach) and two invasive species – Lake Beloye smelt and Ponto-Caspian kilka. In some years, these species constituted up to 97% of predators' rations. We found that penetration and naturalization of Lake Beloye smelt during the period of climatic norm and Ponto-Caspian kilka during the period of climate warming has considerably changed the ratio of prey species in predators' foraging. It was shown that invasive species have constituted a significant part of predators' ration during these periods. However, their share in the ration was not proportionate to their abundance at maximum intensity consumption. Following naturalization and abundance decline, the share of invaders (although remaining dominant pelagic species) decreased and the role of more available mass aboriginal species grew stronger. We found that predatory fish species possess strong preferences towards certain food objects – zander and large perch towards 0+ perch; burbot – 0+ perch and ruffe; Volga zander – 0+ perch exclusively; pike towards roach.

ECOLOGICAL, PHYSIOLOGICAL AND BIOCHEMICAL FEATURES OF INVASIVE FISH SPECIES IN THE TEMPERATURE RANGE OF THEIR LIFE ACTIVITY

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Over the past 50 years, more than 50 new fish species have appeared in the basins of the largest rivers of the Ponto-Caspian basin – Volga, Don and Dnepr, 25 of which can be considered naturalized (Slynko et al., 2010, Slynko, Tereshchenko, 2014). Biology and ecological features of invasive species have been studied quite well. However, comparative aspects of environmental-behavioral and physiological-biochemical features in alien and native fish species are poorly studied. The adaptations of various species of invaders to the temperature of the aquatic environment also are investigated only fragmentally.

In connection with this, the temperature characteristics of vital activity in 15 species of fish, inhabiting the Upper Volga region – their upper lethal temperature (ULT), the final selected temperature (FST) and the temperature range were studied (Golovanov, 2013). Seven species can be attributed to aboriginal species – bream, roach, perch, ruffe, common minnow, groundling, burbot), eight to the conventional species-invasive species – carp, goldfish and crucian carp, Amur sleeper, common kilka, smelt, tube-nosed and big-headed gobies. All species inhabiting this region are divided into four groups according to the indicated temperature characteristics: the most thermophilic (1), thermophilic (2), moderately thermophilic (3) and cold-thermophilic (4). Species-invaders are marked in the first group (carp, goldfish and crucian carp, Amur sleeper and common kilka), third group (tube-nosed and big-headed gobies and sterlet) and fourth group (smelt). In addition, such a species as ruffe from the second group can be considered as a species-invader (which was well illustrated by the example of settling into the American Great Lakes).

The increase in the water temperature in the Rybinsk reservoir in the summer and autumn of 1997–2010 years (Litvinov, Zakonnova, 2012), obviously, was contributed to the introduction and naturalization of the common kilka. Common kilka occupied the ecological niche of smelt, which practically disappeared from the Rybinsk reservoir at the beginning of the 21-st century due to relatively high water temperature in the summer. The upper limit of the habitat of smelt is located at a level of ~ 27–28°C (Ivanova, Lapkin, 1982), which in part explains the sharp decrease in its abundance.

A number of temperature criteria for vital activity in aboriginal species (bream, carp, goldfish and crucian carp, roach, perch, pike) and invasive species (smelt, Amur sleeper, common kilka, also ruffe) inhabiting the Upper Volga basin are considered. Examples of physiological and biochemical reactions of fish to increase the temperature of water are given.

Temperature criteria for vital activity of freshwater fish species, as well as ecological, physiological and biochemical features of their reactions to fluctuations in the temperature of the aquatic environment, can be useful for solving many issues related to the invasion of alien species. For this, new experimental data on thermal selection and thermal resistance of the largest possible number of invasive species found in freshwater and marine waters are needed.

The study was carried out with the support of the Program of the Presidium of the Russian Academy of Sciences: I.21P Biodiversity of Natural Systems. Biological resources of Russia: assessment of the state and fundamental principles of monitoring. 2.5. Influence of anthropogenous regulation of the level regime of reservoirs and temperature on the dynamics of the number of fish of different ecology and the Presidential Programs “Leading scientific schools” SSc-2666.2014.4 and SSc-7894.2016.4 “Ecological aspects of adaptations and population organization in fish”.

EFFECT OF THE HERBICIDE ROUNDUP AND TEMPERATURE INCREASE OF THE ENVIRONMENT ON THE PHYSIOLOGICAL AND BIOCHEMICAL PARAMETERS OF THE AMUR SLEEPER *PERCCOTTUS GLENII* DYBOWSKI

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The glyphosate-based herbicide Roundup is one of the most widely used nonselective organophosphorus herbicides in the world. It is used to control weeds in agricultural crops, as well as to combat the overgrowth of aquatic vegetation in reservoirs, ponds and canals. The widespread use of Roundup is due to its high efficiency, good biodegradability in the environment, and the increasing cultivation of crops that are genetically resistant to this herbicide. Roundup can have adverse effects on non-target organisms, including microalgae, macrophytes, fish and invertebrates (Giesy et al. 2000). Fish are a good bioindicator of water pollution and Roundup has been shown to cause a range of developmental (Webster et al., 2015), behavioral (Giaquinto et al., 2017), morphological, physiological and biochemical changes (Cattaneo et al., 2011; Aminov et al., 2013; Richard et al., 2014).

Climate warming and increases in thermal pollution have changed the temperature of fish habitat. The increase of water temperature can affect physiological and biochemical indices of fish, as well as the organism's response to chemical agents. Changing water body temperatures also promote alien species invasions. The Amur sleeper *Perccottus glenii* Dybowski is an invader of the Upper Volga basin. It is rapidly expanding its range through out Russia and Europe (Reshetnikov 2010). The Amur sleeper is considered to be among the most heat-loving fish species that live in Russia's fresh waters (Golovanov, 2013). Its ability to adapt quickly to changing environmental and anthropogenic factors gives it advantages over many native fish species. Roundup is known to have negative effects on digestive intestinal glycosidase (Golovanova, Aminov, 2013) and acetylcholinesterase (AChE) activities in the brain and liver of fish (Gluszczak et al., 2006; Fan et al., 2013).

The goal of this work was to study the chronic sublethal *in vivo* action of the herbicide Roundup and water heating at the different combinations on activities of digestive glycosidase and AChE, and water-soluble protein (WSP) content in the brain of Amur sleeper juveniles.

Three experimental scenarios of measurements were studied: (I) immediately following 30 days of chronic exposure to Roundup at the concentration of 2 µg/L, (II) after fish transition into clean water and heating at rate 8°C/h, and (III) after holding them for 12 days in clean water in a thermal gradient (temperature range between 14 and 31°C) and subsequent heating at rate 8°C/h. At the scenario I maltase and AChE activities did not change. Amylolytic activity and WSP content respectively were 27 and 31% lower than that in the control fish. Scenario II enhanced the negative effect of Roundup on amylolytic activity (inhibition was 40%), decreased AChE activity by 29%, and maltase activity increased by 35%. At the scenario III the differences in the glycosidase activities in control and experimental groups of fish were less in comparison with scenario II, AChE activity and WSP content did not differ between control and experimental fish.

Thus, a decline in intestinal amylolytic activity (but not maltase) and WSP content (but not AChE activity) in the brain of Amur sleeper on the 30-th days of exposure to Roundup has been shown. Rapid increase of water temperature after exposure to Roundup caused the greatest decrease in the intestinal glycosidase and brain AChE activities. These data show the interaction between chemical and physical factors and support the assumption that thermal stress can alter the organism's response to chemical agents. Holding the fish in a thermal gradient mitigates the negative effects of Roundup and the subsequent effects of a sharp increase in water temperature on activity of digestive glycosidases and does not cause significant changes in the state of the cholinergic system of fish. These results raise concerns about combined action of low environmentally-relevant Roundup concentrations and thermal stress that can cause adverse health effects in wild fish populations.

NEW SPECIES OF INVADERS OF FRESHWATER BRYOZOANS IN THE EUROPEAN PART OF RUSSIA

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The Kopora Bay is under strong hydrodynamic and thermal impact of the power plant. Brackishwater conditions, warming and common involvement of region of the Finnish Bay in a system of world water transport has led to the fact that alien marine and freshwater species, including fouling had received massive development in the waters of the Kopora Bay. During a zooplankton larvae survey of the Kopora Bay in 2014 r. for an assessment of the distribution and spreading of alien fouling organisms during TOPCONS project and contractual work there were found floatoblasts and parts of colonies of freshwater Bryozoa *P. geimermassardi* Wood & Okamura, 2004 in 4 samples of zooplankton from 32 samples collected in 2014–2015. Three samples contained colonies of *P. geimermassardi*, which were used for further investigation. *Plumatella geimermassardi* is new species of freshwater Bryozoa for the fauna of the European part of Russia. Colonies are flat and wide spread on substrate. When a surface is limited, colonies rise perpendicular to the substrate and created branches with free irregular ramification, which can merge in adhesive mass. The species was registered only in closed basins. Finding in the Kopora Bay allows approving, that the species can live in hydrodynamic unstable biotops, also in technologically modified areas. *Plumatella geimermassardi*, appears to be uncommon throughout its known range, and, perhaps, is distributed everywhere in Great Britain, Ireland, Germany, Italy, Finland and probably in the most part of Europe, including the Finnish Bay.

The freshwater bryozoan *P. similirepens* Wood, 2001 was recorded for the first time in Italy in 2004 (Taticchi et al., 2004). The species was sampled from one of the thirteen trout farms inspected during a research project on PKD (Proliferative Kidney Disease) epidemiology in Italy. This is a new species for the European freshwater bryozoan fauna. Previously *P. similirepens* was reported only from Illinois, USA by Wood (2001). The Author found it in only two fish farms and so he concludes that «either the fish hatcheries offer conditions particularly suitable for this species, or else that the bryozoans were introduced to the sites along with received shipments of fish». New freshwater species *P. similirepens* Wood, 2001 for the fauna of the European area of Russia was registered in the Udomlya Lake, Kalinin region, on stones in 2014–2015. The Udomlya lake (tectonic) and Pesvo Lake (thermal cirques) are two most large in a system and they are flowing, technologically modified by construction and working of the Kalinin Nuclear Power Station and development of related infrastructure (dividing dam, water taking and water-supply hydrotechnical constructions and so on). It is most likely primary introductions occurred with stoking of carp fish in the warm Pesvo Lake where fish hatcheries are situated. Average sizes of floatoblasts *P. similirepens* of the Udomlya Lake are more similar with Illinois samples than Italian ones.

PECULIARITIES OF DISTRIBUTION OF INVASIVE PLANT SPECIES IN THE COASTAL ZONE OF WATER BODIES OF THE KALININGRAD REGION

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Often adventitious plant species enter new territories by spreading with water currents. Practice has shown that perennial invasive species inhabiting water bodies fall into coastal biotopes in the form of fragments of vegetative parts. In the Kaliningrad region these are the rhizome perennials: *Acorus calamus* L. and *Aster x salignus* Willd. Fragments of the rhizomes of these species are carried by water currents during spring floods and storm surges in autumn. Settling in the coastal zone of a water body *A. calamus* rhizomes germinate, eventually forming pure single-species overgrowth. On the territory of the Kaliningrad region the most numerous cenopopulations of this species are found in the coastal zone of the rivers, for example, Neman, Pregel, Instruch, Pissa, Angrapa, Deyma and deep-water reclamation canals: Nemansky, Matrosovka, Golovkinsky and Mazursky. *A. x salignus*, like parental species, has a long rhizome, which quickly seizes space in places of the former culture of parental species. In addition, the largest accumulations of it are found along the margins of ameliorative ditches and streams flowing into the Kaliningrad Sea Canal and the Vistula Lagoon. The plant is found both in sparse grass stands and high grass where it can form monotypic mosaic inclusions among other typical coastal-aquatic plants, competing with species of local flora.

The following species among annual invasive species of the Kaliningrad region are prevailing in the coastal zone of water bodies: *Conyza canadensis* (L.) Cronquist, *Bidens frondosa* L., *Impatiens grandulifera* Royle and *Echinocystis lobata* (Mich.) Torr. Et Gray. All these plants are characterized by seed renewal. The latter two species are "refugees" from the culture, which in the coastal-water communities actively supplant local species. Among others, *E. lobata* poses the biggest threat to biodiversity of the region. Settled in willow stands along rivers, canals and the coast of the gulfs, this species annually forms a large number of viable seeds distributed by water flows as well. Currently, the most extensive "capture" areas of overgrowths occur in the middle course of the Pregel River. Their length along the watercourse per totality of fragments is about 3 km. *I. grandulifera* prefers small streams and ditches in alders. It is noted that the seeds of this species are also distributed by water. Two largest cenopopulations of the *I. grandulifera* in the Kaliningrad region are recorded, one of which has been existing for about fifteen years.

As a result of many years of research we have determined several more invasive plants, the distribution of which in the coastal zone of water bodies is not a priority and they do not have a significant negative effect, but they have all prerequisites for this. These include: *Puccinellia distans* (Jacq.) Pari.; *Senecio viscosus* L.; *Juncus tenuis* Willd., which adapt well to open, sparse areas of the coastal zone and *Saponaria officinalis* L.; *Helianthus tuberosus* L.; *Rudbeckia laciniata* L., which form monodominant fragments in overgrowths of high grass. All these species are able to propagate via seed and by vegetative method.

Thus, six invasive plants represent the biggest threat to the species diversity in the coastal zone of water bodies of the Kaliningrad region.

INVASIVE PLANT SPECIES OF THE KALININGRAD REGION (SPECIES COMPOSITION, ORIGIN, PECULIARITIES OF NATURALIZATION)

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For the Kaliningrad region that is located at the crossing of numerous transport highways the problem of importing of alien plant species is very acute. The first systematic research and identification of the adventive fraction of the flora of the region date back to the second half of the 1990s (Gubareva, 1995, 1998, etc.). Later, after the collection of floral materials, an audit of its adventitious component was carried out and invasive species were identified. Based on the results of the analysis of literature data and own research in 2011 it was suggested to divide these plant species into three groups. Accordingly the first group "with a high adaptive potential" was separated, which includes plants that have a significant negative impact on biodiversity of native flora species (11 of them were identified); the second group, which includes species "whose significant negative impact has not yet been manifested and the diversity of the ecotopes populated by them is small" and the third group, which included "potentially invasive species" (Gubareva, 2011).

It was recorded that over the past seven years the number of invasive plant species in the first group has increased from eleven to seventeen. There is a dynamics in other groups identified by us. During the same period the attempts of plant biologists to unify the invasive component of the adventive flora in different regions of Russia led to the suggestion that four groups of invasive plants with different status categories were proposed (Vinogradova et al., 2010, 2011). This division, in our opinion, is the most acceptable.

Based on the new data on the flora of the Kaliningrad region, which takes into account the dynamics of recent migrations, changes in economic activity and the degree of adaptation of alien species, as well as the identification of four groups of invasive plants, a revision and a new understanding of the species composition of this part of the flora have been carried out.

At present it is identified that the invasive component of the flora of the Kaliningrad region is about 110 species. Of these, 17 plants belong to the first category of status ("transformer species"), ten of which are plants whose primary area is North America. Including eight of them were originally introduced into the territory of the region. The first group included six annual, eight perennial species and three others represented by trees and shrubs. The second category of status ("alien species of semi-natural and natural habitats") includes 18, eleven of which came to the region as a result of introductions, including five of which had a primary area in North America. This category includes annual and biennial plants (7 species), perennials (8), shrubs and semishrubs (3). The third category consists of 14 invasive plants, of which initially four were introduced into the region, and the rest are introduced as a result of migration (including transport routes). Seven species of this group pertain respectively to perennials and annuals.

The number of species in the remaining fourth group is not constant, because among the invasive plants there are representatives, whose status remains uncertain in the Kaliningrad region. In general, this group can include from fifty to sixty species.

PLANTATIONS OF ALIEN TREES: IMPACTS ON SPECIES AT VARIOUS LEVELS OF THE FOOD CHAIN

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Alien trees, planted for forestry purpose, represent a serious conservation problem, as they often act as ecosystem engineers, creating the environment for almost all other species. Given the extent of plantations, alien trees alter the environment over large scale, and make it unsuitable for native species. To explore these effects in a complex way, we compared plots dominated by selected alien trees with corresponding stands of native trees. First, we compared 19 one-hectare plots dominated by a North-American tree *Robinia pseudacacia* with 20 plots, dominated by native trees (*Acer*, *Quercus*, and *Tilia* sp. div.). Further, we compared 20 plots with the planted alien *Pinus nigra* with 19 plots with the native *P. sylvestris*. On all plots, we recorded the present species of vascular plants (representing producers), nocturnal Lepidoptera (moths; herbivores) and birds (predators). The differences between the alien and native stands were tested by marginal models in case of species richness and ordination analyses in case of the composition of species and distribution of their basic ecological characteristics. The stands of *R. pseudacacia* hosted significantly less moth species compared to native stands, however, the impact of the target alien trees manifests mainly in differences in species composition and their characteristics. For example, the stands of *R. pseudacacia* harboured more nitrophilous, hemerophilous and hemeroby-tolerant plants, but also plants preferring the continental climate and demanding less moisture. Concerning moths, the stands of *Robinia pseudacacia* hosted more specialized feeding guilds (detritivorous on litter, moss and lichen feeders and generative parts feeders), forest-steppe moths, species associated with open habitats, with faster life-cycle and with smaller body sizes. Similarly to moths, the invaded stands hosted more birds with fast life cycle and associated with open habitats, however, the invaded stands also hosted more habitat generalists. The results show that a detailed approach is needed to reveal the impacts of alien trees and that the focus on species richness only may lead to false optimistic conclusions, underestimating the real magnitude of impacts.

ALIEN SPECIES IN THE STRUCTURE OF THE FISH COMMUNITIES IN THE MIDDLE OB BASIN

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Since the second half of the twentieth century in the Middle Ob river basin have been significant changes of fish fauna, caused primarily by the naturalization of seven alien species of fish: the freshwater bream *Abramis brama*, the pike-perch *Sander lucioperca*, the common carp *Cyprinus carpio*, the belica *Leucaspis delineatus*, the bleak *Alburnus alburnus*, the Amur sleeper *Perccottus glenii* and the Nikolsky's loach *Misgurnus nikolskyi*. At the present time exotic species are 19% of the ichthyofauna.

The freshwater bream, the bleak and the pike-perch are noted in the different sites of the Middle Ob stream, but only the bream has high numbers and biomass. The total share of alien fish species within the Middle Ob varies from 20.1 to 32.0% in abundance and from 2.1 to 63.2% in biomass. 4 survey sites.

The freshwater bream, the bleak and the pike-perch are noted in the relatively large (characterized by a considerable length, catchment area, width and depth) tributaries of the Middle Ob river. In small rivers, introduced species were not found. The total share of alien fish species in the tributaries of the Middle Ob River varies from 0.4 to 22.0% in abundance and from 1.6 to 46.3% in biomass. 12 survey rivers.

The freshwater bream, the pike-perch, the belica and the Amur sleeper are noted in ponds and lakes in the Middle Ob basin. The freshwater bream and the pike-perch are found only in lakes, which connected (seasonal or permanent) with large rivers. There are in the structure of the dominant fish complex. The belica is noted in 38% surveyed ponds and lakes. These water bodies are characterized by a small depth and at the same time small areas of overgrowing by aquatic vegetation. Amur sleeper is found in 50% surveyed ponds and in 18% lakes. The total share of alien fish species in ponds in the Middle Ob basin varies from 5.0 to 100.0% in abundance and from 2.3 to 100.0% in biomass, and in lakes – from 0.7 to 23.6% in abundance and from 0.3 to 14.6% in biomass. 9 survey ponds and 17 lakes.

Thus, in general, the freshwater bream, the belica and the Amur sleeper are widely distributed and abundant in the Middle Ob river basin. The common carp and the Nikolsky's loach are not found, because they have a low number in this area. Alien fish species are not found in the tributaries of the second-order of the Middle Ob River and in water bodies, which not connected with rivers. This, apparently, indicates the spread of exotic species via rivers.

RESISTANCE AND VULNERABILITY OF THE FISH POPULATION STRUCTURE OF FLOODPLAIN LAKES TO INTRODUCTION OF INVASIVE SPECIES

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In the reservoirs of the Oka Reserve, two alien species were discovered.

Amur sleeper *Perccottus glenii* entered the territory of the Oka Reserve by the end of the 80's, being marked in the Pra River (tributary of the Oka River) and floodplain waters.

Lake minnow *Phoxinus phoxinus* – a species has a fragmented range – was not previously recorded in the reserve and was for the first time found in one of the lakes in 2014.

To date, the share of Amur sleeper in the fish population of floodplain water bodies ranges from 0 to 100%. At the same time, in some reservoirs, its share from year to year is quite stable, and in others it is sharply different. Such dynamics of numbers depends on a number of factors.

Undoubtedly, the morphometry of the reservoir, namely its area and depth affect the species diversity. In a too shallow and small pond there is often only one species of fish – invasive Amur sleeper.

A huge role for the structure of the fish population is played by the level of overgrowing by macrophytes of water bodies. So strongly overgrown ponds with muddy bottom determine a high proportion of Amur sleeper in the population.

The next factor is the floodplain relief level. In water bodies of low floodplain, having an area of a water mirror of at least 3 hectares, which are flooded annually during the overflow, the share of Amur sleeper is small and fairly constant. It is 4–10%. Here, the number of Amur sleeper is regulated by predators (pike (*Esox Lucius*), river perch (*Perca fluviatilis*)), which eat aliens and peaceful fish (crucian carps (*Carassius carassius* and *C. auratus*), silver bream (*Blicca bjoerkna*)), eating their spawn.

In large lakes of high floodplains (the area of the water mirror is more than 20 hectares), where there is a full community of fish with the presence of both peaceful fishes and predators, the number of Amur sleeper is also low.

In small lakes (less than 3 hectares) of high floodplains, the share of Amur sleeper is unstable. In the years of high flood, when predators enter them, the share of Amur sleeper does not exceed 30%. If the flood is low and there are few predators or they have not entered the lake at all, the Amur sleeper's share increases to 60%.

A huge role in the structure of fish communities has force majeure circumstances that occur fairly regularly in the Oka floodplain. Severe winters, for example, with complete freezing of the reservoir for a long time, are destructive to both Amur sleeper and aboriginal gold crucians. Interestingly, in lakes with a muddy bottom, for the most part, the gold crucians partially escape, buried in the mud, and the Amur sleepers die.

The sudden elimination of higher aquatic vegetation leaves the Amur sleepers without shelter. As a result, Amur sleepers are often completely destroyed by predators. The lake minnow, having penetrated the lake of high floodplain in 2014, gave an outbreak in 2015. Probably fish rubella disease has been appearing because of arisen high population density, resulting in the death of different fish species. Relative abundance, according to the data of net catch in 2016, decreased almost 4 times. It should be noted that among the dead fish of invasive species – Amur sleeper and lake minnow was not noted.

Thus, research on floodplain lakes has shown that the resistance and vulnerability of the structure of fish populations to introduction of alien species depends both on the morphometry and location of the reservoir, and on environmental factors and epidemics.

DEVELOPMENT OF MONITORING METHODOLOGY OF INVASIVE SLUGS SPECIES IN LATVIA

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Invasive species are considered to be a significant threat to native biodiversity. Usually, they quickly adapt to the environmental condition of a new territory, directly influence natural habitats and native species, and indirectly affect the economy of the country. Monitoring results should serve as an early warning system that gives an immediate signal for further preventing of species spread.

The development and approbation of monitoring methods of invasive species in Latvia began in 2015. There are 16 alien mollusc species out of which three species, *Arion lusitanicus* auct. non J. Mabille, 1868, *Kryniocephalus melanocephalus* Kaleniczenko, 1851 and *Dreissena polymorpha* Pallas, 1771 are considered to be invasive according to invasive species criteria. Current monitoring of invasive slug species in Latvia focuses on two species: *A. lusitanicus* and *K. melanocephalus*. In Latvia, *A. lusitanicus* was introduced in 2009, whereas *K. melanocephalus* was introduced in 1997. New localities of these species are discovered every year. In light of this, the aims of present monitoring are to record species distribution, population size and the speed with which they are spreading throughout the territory of Latvia, as well as to figure out how intense the degree of invasion should be to consider it as serious threat to natural ecosystems.

Slug tracking is performed in sample plots (2x10m) in the evening (no earlier than 20.00 o'clock). The spread area of slugs within locality recorded early in the morning. The number of sample plots depended on the size of the slugs' locality. The number of slug individuals in sample plot is evaluated as follows: none (0), some (1–10), few (11–20), moderately (21–50), many (51–100), very many (> 100). The degree of slugs invasion in locality is evaluated in the scale from 0 to 5, where 0 – no invasion; 1 – very low; 2 – low; 3 – medium; 4 – high; 5 – very high. The monitoring of *A. lusitanicus* is performed in all known localities (natural and anthropogenic), whereas the monitoring of *K. melanocephalus* is carried out in the known localities of natural ecosystems. We found that in anthropogenic environment, slug tracking should be carried out on roadsides or in ditches.

PHRAGMITES ALTISSIMUS (POACEAE) IN CIS-URALS AND WEST SIBERIA

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Phragmites altissimus (Benth.) Mabilie belongs to high-grass helophytes, has the Eurasian temperate-meridional area, and in phytocenoses it is a powerful edificator. On the territory of Russia, the natural area of the species covers the delta of the Volga, the lower reaches of the Don, the Crimea, the Ciscaucasia, the southern regions of Eastern Siberia and the Far East. Outside Russia, the *P. altissimus* occurs in the Black Sea Coast, in the Atlantic and Middle Europe, the Mediterranean, Asia Minor, China, Mongolia, North Africa (Tsvelev, 1976, 2011; Probatova, 1985). In all areas located to the north of these territories, this species considered adventive (Tsvelev, 2011). So, as an alien species, it is recorded in the upper reaches of the Volga and the Don (Papchenkov, 2008), on the islands of the Gulf of Finland in the Baltic Sea (Tsvelev, 2000, 2011), in the reservoirs of Tver (Notov, 2009) and Yaroslavl (Papchenkov, 2008) regions.

We show the habitat of *P. altissimus* in the basin of the Kama River – the largest left-bank tributary of the Volga River, where it is also considered as an adventive inclusion in the flora (Kapitonova, 2011). In Cis-Urals, the highest reed grows mainly in transformed and artificial habitats: in shallow waters and coasts of reservoirs and ponds, in watered quarries, technogenic lakes. Currently, over 10 locations of the species are known within the Udmurt Republic and the Republic of Bashkortostan. As a rule, this species forms dense, high, often single-species thickets. We have noticed that the population of the highest reed can a considerable time hold occupied positions; in this case, it reproduces mainly vegetatively. They can grow both on the shore and at a considerable depth (up to 2 m). We also noticed that the plants are blooming and probably able to form fruits. This confirmed by our observations on individual shoots of *P. altissimus*, growing among thickets of a closely related species – *Phragmites australis* (Cav.) Trin. ex Steud.

In West Siberia, *P. altissimus* was known from the Southern Trans-Urals, where it was noted in the Kurgan city, on the coast of the Tobol River (Naumenko, 2008). We discovered the growth of this species much further north – in the vicinity of Ingair station (Tobolsk district, Tyumen region) (Kapitonova, 2016). The distance from the place where the species is found to the northern boundary of the area of its natural distribution is not less than 1000 km, and to the nearest place of growth in the Kurgan city – about 400 km. In the place of the find *P. altissimus* was growing on the slope of a dirt road, laid along the main gas pipeline track. In this place, the road crossed the beaver dam on the stream, and the reed population was in the water and on the coast of this small pond. The examined shoots of *P. altissimus* were about 3 m tall, the width of their leaves was 3–4 cm (the herbarium was somewhat narrower), the length of the inflorescences varied within 33–38 cm. These are not the largest sizes for this species, especially when compared to giant reed plants in the delta of the Volga River, where shoots, according to our observations, reach a height of 6–7(7.5) m, and the width of the leaf blade is 6–7 cm. Nevertheless, the highest reed plants that we discovered were in marked contrast with the growing thickets of the widespread in Western Siberia southern reed. The *P. altissimus* had higher and powerful shoots, large inflorescence and wider leaves. At the time of observation (mid-July), the plants of highest reed were in the budding phase.

So, *P. altissimus* shows high potential opportunities for the development of territories located much to the north of the area of its natural distribution, using as migration routes the anthropogenically disturbed ecotopes, including linear engineering constructions.

NATARULIZATION OF MEDITERRANEAN GOBIES (GOBIIDAE) IN THE COASTAL ZONE OF SOUTHWESTERN CRIMEA

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The family of gobies (Gobiidae) in the Black Sea is unique in its species richness and has more than 35 species. It consists of two main groups – autochthonous endemics, the formation of which took place within the Ponto-Caspian basin, and the species that came from the Mediterranean Sea after the formation of the Bosphorus Strait, including those that were introduced only very recently. Thus, 9 new species of the Gobiidae family of Atlantic-Mediterranean and Mediterranean origin were discovered near the Crimean coasts since the beginning of this century. These species have proved successful both in increasing the species richness and in expanding their areal, which is an example of the permanent process of the Black Sea fauna's mediterrization.

Two species (*Gammogobius steinitzi* and *Chromogobius zebratus*) have very narrow localization and are known only for findings in the coastal zone near the Tarkhankut peninsula in the north-west of the Crimea (Kovtun, 2012; Kovtun & Karpova, 2014). In other areas of the Black Sea they are not marked. The greatest number of finds of new species (7) is concentrated in the area of the south-western Crimea.

Gobius xanthocephalus and *Pomatoschistus bathi*, discovered originally near Abkhazia (Vasil'eva & Bogorodsky, 2004), have now become common in the south-western Crimea, and the second of them is mass along the entire coast of the peninsula (Boltachev et al., 2016). *Gobius cruentatus* was simultaneously noted off the coast of Turkey and Sevastopol at the beginning of the century (Engin et al., 2007, Boltachev & Karpova, 2014), over the past period its areal off the coast of the south-western Crimea has expanded. This species also began to meet constantly near the Abrau peninsula (Prokofiev, 2016). *Zebrus zebrus*, originally known for a single find off the coast of Turkey (Kovačić, Engin, 2009), was first met in 2013 in the bays of Sevastopol, and has become very numerous over the past three years (Karpova et al., 2015). At the same time, *Millerigobius microcephalus* was found in the Sevastopol Bay, but later its findings did not repeat, it is possible that *Zebrus zebrus* was more successful in developing new water areas and ousted *Millerigobius microcephalus*, which occupies a similar ecological niche. The discovery in the bays of Sevastopol of another representative of this family, the *Gobius couchi* Miller & El-Tawil, 1974 was a result of our monitoring studies. A very rare species *Chromogobius quadrivittatus* has now become quite massive in the bays of Sevastopol.

Thus, by now 6 species have created self-replicating populations, and 3 species have significantly expanded their areal. Obviously, a significant number of new discoveries for this region and for the Black Sea in general is due not only to the geographical location of the Crimean Peninsula, but also to the peculiarities of habitat conditions and the diversity of biotopes in the area, because among the new species of gobies, cryptobenthic species predominate.

PHYTOPATHOGENIC FUNGI – AN ASPECT OF EXOTIC WOODY PLANTS INTRODUCTION IN BOTANICAL GARDENS AND PARKS OF BIG SOCHI

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The Big Sochi area is a unique place on the territory of Russia, where the number of introduced and widely cultivated tree plants has already exceeded the number of native species at present time. This is partly because this region has a humid subtropical climate, but there is no typical subtropical Mediterranean flora and vegetation, which was pushed to the south during the last ice age and did not recover until modern time. Currently, due to human activities on the introduction of plants, there is a reverse process – the rapid invasion and spreading of many exotic subtropical plants and their invading into the local plant communities. According to some scientists, the local plant communities transform into principally new phytocenoses nowadays, the basis of which will be invasive species from among subtropical exotic plants, including trees and shrubs.

This process was accompanied, is accompanying and will be accompany by active incoming, spreading and naturalization of many organisms associated with woody introduced plants, including such an important group of organisms as phytopathogenic fungi. They are mostly relatively low-risk plant consorts, but some fungi can be extremely harmful pathogens, which are can cause significant damage to main fruit crops or even can cause massive dieback of trees in natural forest stands. The analysis of the available data shows that the greatest number of invasive plant pathogenic fungi have come to Europe from North America and East Asia, and the highest concentration of invasive fungi affecting woody plants is observed in Europe in countries along the Atlantic coast and the Baltic Sea region (mild maritime climate) and in the mountain and foothill regions of Southern Europe with a subtropical and temperate climate and a wide variety of ecotopes (the Pyrenees, the Alps, the Balkans, the Carpathians, the Caucasus).

Among the dangerous alien species appeared in Sochi in the 20th century are those harmful fungi: *Ophiostoma ulmi* and *O. novo-ulmi* (Dutch elm disease, caused the massive death of the elm), *Cryphonectria parasitica* (chestnut blight significantly destroyed the chestnut forests of the Southern Caucasus) and *Erysiphe alphitoides* (oak powdery mildew, causes now hard oppression of oaks). In the beginning of the 21st century new and previously unknown fungal plant pathogens were found: *Calonectria pseudonaviculata* (= *Cylindrocladium buxicola*) on *Buxus* spp., *Erysiphe flexuosa* on *Aesculus* spp., *E. magnifera* on *Magnolia* spp., *E. platani* on *Platanus* ssp., *Pseudoidium hortensiae* on *Hydrangea* spp., *Lecanosticta acicola* (= *Mycosphaerella dearnessii*) on *Pinus* spp. All of them cause significant damage to host plants and probably came and spread here during the last two decades. Also two dangerous pathogens of pine trees are distributed in the adjacent areas of the Krasnodar region: *Dothistroma pini* and *D. septosporum* (= *Mycosphaerella pini*), which can also be found in the territory of Big Sochi. These data show that the invasion rate of alien plant pathogenic fungi to the Big Sochi area is still high due to the warm humid subtropical climate combined with the high diversity of woody plants and the active importation of many ornamental plants from foreign countries.

With the high probability in the near future one should expect the appearance of the following dangerous pathogens of woody plants on the territory of Big Sochi (now present in Europe): *Ceratocystis fagacearum* (oak wilt oak wilt), *C. platani* (canker of sycamore), *Eutypella parasitica* (maple cancers, *Eutypella* canker of maples), *Hymenoscyphus fraxineus* (ash necrosis, ash dieback), *Monilinia fructicola*, brown rot of stone fruits, *Ophiognomonium clavignenti-juglandacearum* (butternut canker), many extremely harmful invasive *Phytophthora* species, for example, *Phytophthora* × *alni* and *Ph. ramorum*.

**THE RESULTS OF 10 YEARS OF RESEARCH OF FOUR-EYED FIR BARK BEETLE
POLYGRAPHUS PROXIMUS BLANDFORD (COLEOPTERA, CURCULIONIDAE:
SCOLYTINAE) INVASION IN WESTERN SIBERIA**

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The endemic of the Far Eastern origin – four-eyed fir bark beetle *Polygraphus proximus* Blandf was first registred in Siberia in 2008 during pheromone monitoring of a six-toothed bark beetle *Ips sexdentatus* Boern in dark coniferous forests with a predominance of Siberian stone pine (*Pinus sibirica* Du Tour).

The high population of *P. proximus* even in a new habitat was the reason for further versatile study of this species. Special studies of fir bark beetle invasion in the Tomsk region were launched in 2010, when unusually high rates of Siberian fir (*Abies sibirica* Ledeb.) mortality caused by the massive breeding of a new alien pest were revealed.

In subsequent years studies were also conducted in the forests of the Kemerovo and Novosibirsk regions and in the Altai Republic.

The ecology of the fir bark beetle in the secondary area was studied in detail. The habitats and general distribution of *P. proximus* in the West Siberian region of invasion are established. It is found out that by now the four-eyed fir bark beetle is widely distributed in the southern taiga on the West Siberian Plain: in the fir forests of the Kuznetsky Alatau, Mountain Shoria, Salair and the North-Eastern Altai. The features of alien bark beetle behavior, phenology, demographic characteristics in invasive populations, the peculiarities of trophic links with Siberian fir and the possibility of its feeding on other Siberian conifers, the relationships with aboriginal Siberian fir dendrophages, the role of natural enemies and fungal pathogens in regulation of its populations in Western Siberia are investigated.

Various ecological effects caused by *P. proximus* invasion in Siberian dark coniferous forests such as: transformation of species composition, age and spatial structure as a result of mass death of trees and large fir growth; increase of patchiness of forest community and illumination favorable for medium and small fir undergrowth; changes in the composition spatial and ecological structure of the ground cover, gradual change of the initial cover with small taiga herbs and green moss to var-iiherbetum and magniherbetum phytocenoses with increased density of the herbs layer, which prevents undergrowing; competitive displacement of earlier mass aboriginal Siberian fir consortia, changes in the composition and structure of xylophilic entomocomplexes, including from the number of new food chains during processing for invader species of entomophages (obligate and facultative predators and parasitoids) are quantified. The transformation of the various components in the recipient ecosystems for the fir bark beetle suggests the establishment of an alien species as the initiator of a new type of zoogenic successions for Siberia.

Taking into account the observed changes the principles and methods for monitoring of fir forests in the zone of invasion of the *P. proximus* in Siberia have been developed.

The studies were supported by the Russian Foundation for Basic Research (grants No. 12-04-00801a, 12-04-10089-k, 14-04-10093-k, 16-44-700782 p_a).

THE ROLE OF ALIEN MAMMALS IN THE FORMATION OF MODERN THERIOFAUNA IN EUROPEAN PART OF RUSSIA

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Large-scale actions on the mammal introductions on the one hand and anthropogenic landscape transformations on the other hand, have led to changes in the composition of modern mammal fauna. Alien species of mammals are found almost all over Russia today. Their number varies from region to region. The maximum quantity of alien mammal species is noted in the south of the European territory of Russia – 27 species. Kamchatka takes the second place – 10 species (Khlyap et al., 2011). The task of this work was to assess the participation of alien species in the formation of fauna at the present stage and to assess the changes of the regional theriofauna due to mammal invasions.

The basis was the Information Retrieval System for Fauna and Flora in Protected Natural Areas of the Russian Federation, created in the IPEE RAS and placed on the web-portal of this institute (Petrosyan et al., 2004; <http://www.sevin.ru/natreserves/>). The lists of species were corrected by open sources available on the Internet and according to the author's own observations in the Prioksko-Terrasny Reserve, the Utrish Nature Reserve and in the Valdai National Park (Albov, Khlyap, 2015; Albov et al., 2016; Khlyap et al., 2015, 2016). Reserves can be viewed as a network for monitoring wildlife. They serve as an important source of knowledge about alien species. Previously, some changes in the theriofauna of 37 biosphere reserves were analyzed (Bobrov et al., 2008; Neronov et al., 2008). Now we used data on 53 reserves, located in the European part of Russia, in the Urals and in the Caucasus.

There are 45 alien species of mammals in 53 reserves. Among them are representatives of the 7 orders: Eulipotyphla – 3 species, Chiroptera – 3 species, Lagomorpha – 1 species, Rodentia – 14 species, Carnivora – 15 species, Artiodactyla – 7 species, Perissodactyla – 2 species.

There is no reserve, in which alien species are absent at present. The proportion of alien species from the entire mammalian fauna is quite high: 5–9.8% in 16 reserves, 10–14.9% in 19 reserves, 15–19.6% in 11 reserves, 20–30% in 7 reserves. The average – 13.2%. The lowest proportion of alien species (5% or less) was in the mountain reserves: Shaitan-Tau, Dagestan, Erzi. Among the leaders in the proportion of alien species: the Astrakhansky Reserve (24.24%) the Prioksko-Terrasny Reserve (25.42%), and the Tsentralno-Chernozemny (29.79%)

The mammal species richness of riparian ecosystems has undergone the greatest changes. Alien riparian mammals are widely dispersed. Ondatra (*Ondatra zibethicus*) occurs in 81% of the reserves. The American mink (*Neovison vison*) – in 68%, the beaver (*Castor fiber*) – in 60%. Among other alien species, only the raccoon dog (*Nyctereutes procyonoides* – in 79% of the reserves) and the synanthropic rodents: the norway rat (*Rattus norvegicus* – in 66%), the house mouse (*Mus musculus* – in 58%) are comparable to riparian alien mammals in the amplitude of its distribution. All other alien species of mammals are found in less than 25% of the reserves. Alien species have not only replenished the species richness of riparian ecosystems, but they are often numerically dominated by ecologically similar species and have a significant impact on ecosystems.

The obtained results reflect the general current trends of fauna changes as a result of biological invasions, which are observed practically for any countries, any regions and for many groups of living organisms.

It can be concluded that the processes of faunogenesis did not end in the past. They are still in our days. Biological invasions – one of the leading factors in the formation of modern theriofauna of the European part of Russia.

Was supported by the Russian Science Foundation, Project No 16-14-10323.

PAST HERBARIUM AS AN IMPORTANT SOURCE OF DATA FOR TRACKING THE ORIGIN AND EARLY DISTRIBUTION OF A LIME LEAF MINER

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Past herbaria serve not only as valuable source of data for botanists but can also be useful for entomologists to study the diversity and abundance of herbivores, origin of invasive species and their early distributions. Larvae and pupae of leaf mining insects found in mines in herbarized leaves could be efficiently used for generic analysis, which undoubtedly increases the importance of herbarium collections for entomological studies. As an example, herbarium data played a critical role in confirming the Balkan origin of an invasive horse-chestnut leaf miner, *Cameraria ohridella* Deschka and Dimić, 1986 (Lepidoptera: Gracillariidae) and reconstructing its past spread in Europe (Lees et al., 2011).

Here we focus on another invasive gracillariid – the lime leaf miner *Phyllonorycter issikii* (Kumata, 1963). During the last three decades, this East Asian species has spread to most of Europe and largely populated limes *Tilia* spp. (Malvales: Malvaceae). This pest has even penetrated Siberia despite the fact that plants of the genus *Tilia* are scarcely present in the Siberian flora.

We examined herbarium collections of *Tilia* stored in the Botanical Institute of the Russian Academy of Sciences (Saint Petersburg) and in the Central Siberian botanical garden SB RAS (Novosibirsk) for the presence of typical mines.

The herbarium collection in Novosibirsk was represented mainly by scarce specimens collected in Siberia in the last three decades of the 20th century. No *Phyllonorycter*-like mines have been detected in this collection. In contrast, the *Tilia* herbarium in Saint Petersburg was impressive, containing about 3000 herbarium sheets with > 40000 leaves of *Tilia* spp. collected during the last two centuries. Two thirds of the herbarium sheets came from Europe (30 countries), Western Russia and Siberia, one third from East Asia (Japan, Korea, China and the Russian Far East).

No typical mines have been found in Europe, Western Russia and Siberia before 1960s, whereas *P. issikii* mines were abundant in leaves sampled in 1990-2014 in Western Russia. The herbarium material collected in Eastern Asia often carried traces of *Tilia*-feeding gracillariid, particularly in the Russian Far East. Mines were regularly documented in herbarium collected in Primorye in 1858-1970, with a pronounced infestation in Suputinsky (presently Ussurisky) Nature Reserve in 1914, 1936 and 1951-52. Surprisingly, the typical mines were regularly observed in the three northeastern provinces of China in the herbarium sampled in the first half of the 20th century, despite the fact that *P. issikii* was not known in this country before 2016 (Kirichenko et al., 2017).

As a conclusion, herbarium data supported the hypothesis of the recent occurrence of *Tilia*-feeding *Phyllonorycter* in the West and its long-term presence in the East. An extensive sampling in East Asian (especially in China) is required to detect the spots of high genetic diversity of *P. issikii* in order to understand its invasion westward and detect the main sources of invasive populations.

The study is supported by the Russian Fund for Basic Research, Russia (grant № 15-29-02645).

EVALUATION OF THE ROLE OF ALIEN FISH SPECIES IN THE CHEBOKSARY RESERVOIR BASED ON THE ANALYSIS OF DATA ON CATCHES BY VARIOUS FISHING GEARS

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At present, the distribution of alien fish species in the Volga reservoirs is well described. Their role in the ichthyocenosis of reservoirs is very actual. One of the criteria for such an assessment is the number of alien species in comparison with local species.

Alien species of the Cheboksary Reservoir are mainly related to fish that are not large in size. Therefore, only large size fish can be caught by commercial fishing gear – bottom trawl, fishing nets, fixed and drift gillnets. As by-catch, single or extremely rare *Hypophthalmichthys molitrix* (Valenciennes, 1844), *Coregonus albula* (Linnaeus, 1758), *Clupeonella cultriventris* (Nordmann, 1840), *Ctenopharyngodon idella* (Valenciennes, 1844), *Mylopharyngodon piceus* (Richardson, 1846), *Benthophilus stellatus* (Sauvage, 1874). Data on catches by commercial fishing gears do not provide an assessment of the true role of alien species in the reservoir's ichthyocenosis.

The authors made an attempt to estimate the number of alien species according to the data of fishing by various small-mesh fishing gears, including non-traditional ones, which allow to investigate all biotopes of the reservoir. There were used: pelagic trawl, small trawl in bottom and pelagic variants for motor boats, small fishing seines, channel trap. The aim of the research is to estimate the number of alien species in comparison with other local fish species of similar ecological groups. Evaluation criteria – the coefficient of occurrence in fishing areas and the average number. There were used data for the period 2007–2016, 468 samples were analyzed with a total catch area of 66.9 hectares, 48368 ind. were measured.

For example, brief results of studies on alien fish species leading pelagic life are presented. Comparable native species are *Alburnus alburnus* (Linnaeus, 1758), *Pelecus cultratus* (Linnaeus, 1758), *Abramis ballerus* (Linnaeus, 1758), *Leucaspis delineatus* (Heckel, 1843).

Osmerus eperlanus (Linnaeus, 1758) and *Coregonus peled* (Gmelin, 1789), previously common species, have not been recorded in catches for the last 10 years in various catches.

C. albula is recorded in the shallow coastal zone with depths of up to 3–5 m at the river section of the reservoir. Its number are rather high, but the occurrence is very low (70 ind./ha, 0.05).

C. cultriventris in the reservoir pelagial is the absolute dominant in the catches (3457 ind./ha, 0.81). Local species – *A. alburnus* and *P. cultratus* have significantly lower indices (15–21 ind./ha, 0.29). In a shallow-water zone in depths up to 2–3 m, on the contrary, the concentration of *A. alburnus* is higher (7054 ind./ha, 0.72) than the concentration of *C. cultriventris* (1254 ind./ha, 0.04). The indicators of *C. cultriventris* are comparable with indicators of *L. delineatus* (945 ind./ha, 0.02), but significantly higher than other pelagic fish species. In the near-bottom horizon of water the share of pelagic species is 22.9%: *C. cultriventris* (181 ind./ha, 0.21), *P. cultratus* (125 ind./ha, 0.13), *A. alburnus* is not marked.

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Comparing the above values, *C. cultriventris* is numerous species, *C. albula* is a small species with a local distribution pattern, *O. eperlanus* and *C. peled* – species that disappeared in the 2000s.

The results of studies, taking into account previously defined biotope areas, make it possible to calculate the indicative stocks of fish and assess the role of alien species in the reservoir's ichthyocenosis.

ON ALIEN POLYCHAETE SPECIES OF RUSSIAN SOUTH-EASTERN BALTIC AND ADJACENT WATERS

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Climate change and human impacts have resulted in numerous cases of aquatic species introduction and/or expansion beyond the limits of their natural geographic range, in the Baltic Sea. In the South-Eastern Baltic (SEB) since the last decade of the 20th century only in Polychaeta group five more alien species were registered.

Alien polychaetes of the area of interest belong to 3 families: Spionidae (*Marenzelleria neglecta*, *Marenzelleria arctia*, *Boccardiella ligerica*); Sabellidae (*Laonome* cf. *calida*); Ampharetidae (*Alkmaria romijni*). *B. ligerica*, *A. romijni*, *M. neglecta*, *M. arctia* are the species with native areal responds to arctic-boreal zoogeographical region. *B. ligerica*, *A. romijni*, *M. neglecta* – atlantic species (Zhirkov, 2010.) *B. ligerica* and *A. romijni* originate from Celtic sub-region, *M. neglecta* – boreal west-atlantic sub-region. *M. arctia* – arctic-pacific species of arctic shelf subregion. Sabellid *L. cf. calida* is the only invasive polychaete in the Baltic, which originates, most probably (Capa et al., 2007), from the notal zoogeographic region. This is australian species (south-australian sub-region). Ecologically, all aliens mentioned are the typical brackishwater species.

M. neglecta inhabits eutrophic shallow lagoons of SEB, dwelling on the silts and silty sands, at salinity 1.5–7.7‰. In the freshened Curonian Lagoon it is found only in brackish northern part, in the Vistula Lagoon is widespread everywhere. In Russian SEB waters another species of *Marenzelleria* genus, *M. arctia*, occurs – at various sediments to the depths of 80 m, salinity – 1–7.0‰. In Polish SEB waters *M. arctia* also occurs (S. Gromisz, MIR, Gdynia pers. comm.). There is reason to believe that and in Lithuanian waters SEB inhabits the same species, not the typical lagoon inhabitants *M. neglecta*. *B. ligerica*, *L. cf. calida*, *A. romijni* are found locally, only in the Vistula Lagoon, at silty sediments. The first two species dwell at salinity 1–7.7‰, the latter one is more stenohalinous and does not enters into freshened areas if below 4.0‰. In 2015 information on *B. ligerica* settlements with high density in the lower reaches of the Polish rivers belong to Vistula Lagoon basin (H. Kendzerska, University of Gdansk, pers. comm.). In the Russian rivers of the basin such the settlements has not observed yet. In 2016, *B. ligerica* once recorded in the sea at 21-meter depth, salinity 7–7.5‰, at sandy sediments.

MORPHOLOGICAL AND ECOLOGICAL CONSEQUENCES OF TRANSLOCATIONS

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Vast mammal translocation projects started on the Eurasian continent in the 20-th century. The practical value of those measures is evident and lies in fauna restoration, and increased productivity of hunting grounds. The fundamental issue is in the fact that these processes of an artificial splitting of populations acts as a trigger that brings about initial stages of speciation. Out of about 60 mammal species being actively translocated in Russia and neighboring countries most successful was the translocation of three species, namely, *Castor fiber*, *Nyctereutes procyonoides* and *Neovison vison*. Nowadays, after some decades, it is possible to evaluate the range of morphological variability and the integration of animals into natural communities.

Basing on size-adjusted and discrete morphological characteristics of animal skulls, an important conclusion has been drawn out stating that with the consideration of the polymorphism diversification ("adaptive norms" as treated by Schmalhausen and Mednikov) the incoming species populations preserve basic characteristics of parent population. Evidently, the "taxonomic stability" with them is very strong despite such potentially destabilizing factors as those connected with the environmental stress. Adaptive variability and stochastic processes have not been able to generate new stable taxons, an adaptation-oriented gradual morphological variability is at work. An artificial animal settlement on larger territories with contrastive environments has not brought about species diverging into subspecies. Here, only hybridization of *C. fiber* subspecial forms and that of morphological types of *N. vison*, which originated by selection processes, might be cited as exceptions. A considerable increase of morphological variability is a result of anthropogenic influences or that of natural animal dispersion reasons. Morphological variability caused by those reasons is ephemeral and may be explained by the Wahlund effect in a highly structured population, it is levelled up with panmixia.

Another aspect of the issue is the intrusion of new species into stable biocenoses. A partially restored inside its historical area *C. fiber* has no direct competitors, except a vicarious *C. canadensis*. The reintroduced species affects phytocenoses and the hydrosphere, which brings out changes in interconnected faunistic complexes. *N. procyonoides* due to their acquired wide ecological niche do not actually confront the aboriginal Canidae. Some antagonisms arise when using common burrows with *Meles meles* and *Vulpes vulpes*. *N. vison* when colonization and naturalization implements their aggressive strategies. *Mustela lutreola* disappears as a species due to the Gause competitive exclusion law and is substituted with a more viable American species. Besides, *M. putorius* is a part of interspecific competitive relations. When settling the translocated animals experience the environmental resistance impacts, such as competition with aboriginal species that have already assimilated the topical conditions, have analogical food preferences and similar behavior. All that fits into a Hutchinson's concept of the niche-hypervolume. Despite different life strategies of invaded species, the latter's vitality is high, which make them successfully naturalize in ecological systems.

INVASIVE SPECIES OF PLANKTONIC ALGAE IN THE VOLGA RIVER BASIN RESERVOIRS: ECOLOGY AND DISTRIBUTION

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The Volga River is a unique watercourse having the length of 3530 km and the catchment area of 1.360.000 km². Recently the river represents a chain of 9 reservoirs stretching in the meridional direction, connected to each by unite drainage and also connected to the basins of the Caspian, Azov/Black and Baltic seas by a series of channels. The whole reservoir system lyies in three major geographic regions: forest, steppe and desert zones. The Volga River reservoirs were created during a long period from 1937 to 1981, and they differ in surface areas, total volume, maximum depths, water turnover times. As measured by chlorophyll concentrations their trophic status varies from mesotrophic to eutrophic. Modern consequences of fast transformation of the Volga River reservoirs: increase in water temperature, mineralization and trophic state determined both by natural (climate) and anthropogenic impacts trigger the expansion of species better adapted to the changed environmental conditions. Now 15 invanding diatoms and 1 dinophyte are known in the Volga River reservoirs. Intensive development of the majority of invasive species of planktonic algae is associated with highly-trophic waters and maximal warming up of the water column during summer time. The direction of the main vectors of their expansion is from south to north. Invasive species determining the structure of modern planktic communities include first of all *Skeletonema subsalsum* (A. Cl.) Bethge and *Actinocyclus normanii* (Greg.) Hust. *Skeletonema subsalsum* started to actively spread in the Volga reservoirs from the Ponto-Caspian, after finishing of main hydro-engineering works in 60th of XX Century, while *Actinocyclus normanii* started its spread in mid 80th after impounding in 1981 of the last reservoir in the Volga cascade. Besides, nowadays in the all Volga reservoirs 6 brackish water species non-indigenous to the river. These are species of g. *Thalassiosira*: *T. incerta* Makar., *T. pseudonana* (Hust.) Hasle et Heimdal., *T. weissflogii* (Grun.) Fryxell et Hasle, *T. guillardii* Hasle., *T. faurii* (Gasse) Hasle and *T. gessneri* Hust. In 80th in the Volga River mouth *Thalassiosira proschkinae* Makar. was found.

During the extremely hot summer of 2010 and in summer of 2015, *Skeletonema subsalsum* and *Actinocyclus normanii* reached their maximum development in the highly trophic Cheboksary Reservoir. Before that, in summer 2001–2009, *Actinocyclus normanii* was not found in the Cheboksary Reservoir. In 2015 *Skeletonema subsalsum* was found in all reservoirs of Volga River, and *Actinocyclus normanii* was found only in Rybinsk, Cheboksary and Kuibyshev reservoirs.

A new species of planktonic dinoflagellates *Peridiniopsis kevei* Grigor. et Vasas was found in 1989–2011 in the phytoplankton of the upper Volga River reservoirs (Ivankovo, Uglich, Rybinsk and Gorky reservoirs). This species was found for the first time in the northern part of the Rybinsk Reservoir in late 1980th. In 1990th the species started to spread all over the reservoir area as well as in the Ivankovo and Uglich reservoirs; in early 2000th, in the Gorky Reservoir. The species develop most actively in summer time. The number of *P. kevei* was maximal in the Rybinsk Reservoir, especially in the rivers inflowing the reservoir and at the coastal shallows subject to zoogenic eutrophication during anomalously hot summer. Establishing of *P. kevei* in the reservoirs of the Volga River upper reaches coincided in time with that in the European waters.

TREMATODE FAUNA OF THE INVASIVE ROUND GOBY *NEOGOBIOUS MELANOSTOMUS* IN THE BLACK AND AZOV SEAS

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The round goby, *Neogobius melanostomus*, is one of the dangerous invasive fish species originated from Black and Azov seas region. Data on Gobiidae parasites in the Black Sea and Sea of Azov have been collecting since XIX century and Trematoda are the most abundant parasite group. Modern data on *N. melanostomus* parasite fauna in its native areas are rather scarce.

Materials and methods. More than 500 specimens of *Neogobius melanostomus* caught in the North part of the Black Sea (Karkinitzky Bay, Snake Iceland, Sevastopol region and Kerch Strait) and in the Sea of Azov (near Cape Kazantip, Stepanovka and Kirillovka) during 1995–2017 were examined for helminths using standard procedure of parasitological dissection. Prevalence, abundance and mean intensity of invasion were calculated. All the appropriate literary data on the Black and Azov seas region and the host were analyzed.

The round gobies examined yielded a total of 8 Trematoda species (*Timoniella imbutiforme* met., *Cryptocotyle concavum* met., *Galactosomum lacteum* met., *Cardiocephaloides longicollis* met., *Pygidiopsis genata* met., *Metadena pauli* met., *Helicometra fasciata*, *Pronoprymna ventricosa*) – most of them are generalists known from diverse fishes in costal ecosystems of Black and Azov seas.

The most diverse digenean fauna (six species) was registered near western Crimean coasts of the Black Sea (Sevastopol region); metacercariae of *C. concavum* and *G. lacteum* we registered from *N. melanostomus* inhabiting Karkinitzky Bay and Kerch Strait; the only Trematoda species, *C. concavum* met., was found from round gobies in the Sea of Azov. The gobies collected from Snake Iceland shelf zone were free of Trematoda invasion.

C. concavum met. infecting skin, gills and fins of round gobiids with high to extremely high prevalence, abundance and mean intensities are the most stable component (core-species) of *N. melanostomus* trematode fauna in all the investigated Crimean shelf regions meaning as Black as Azov Seas. Extremely high infection of *N. melanostomus* with *Cryptocotyle concavum* met. (P=100%) was registered near north-east coasts of the Sea of Azov. Round goby (*N. melanostomus*) believed to be the main second intermediate host of trematodes *C. concavum* in southern region of the Sea of Azov (Cape Kazantip).

Obvious long-term changes in species composition and abundance of Trematoda in round gobies in Black and Azov seas can be noted comparing data published during 1960–70th (about 30 Trematoda species) and modern ones (13 species); six Digenea species previously being common for round gobies in the Black and Azov Seas haven't been find from this hosts since 1970-s: *Aphanurus stosschi*, *Lecithaster confusus*; *Bacciger melanostomus*, *Paratimonia gobii*, *Bucephalus marinum* met., *Cryptocotyle jejuna* met.

COMPETITIVE TROPHIC RELATIONSHIPS BETWEEN EUROPEAN SMELT AND ARCTIC CHARR IN A SUBARCTIC LAKE (RUSSIA)

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The fishery importance of the lakes of the Murmansk region is due to the presence in the ichthyofauna of valuable objects for the fishery. Of the 14 fish species inhabiting them, 5 belong to the suborder of Salmonidae: trout, charr, whitefish, vendace, grayling. In Lake Imandra in the last century, the production of charr was in some years reached 170 centners. In commercial catches, the proportion of char and smelt in different years varied from 1–14% to 1–6%, respectively. Both species were defined as "present in commercial quantities".

Lake Bolshoy Vudyavr is located in the foothills of the Khibiny massif and is connected with the lake Imandra river Belaya. It is classified as small ($S = 3.49 \text{ km}^2$), has a glacial origin. Near the lake since 1929, the extraction and processing of apatite raw materials is carried out, annually about 70 million m^3 of insufficiently purified mine waters enter it.

In 1930, there were 5 species in the ichthyofauna of the lake: *Salmo trutta*, *Salvelinus alpinus*, *Coregonus lavaretus*, *Thumallus thumallus* and *Lota lota*. Descent of flotation waters by an apatite-nepheline factory along the Belaya River led to the almost total disappearance of fish. Ichthyological survey in 2006–2008 showed the presence of the charr and the nine-headed stickleback *Pungitius pungitius*. In further studies, European smelt was found in the catches, the number of which quickly increased. In 2014, its share in the catch was 40%, in 2015 – 88%. With a small lake size, serious competition between both species for fodder resources should be expected.

The total abundance and biomass of zooplankton averaged 44.3×10^3 specimens/ m^3 and 1.5 d.w.w. g/m^3 , i.e. according to trophy, the lake corresponded to the α -mesotrophic type. The number of bottom invertebrates averaged 2.2×10^3 specimens/ m^2 , the biomass was about 14 g/m^2 . According to the level of zoobenthos development, the Bolshoy Vudyavr lake corresponded to the β -mesotrophic type of water bodies. The water quality grade is III, and the degree of soiling is "moderately polluted".

Analysis of nutrition showed that the ration of charr was composed of 17 taxonomic groups, the diversity was formed due to insects (orders of Diptera, Hemiptera, Coleoptera and Trichoptera). Bivalve mollusks, Cladocera (Daphnia), Cyclops and nine-headed sticklebacks were rare. By frequency of occurrence, family Chironominae was leading. The total index of filling the stomach ranged from 16.2 to 91.7‰ .

As a part of forage objects of smelt, there were only 5 taxonomic groups. In the stomachs there were the order Cladocera *Daphnia longispina*, *Bosmina obtusirostris*, order Copepoda *Acanthocyclops gigas* and larvae of the chironomids r. *Psectrocladius* and r. *Microtendipes*. Daphnia was the leader in frequency of occurrence and mass fraction. The total index of filling the stomach ranged from 1.2 to 113‰ .

Common for both species were daphnia, cyclops and larvae of chironomids. It should be noted that during the years of study the smelt size did not exceed 20 g and the folk length 14 cm. With larger sizes, the basis of its feeding in the lake Imandra is mainly a vendace and 9 spiked stickleback. Thus, in the absence in the Bolshoy Vudyavr of the vendace, competition for the nine-headed stickleback will intensify, and perhaps a large smelt will consume the fry of charr.

INVASIVE FISH SPECIES IN CZECH REPUBLIC

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The issue of the occurrence of non-native fish species on the territory of Central and Eastern Europe was discussed earlier by Mikodina (2013). Presented paper analyzes the current situation in the Czech Republic, one of the countries in the region. Czech Republic has no direct contact with any of the seas. Surface waters from its territory are drained into the three main areas: the North, Baltic and Black Seas. Surface waters are constituted by river waters, dams and ponds.

The total annual production of market fish from aquaculture is around 21 metric tons with moderate growth tendency. It is dominated mainly by the traditional extensive and semi-intensive fish farming in ponds, e.g. common carp (87% share of total fish market) and herbivorous fishes (5%). To a lesser extent, intensive fish farming in flow-through systems (especially alien Salmonidae) is being carried out. Recently has been expanding an intensive breeding of fish species from temperate zones in recirculating systems (5% of the total market fish production in the Czech Republic, with non-native fish species prevailing). Commercial fishing is not practiced on the territory of Czech Republic anymore although angling is widespread. The total catch of fish by anglers is 4.5 metric tons per year (the largest volume of fish is constituted by carp, about 65%). Fisheries management of rivers and reservoirs is a major contributor to the stock of many fish species of aquaculture origin. For the need of angling, only a few non-native species are stocked in to the open waters alongside the native species. These introduced species do not pose any threat to aquatic ecosystems, because they do not reproduce naturally in open waters of Czech Republic (e.g. *Ctenopharyngodon idella*, Acipenseridae) or only to a limited extent (*Oncorhynchus mykiss*, *Salvelinus fontinalis*, several species of Coregonidae: *Coregonus lavaretus*, *Coregonus peled*, *Coregonus albula*, *Coregonus wartmanni*), not allowing the creation of naturally sustainable populations. Quite different is the situation with two invasive species, *Carassius auratus* and *Pseudorasbora parva*, whose deliberate transport and stocking in ponds caused unwanted creation of viable populations (with a view of expanding the food base for reared predatory fish species). In the future, other emerging invasive species as *Neogobius melanostomus* and *Proterohinus semilunaris* may be more prominent in flowing waters of Czech Republic. The occurrence of *Percottus glehnii* has not yet been recorded in the Czech Republic however can be expected in the near future due to its presence in all neighboring countries.

A total of 43 non-native fish species originated mainly from North America, East Asia and Africa were imported to Czech Republic for aquaculture purposes. Five species: *Salmo trutta*, *Thymallus thymallus*, *Barbus barbus*, *Vimba vimba*, *Lota lota*, were intentionally introduced into open waters for stocking reasons, including their uncontrolled spreading by hobby of fish keepers. The introduction of non-native fish species into Czech Republic has led to the introduction of some fish diseases like botriocephalosis, caviarosis and recently Koi herpes virus (KHV). Low in species numbers but significant in ecological implications is group of three species: *Carassius auratus*, *Pseudorasbora parva*, *Percottus glehnii* spontaneously migrating from neighboring countries.

ROSY BITTERLING (*RHODEUS OCELLATUS*) IN WATER BODIES OF SOUTHERN KAZAKHSTAN

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Rosy, or rose, bitterling *Rhodeus ocellatus* (Kner, 1866) is a non-native fish species for water bodies of the Southern Kazakhstan. It was revealed here for the first time by G.K. Kamilov and A.T. Borisova (1966, 1972) and described for the Akkurgan fish breeding farm in the Aral Lake basin as bitterling *Rhodeus sericeus* (Pallas, 1776). Then, A.P. Makeeva (1976) did a detailed morphological investigation of the fish larvae and young fishes and defined this species as the rosy bitterling. Ichthyologists of the region have paid no attention to the species, and so we investigated modern distribution and state of populations of the *Rhodeus ocellatus* in water bodies of Syrdarya, Talas and Chu watersheds.

The Talas river with some ponds on the river horns, the Ters-Asa river with the Ters-Aschybulak water reservoir, the Biylikol Lake and some small rivers on the north-eastern flank of the Karatau Mountains were investigated 2008–2016. The rosy bitterling was not found there. In contrast, this species was wide spread and usually numerous both side of the Talas watershed.

Morphological features of bitterlings caught in the Syrdarya and Chu watersheds belonged to the rosy bitterling *Rhodeus ocellatus*. This species was observed in the Syrdarya River from the Keles river middle reach and the Shardara water reservoir up to the river mouth as well as the Syrdarya tributaries like Karashyk and Arystandy rivers and irrigation canals. This species inhabited the Chu River from the border of Kazakhstan up to the end of the river and many tributaries too. The species was not numerous about 30 years after its penetration in the Syrdarya watershed and was not observed in the Chu watershed until XXIst century. Now it becomes a usual fish species there. Part of the rosy bitterling in fish communities in both watersheds varied significantly from about 1 up to 50% in different biotopes and years. The obtained data did not reveal any linkages between the rosy bitterling abundance and other fish diversity or flow regimen. The fishes were found in biotopes with different stream velocity and different water turbidity. Despite the numerous piscivorous fishes like pike, asp, perch, pike-perch and snakehead no one rosy bitterling was found in their stomachs yet. Sometimes rosy bitterlings were preys to water snake *Natrix tessellata*.

Every summer all the investigated adult fishes had significant fat reserves despite their abundance. Despite the big differences in body size, condition factors by Fulton or Clark did not varied significantly. Each samples contained adult fishes with different state of gonads maturity. Eggs number varied from 30 to 160 on different states. Maximal body size of fishes in the both watersheds was about 60 mm that is near to natural range.

In the Syrdaraya and Chu rivers, adult fishes mostly were found near to overgrown shores in the main stream, when young ones inhabited cutoff meanders and river branches with retarded flow. In small rivers fishes of different sizes were caught together. Native fish fauna in both referred watersheds bear strong direct and indirect human impact that lead to significant changes in fish fauna, and so we cannot distinguish just impact of rosy bitterling to native fishes. Investigated populations of the rosy bitterling showed better ability to adaptation to changed environment that many indigenious fish species.

This investigation was supported by the grant #2678/ GF 5 given by the Ministry of Education and Science of the Republic of Kazakhstan.

ESTIMATES OF THE RATE OF PHENETIC ADAPTOGENES FROM ALIEN FISH SPECIES

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The change of plastic signs in fish caught outside of their natural range by some researchers is seen as a microevolutionary process leading ultimately to allopatric speciation. We tend to disagree - phenetic morphological characteristics, nothing like adaptogenes. A simple expression is proposed for the detection of speed variation in morphological parameters:

$$V=s / T x N,$$

where s – the period of alien species into a new environment; T – average age of maturation of males and females; N – the number of statistically significant characteristics that differ from the parent population.

Example. The appearance of one new characteristic value from *Pseudorasbora parva* discovered on average every 1.25 generation, and *Percottus glehni* 1.16 through generations of generations, i.e. approximately with the same speed. Although cebasek in the new habitat lives of 30 years and rotan for 42 years.

ANALYSIS OF NUCLEAR (ITS 1-2) AND CHLOROPLASTIC (TRNL-F) SEQUENCES OF NUCLEOTIDES IN INVASIVE SPECIES OF *AMELANCHIER* MEDIK.

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Among the widespread neophytes in Russia, there are representatives of the genus *Amelanchier* Medik. (Rosaceae, Maloideae), whose taxonomy is difficult and variously treated by different authors. The species identification in this group is faced the problems caused by polyploidy, hybridization, and apomixis accompanied by the formation of agamic complexes (Campbell et al., 1997).

In the primary range of the genus *Amelanchier* in the North America are known a variation in DNA sequences, several ploidy levels and the presence of micro-species (Weir et al., 1996; De Barba et al., 2014; Burgess et al., 2015).

Two species of *Amelanchier* occur in European Russia as naturalized plants: *A. spicata* (Lam.) C. Koch and *A. alnifolia* (Nutt.) Nutt., and the former became an invasive species-transformer, forming communities lacking herbaceous plants and substituting natural vegetation (Kuklina, 2011). By the beginning of the 21st century herbarium collections from Moscow, Leningrad and Ryazan regions, indicate the spreading of plants with leaves intermediate between *A. spicata* and *A. alnifolia*. Despite the rare seed production, their invasive potentials look high due to spreading by a long hypogeogenic rhizomes.

We sequenced nuclear ITS1-2 and chloroplastic trnL-F for 18 *Amelanchier* samples, including putative parent species, *A. spicata* and *A. alnifolia*. The chloroplastic trnL-F sequences (KY799087-KY799094) and nuclear ITS1-2 sequences (KY661718-KY661735) are deposited in GenBank NCBI.

The trnL-F sequences (961 bp) revealed no differences in the studied samples of *Amelanchier*, as well as among the putative parent species. The ITS1-2 variation confirmed the putative hybrid origin of plants intermediate between *A. spicata* and *A. alnifolia*.

It is likely that they originated more than once, with subsequent spreading by means of vegetative reproduction. Thus the invasive potentions of such populations might be quite different.

The work was supported by the RFBR, 15-29-02556.

INVASIVE WEEDS OF UKRAINE STEPPES

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Plants invasion is the most serious and global ecological issue of today. Invasive species alter the soil's vegetational cover and its taxonomic structure, change the ecosystem of cultivated plants in agrophytocenosis, causing their decay, as well as causing plant diseases, infestation, lead to crop loss and other material, energetical and social losses.

In Ukraine's steppe zones, where a dramatic transformation of vegetational cover has been observed for a long time due to human economic activities (82% of the territory is allotted for plough land), favourable conditions for intensive and massive growth of invasive and potentially invasive plants were created.

At different times, 500 to 830 species of adventitious weeds (Protopopova, 1990; Vasileva, 1998; Konoplya, Drel, 1998; Burda, 2006; Maryushkina, 2006; Kurdyukova, Konoplya, 2012 and others), 9 to 58 of which were counted as invasive, were recorded there (Vorobev, 1973; Petrik, 2002, 2006; Shevera, 2006; Protopopova, 2009 and others).

We have estimated that 92% of all agricultural lands are to a certain extent infested with various invasive plant species of North American, Central American, Asian, Middle Eastern, and Mediterranean origin.

19 expansive species have been estimated to pose the greatest immediate and potential threat. They tend to be stress tolerant, quick and effective in terms of propagation; they have high levels of phytocenotic activity and broad ecological amplitude. Furthermore, 104 plant species with infectivity are notable for wide variation of biological property, as well as high compliancy levels.

The main sources of invasive plants' infusion are grain and animal food (72%) imported to Ukraine's steppe zones, bulk construction materials (12%), animals (7%) and other ways (9%).

The primary centre of creation, propagation and naturalization of invasive plant species is ruderal sites (animal farm lands, milling plants, cargo and terminal bases, sea ports, railroads depots, and roadside verges) – which altogether constitute 81%. From there they travel onto uncultivated lands, multiply their population and enter agrophytocenosis. For the last 20 years, the most dangerous have been proved to be *Ambrosia artemisiifolia* L., *Cyclachaena xanthiifolia* (Nutt.) Fresen, *Anisantha tectorum* (L.) Nevski, *Xanthium albinum* (Widder) H. Scholz, *Cenchrus longispinus* (Hack.) Fernald, *Erigeron canadensis* L., *Cardaria draba* (L.) Desv., *Erigeron annuum* (L.) Pers and others.

Propagation of the invasive segetalis plants (19%) is primarily determined by agrophytocenosis type, as well as ambient soil and climatic conditions. Thus, *Abutilon theophrastii* Medik., *Asclepias syriaca* L., *Avena fatua* L., *Polygonum convolvulus* L., *Sisymbrium volgense* M. Bieb. ex Fourn., *Portulaca oleracea* L., *Orobanche cumana* Wallr., *Cuscuta campestris* Yuncck travel from agrophytocenosis along fields, field tracks and shelter-belt forests, as well as to grassland and grazing lands, and then to ruderal sites.

According to our calculations, direct and indirect losses and damages from invasive plant species exceed RUB 208 billion annually.

ALIEN SPECIES OF BENTHOS OF VOLGA AND KAMA RESERVOIRS: DIVERSITY, REPRODUCTION AND DEVELOPMENT STRATEGIES, CONSEQUENCES OF DISTRIBUTION

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The rivers system of the Volga and Kama was transformed into qualitatively new reservoir ecosystems as a result of regulation of their flows. That process is accompanied by the spread of alien species, the diversity and role of which continues to grow in the Volga and Kama Reservoirs.

7 alien species of zoobenthos have been identified on the deep and shallow areas of the Gorky Reservoir, 12 species – of the Cheboksary Reservoir, 29 species – of the Kuibyshev Reservoir, 33 species – of the Saratov Reservoir and 37 species – of the Volgograd Reservoir. The basis of abundance (up to 79%) and biomass (up to 99%) was mollusks *Dreissena* sp. – *D. polymorpha* (Pallas, 1771) and *D. bugensis* (Andrussov, 1847). The highest frequency was found for the Ponto-Caspian polychaete *Hypania invalida* (Grube, 1860) – 43%. It was found that Ponto-Azov gastropod *Lithoglyphus naticoides* (Preiffer, 1828), also spread widely along the shoreline of the reservoirs and tributaries of rivers.

In the reservoirs of the Kama cascade 17 species of invaders of the Ponto-Caspian and Ponto-Azov complexes are registered, all of them are found in the Nizhnekamsk Reservoir. For the first time, the amphipod of the Ponto-Azov complex *Dikerogammarus villosus* (Sowinsky, 1894) was detected in the reservoirs of the Kama River, which along with *Pontogammarus robustoides* (G.O. Sars, 1894) is considered to be one of the most aggressive predators in Europe Rivers. 8 alien species: widespread Caspian crustaceans *Dikerogammarus haemobaphes* (Eichwald, 1841), *Pontogammarus robustoides*, *Chelocorophium curvispinum* and *C. sowinskyi* Martynov, 1924, Baikal amphipod *Gmelinoides fasciatus* (Stebbing, 1899), Ponto-Azov leech *Caspiobdella fadejewi* (Epstein, 1961) as well as molluscs *Dreissena polymorpha* and *D. bugensis* penetrated into the Votkinsk Reservoir. The proportion of invaders in the reservoir was no more than 25–30% of total biomass. Two alien species – *Gmelinoides fasciatus* and *Dreissena polymorpha* were recorded in the Kama Reservoir in small quantities only on the biotopes of shallow area. The major part of the benthic population was the aboriginal species of larvae of chironomids and oligochaetes.

Crustaceans and mollusks demonstrate the greatest invasive activity among all taxonomic groups of benthos in the reservoirs. Caspian mollusks *Dreissena polymorpha* and Baikal amphipods *Gmelinoides fasciatus* are recorded in all reservoirs of the Middle Volga and Kama Rivers. There is a mass development of Caspian crustaceans in the reservoirs of the Lower Volga: amphipods (20 species), mysids (5 species), cumacean crustaceans (5 species). Most of the massive alien species are close in characteristics to r-strategists (eurybionticity, euryphagy, generation development time, high fertility, rapid growth and early maturity, predominance of females during breeding). Significantly increasing its number in a short period of time, the invaders become dominant in the reservoirs-recipient.

A feature of the Volga Reservoirs is the mass development of the polychaete *Hypania invalida* on the silt biotopes of the former riverbed and flooded bottomland in the settlement of mollusks *Dreissena*. Bottom communities of Kama Reservoirs are characterized by a significant predominance of small amphipod *Chelocorophium curvispinum* and *C. sowinskyi* in consortium of *Dreissena* sp. on silted biotopes of deep and shallow areas of the waterbodies.

GREAT EGRET, A NEW INVASIVE SPECIES IN THE UPPER VOLGA

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Great egret is a true cosmopolite species found on all continents except for Antarctic. The species breeds in colonies, in trees close to large lakes with reed beds or other extensive wetlands. It feeds in shallow water or drier habitats, feeding mainly on fish, frogs and small mammals.

In the European part Russia, great egrets started increasing their abundance and settling further and further north in 1970s after almost complete disappearance due to hunting in 1800s – early 1900s. Now, great egret is sighted in all regions of the European Russia, including the northernmost, Murmanskaya oblast [Krasnov, 2016].

The first great egret encounters in the Upper Volga region (including the following oblasts – Tverskaya, Moskovskaya, Yaroslavskaya, Kostromskaya, Ivanovskaya and Nizhegorodskaya) have taken place in 2003 (Melnikov et al, 2003). Since then, such sightings became systematic. However, first nesting great egrets were found only in 2015, on an island in the Rybinsk reservoir, Yaroslavskaya oblast (Petrova, Pavlov, 2015). The number of nests in this colony increases, thereby indicating a slow but steady growth of great egret abundance.

We are planning to band great egrets and grey herons (*A. cinerea*) in Volga-Baltic region in 2017, to be able to track the migration routes and find the donor population(s) of birds in the studied region.

The reported study was funded by RFBR according to the research project № 16-04-00028 a.

SCIENCE TO SUPPORT INFORMED DECISION-MAKING: EXAMPLES FROM THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

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The mission of the United States Environmental Protection Agency (US EPA) is to protect human health and the environment. We work to achieve our mission through a combination of applied research and technical guidance for localities, states, tribes, and regions to best manage their terrestrial and aquatic systems – including the built environment in which we work and live. The US EPA's National Aquatic Resource Surveys (NARS) are statistically designed assessment approaches for the federal government via the EPA to work with local, state, and tribal governments to understand the condition of the nation's coastal waters, lakes and reservoirs, rivers and streams, and wetlands. Over the past decade we have assessed and reported to the United States Congress and the public on the condition, status, and trends of our aquatic resources. These data, collected in partnership with local, state, and tribal governments, include biological, chemical, physical, and human health indicators of condition and stressors at the scale of the contiguous US. In this presentation, I introduce the NARS and review and status and condition of the aquatic resources of the United States. There are major stressors, including the presence and abundance of invasive species, which are affecting aquatic resource integrity across the various types of waters assessed. Robust scientific data is critical to making informed decisions, and our experiences through the NARS program are helping the US EPA and our local, state, and tribal partners to better manage the aquatic resources of the United States into the future.

ALIEN PLANT SPECIES IN ECOSYSTEMS OF CENTRAL CAUCASUS

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The acute problem of biological invasions, which present by the world scientific community as a threat for biodiversity and which cause ecological and economic damage to various regions of the Earth, is also relevant for the North Caucasus. There was a need to study the alien plant invasions into natural plant communities and related processes of their transformation. The territory of is of interest in that aspect because there is a height difference of lands from 110 m above sea level (Mozdok district) to 4780 m (Dzhimara mountain) in a comparatively small area (7,987 km²) of the Republic of North Ossetia-Alania (RSO-A). Due to this, one can observe a nature under conditions of vertical zoning from the plain steppes through broad-leaved forests to high-mountainous pine and birch forests and subalpine meadows. This work is review to the study of alien (invasive) plants on the northern macroslopes of the Greater Caucasus.

After long-term observations 22 invasive plant species were registered in RNO-A as invasive plants: *Acer negundo*, *Ailantus altissima*, *Amaranthus retroflexus*, *Ambrosia artemisiifolia*, *A. trifida*, *Conyza canadensis*, *Echinocystis lobata*, *Elsholtzia ciliaia*, *Galinsoga parviflora*, *Gleditsia triacanthos*, *Impatiens glandulifera*, *I. parviflora*, *Medicago sativa*, *Muhlenbergia schreberi*, *Parthenocissus quinquefolia*, *Paspalum dilatatum*, *Phalacrolooma annuum*, *Robinia pseudoacacia*, *Silphium perfoliatum*, *Xanthium albinum*, *Xanthium spinosum*, *Xanthium strumarium*.

We have observed plant communities with high proportion of invasive species over the past 10 years. Sampling plots were laid in each vertical zone test and their description was carried out according to the standard phytocenological (geobotanical) methods: in Mozdok region – Lukovskaya, Vesolyoye, Chernoyarskaya villages (steppe belt), in the Kirov district – Zamankul and Kardzhin villages (forest-steppe belt), in the Alagir district – Tamisk and Biragzang, villages, in Prigorodny district – Koban and Sunzha villages (forest broad-leaved belt), in the Alagir district – Buron, Upper Zgid and Tsei villages, in Prigorodny district – Gornnaya Saniba village (forest mountain belt), in the Mozdok region – Kievskoe, Pavlodolskaya, Sukhotskaya villages (floodplain forests), in arid hollows in the Alagirsky district – Unal village, in the Prigorodny district – Fiagdon, Dargavs, Chmi villages (the highland-xerophytic, subalpine belt), the Prigorodny district – Tarskoe, and Digorsky district – the Chifandzar swamp (intrazonal swamp vegetation).

There is an opportunity to advance two main hypotheses on the basis of long-term observations:

- 1) Alien plants become less invasive along altitude gradient above sea level (invasion risk level decreases in higher-altitude belts).

- 2) Invasive woody plants (agriophytes) can play role of species-transformers only in certain high-altitude belts.

ALIEN FLORA OF THE KOSTROMA REGION (MIDDLE RUSSIA): COMPOSITION, TAXONOMIC STRUCTURE AND DYNAMICS

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The alien flora of the Kostroma region was studied by different authors since 1860-s but there was no comprehensive species list (366) till recently (Borisova, 2008). Despite the increasing interest in the regional alien flora there is no sufficient data on its nowadays composition, taxonomical structure and dynamics. The current aim is to compile all floristic data on alien plant species of Kostroma region. In this study data from 50 floral works published since 1867 to 2016 were critically evaluated and supplemented by materials available in Russian herbaria (LE, MW, IVGU). Our floristic study in Kostroma region was conducted in 2011–2016.

The alien flora of Kostroma region has at least 434 species belonging to 250 genera and 61 families. 79% of the aliens are neophytes and 21% are archaeophytes. As to the invasive status, 47.2% are casuals, 36.7% are naturalized, 16.1% are invasive. 11% of invasive species were classified as transformers (e.g. *Acer negundo*, *Heracleum sosnowskyi* and *Echinocystis lobata*) and 11% as potential transformers (e.g. *Amelanchier spicata* and *Hippophae rhamnoides*). Among 205 casual taxa 4.4% are archaeophytes and 95.6% are neophytes, 33.3% of naturalized species are archaeophytes and 66.7% are neophytes, 40.0% of invasive species are archaeophytes and 60.0% are neophytes (all transformers are neophytes). 3.7% of alien species are supposed to be extinct (e.g. *Lolium temulentum* and *Agrostemma githago*) while 3.9% show decrease in their frequency and became very rare in the region (e.g. *Bromus secalinus* and *Lithospermum arvense*). At the same time 18 native species including rare (e.g. *Eupatorium cannabinum* and *Lithospermum officinale*) were recorded as an alien inhabiting human-made sites.

Taxonomic structure of archaeophytes and neophytes is considerably different. Brassicaceae (16.7%), Poaceae (14.5%), Asteraceae (12.3%) and Lamiaceae (10.0%) are most represented among archaeophytes. Asteraceae (16.3%), Rosaceae (10.8%), Poaceae (9.9%), Brassicaceae (7.6%) and Fabaceae (5.8%) are typical to neophytes. *Populus*, *Rosa*, *Vicia* and *Amaranthus* (each includes 7 species) are the most represented genera among alien total.

Almost all alien species (99.3%) are living in human-made habitats, 17.3% are in seminatural habitats and 1.2% penetrate into natural habitats as well. 16.6% of aliens were found in both human-made and seminatural habitats. Mostly alien plants (67.5%) are living in one or two habitats, while 32.5% are in three or more habitats.

The accumulation of floristic data in the Kostroma region is uneven, therefore picture of gradual enrichment of alien flora is quite rough. First aliens in the region were recorded in 1820-s (4 species). Then there were three peaks of floristic researches provided a significant part of data on composition and distribution of alien plants: in 1860–1885 (121 species known), in 1960-s (ca. 200 species) and in 2000–2012 (ca. 400 species).

Compared to other regions of the Middle Russia (e.g. Moscow, Tver, Ivanovo, Tula, Kaluga) alien flora of Kostroma region is quite poor that might be related with low development of industry and infrastructure on the one hand and lack of floristic data on the other. We assume that alien species composition of the region revealed by 70–80% for now.

NEW INVADERS IN BELARUSIAN PART OF THE CENTRAL EUROPEAN INVASION CORRIDOR

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The Dnieper River with its large tributaries such as Pripyat, Berezina and Sozh being a substantial part of the Central European invasion corridor (Bij de Vaate et al., 2002) are likely to play an important role in spreading of the Ponto-Caspian aquatic species to Central Europe.

The monitoring of alien species has been conducting since 2006 (Mastitsky & Makarevich, 2007). Eight alien amphipods and two alien mysids have been recorded in Belarus till 2015 (Semenchenko et al., 2009, 2016; Makarenko & Vezhnovets, 2014). Two new species such as *Echinogammarus trichiatus* (Martynov, 1932) and *Paramysis lacustris* (Czerniavsky, 1882) were recently recorded in the Belarusian part of the Central European invasion corridor.

E. trichiatus (Martynov, 1932) was overlooked in Belarus and identified as a *Chaetogammarus ischnus major* Cărbănușu, 1943 (Makarenko & Vezhnovets, 2014). For the first time, this species was sampled in the Dnieper River near Nizhnie Zhary vill. in 2010 (Lipinskaya, 2010 unpublished). The identification of this specimen was checked using DNA barcoding techniques (Lipinskaya & Makarenko, 2015) (BOLD accession № SPCNAS-GTI 0178). In 2017, eight sequences of *E. trichiatus* (BOLD accession № SPCB-ET001 – SPCB-ET008) were obtained from specimens collected in 2016 (Lipinskaya, 2016 unpublished).

P. lacustris was mistakenly mentioned in the checklist of aquatic alien species of Belarus (Semenchenko et al., 2009) with the link on article (Semenchenko et al., 2007) showing this species as a potential invader of the Dnieper River. *P. lacustris* was found for the first time in Lake Drisyaty in 2006 and in the Neman River in Hrodno river port in 2008 (Semenchenko et al., 2009). For the first time, this mysid was found on three sites of the Dnieper River in 2016 (Lipinskaya, 2016 unpublished). The upper site of *P. lacustris* distribution in the Dnieper River is near Rechitsa town (Lipinskaya, 2016 unpublished).

Thus, nine alien amphipods and two alien mysids established in Belarusian part of the Central European invasion corridor now.

CANADIAN APPLE MEALYBUG (*PHENACOCCLUS ACERIS*) (HOMOPTERA, COCCOIDEA, PSEUDOCOCCIDAE) - 25 YEARS OF INCREASING THREAT FOR TREES AND SHRUBS OF KAMCHATKA

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Canadian apple mealybug *Phenacoccus aceris* was casually delivered to Kamchatka in 1992 with redcurrant seedlings. Up to 70–90% of fruit and berry crops had been cut down by 2013 in all allotment associations of Elizovo district as the result of long lasted and failed fighting with those insects. Annual loss for allotments, caused by mealybug, is 294 million rubles as minimum.

On the territory of Kamchatka, mealybug has settled in all populated places by means of seedlings and the speed of its self-settlement in eco systems is about 1 km per year. By now, this pest has already settled in no less than 16 species of deciduous trees and bushes. Max number of the pest was fixed in 2008–2014 and there were around 600 cocoons per 1 dm² of hawthorn bark; wintering cocoons were located in floor-by-floor position of up to 1800 species per 1 dm² of the bark, and by autumn, it had been discovered that 60–80% of trees had shrinkable branches and absence of fruiting. The variation of spring-and-winter temperatures regulates the number of species. In 2015–2016, was noticed a considerable decreasing of mealybug population due to delay of progression of female insects caused by cold and rainy period; that is why, by the time of males flyouts only 1% of females was ready for fertilization. As the result, for the first time in many years a medium-level honeysuckle crop was noticed.

Phenology. At the end of March, when the maximum temperatures (T°) are more than +5°C female larvae come out from the wintering cocoons on the hawthorn. Female species spread over the tree with the start of sap flow, at the average daily $T^{\circ} \geq +5^{\circ}\text{C}$, usually after mid-April. Males' flyout from the wintering cocoons coincides with the beginning of budding of the hawthorn and with stable transfer of average daily temperatures $T^{\circ} \geq 10^{\circ}\text{C}$ (the beginning of June). Oviposition happens due to the sum of active temperatures $T^{\circ} \geq 374^{\circ}\text{C}$ ($T^{\circ} \geq 0^{\circ}\text{C}$), accumulated in 2013 during 59 days. Females with egg pouches appear from mid-June within the period of leaf flushing. The duration of ovification is 32–38 days. Escaping from the egg pouches starts from the 3d decade of July, by the fruit-setting period, while accumulating of effective temperatures more than 660° ($T^{\circ} \geq +10^{\circ}\text{C}$). The appearance of wintering larval cocoons was noticed on the 1–2nd decade of September after the first frosts. Feeding continues till the end of October- beginning of November. The total feeding period is 156 days – the longest as for the insects of Kamchatka.

Mealybug is eurythmic specie, during the feeding period it can stand variations from $T^{\circ} = -7^{\circ}\text{C}$ to $T^{\circ} = +31^{\circ}\text{C}$. Fertility is high: up to 700–800 eggs, 550 eggs per one female insect at average. Sex balance is uneven, only 79–51% of male insects hatched from the wintering cocoons in the laboratory. Parasite fauna, being the main regulator of sucking insects' size, was not found on mealybugs. In early spring, the predators feed on larvae, but with the appearance of aphids and caterpillars they eat more usual and available food.

The main factors, directed to naturalization of mealybug:

1. Absence of internal phytosanitary control, carried out from continent to Kamchatka and inside of Kamchatka.
2. Increasing of average temperatures at the last ten years on +1,2° in comparison with 1981–2013 (as per mid-year and feeding period of mealybug (april–october)), and on 0,8 in comparison with 55th years term of GMS Sosnovka existence. (1957–2013).
3. Absence of Parasite fauna.
4. Absence of annual, planned complex contemporary protection. We have proposed such system of protection, based on the knowledge of invader ecology, which is annually posted in the Mass media, and in www.kronoki.ru, Kronotsky reserve site.

CRAYFISH DISPERSAL IN ALTAI TERRITORY WATER BODIES

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In 1976–1979 the long-fingered crayfish was spontaneously transported from the basins of the Kuban and the Don to the Altai Territory. Initially, the crayfish was introduced into Lake Bolshoy Utkul in the Troitsky Region. Crayfish got acclimatized successfully and a few years later a fishery population was formed and their self-dispersal began on the headwaters of the Ob. The second center of spontaneous crayfish introduction was the Skluikhinskoe Reservoir of the Rubtsovsky District, from where it spread along the Alei basin. The Kuchuk was the third place where crayfish actively utilized the river water area and the reservoir. Simultaneously with the self-dispersal in this water resource, systematic work was carried out in the Altai Territory to introduce the species into the Gilevskoe Reservoir (1983, 1984), into the pond of Suslovo, the Kasmala basin (1983), in the right-bank of Lake Petrovskoe (1987) and Lake Krasilovskoe (1990) (Reservoirs of the Altai ..., 1999).

By the end of the 20th century the crayfish were to be found in the harvests of river systems: Aleiskaya, Barnaulskaya, Kasmalinskaya, Kulundinskaya, Burlinskaya, in the lakes of the Biysko-Chumyshskaya group and also in the Ob. However, among all the crayfish reservoirs of the Altai Territory, only in some the species has formed significant fishery clusters. Currently, crayfish fishery is functioning in Lake Peschanoye, Lake Khomutinoye in the Burlinsky District, Lake Maloe Topolnoye in the Khabarsky District, Lake Mostovoe in the Zavyalovsky District and in Lake Gorko-Pereshechnoye in the Yegoryevsky District, and fishing is also possible in Lake Bolshoy Utkul in the Troitsky District (Vesnina, Lukerin, 2014).

The study of the crayfish stocks in the reservoirs of the Altai Territory has been carried out since 2007, which are dynamic. The main reason is the redistribution of crayfish fishery stocks from rivers to lakes.

In 2007–2008, the main volume of possible crayfish catch was concentrated in river systems, making up to 149 tons, in lakes the volume was about 30% of the total stock. As the result of low water levels and water temperature in the winter 2008–2009 a significant proportion of crayfish died, reducing the amount of possible catch by almost 100 tons. In the following years, there was a further reduction in crayfish stocks in rivers to 11 tons. At the same time, the number of rivers where fishery was possible got reduced. Until 2012, fishery stocks were registered in six water-courses of the Altai Territory, in 2013 – only in two, and in 2014 – only in the Burla.

The crayfish stocks in small reservoirs of the region fluctuated due to the population increase in the Gilevskoe Reservoir in 2009. The possible catch amount of crayfish in the reservoir was about half of the total. In the following years, there was a reduction in its numbers. In 2012, in the Skluikhinskoe Reservoir, and then in Gilevskoe Reservoir (in 2013), massive crayfish deaths were observed depriving the water bodies of their fishing status. Currently in the Skluikhinskoe Reservoir the crayfish are encountered separately.

Having formed fishery clusters in river systems, the crayfish actively settled in the lakes. From 2009 to 2013 the number of crayfish fishery lakes increased twice. The volume of possible crayfish catch in the lakes exceeded 250 tones. The main fishery clusters were recorded in Lake Mostovoe of the Zavyalovsky District and Lake Peschanoye of the Burlinsky District with an amount up to 100 tons per year.

MODELING, ORGANIZATION AND MAINTENANCE OF AN INTERREGIONAL MONITORING NETWORK FOR CONTROLLING THE INTRODUCTION AND RESETTLEMENT OF INVASIVE PLANT SPECIES

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In Russia, information support for monitoring invasive plant species is not yet sufficiently developed. An important step in this direction was the creation of the portal "Alien species in the Russian territory" in the sevin.ru domain. However, the availability of an information system of a national scale does not mean that there should not be a network of a regional-level. Russia includes different climatic and natural zones. Therefore, the composition of regional fractions of invasive species is significantly diverse.

The development, approbation and presentation of a regional approach to the monitoring of invasive and potentially invasive plant species should include a number of sequential steps:

1. Identification of the composition of invasive and potentially invasive species recorded in the territory of a region.
2. Distribution by the degree of invasive danger (status 1–4).
3. Selection, structuring and adaptation of scientific information for posting it on the web-site.
4. Selection of qualitative author's illustrations showing systematic features of the species and its presence in ecosystems of a region.
5. Representation of a map-scheme of a region, on which the identified pattern of settlement of the species is indicated by the method of grid mapping.
6. Checking through the site forum the possibility of interaction with the population of a region and collecting additional monitoring information about the appearance and resettlement of the most aggressive plant species.
7. The organization of scientific and educational information support to control species that are potentially dangerous, but are located on the periphery of the second range and can be destroyed in the primary outbreak centers.
8. Provision of information about the possibility of the appearance in a region of new invaders found near the borders of a region.
9. Development of recommendations for economic structures on the application of scientifically justified measures of control over aggressive and dispersed species.

ALIEN SPECIES OF AMPHIPODS (CRUSTACEA) IN THE WATER BODIES OF THE BELARUSIAN POLESIE

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Registering invaders, studying biology characteristics in the acquired habitat, monitoring their populations, identifying possible pathways, forecasting further resettlement of these species, as well as developing science-based and effective measures for the prevention of negative effects are a priority on a global scale being important not only scientific, but also practical problems.

The studies of Amphipoda alien fauna have been carried out since 2006 in Belarus (Semenchenko, Pugachevsky, 2006). This group most intensively occupies (colonizes) new habitats in the new acquired area. In connection with the expansion of alien species the current distribution of the order aboriginal representatives is being significantly reduced.

The Polesie territory is most susceptible to the penetration of the brackish water fauna of Ponto-Caspian origin due to the presence of large river basins and the extensive network of drainage channels. In addition, the river system of this region is a part of the central European invasive corridor (the Dnieper-Pripyat, the Mukhavets-Western Bug) connecting the reservoirs of the Black and Baltic Seas basins. Therefore, the registration of alien species in this area is an actual task not only for Belarus and neighboring countries, but also throughout Europe.

Collecting field material was carried out in the summer for 2011–2015. In the course of the study all main Polesie waterways were examined: the rivers Mukhavets, Pina, the Dnieper-Bug channel, the Pripyat, the Dnieper, the Sozh, the Goryn as well as their tributaries of different orders, additional reservoirs and large drainage channels.

To date there have been registered fifteen species of the order Amphipoda in the fauna of the reservoirs and water currents of Belarus. Nine representatives of these species are alien: *Chelicorophium curvispinum* (G.O. Sars, 1895), *Chelicorophium robustum* (G.O. Sars, 1895), *Echinogammarus ischnus* (Stebbing, 1899), *Echinogammarus trichiatus* (Martynov, 1932), *Dikergammarus haemobaphes* (Eichwald, 1841), *Dikergammarus villosus* (Sowinskyi, 1894), *Obesogammarus crassus* (G.O. Sars, 1894), *Obesogammarus obesus* (G.O. Sars, 1896) and *Pontogammarus robustoides* (G.O. Sars, 1894) (Semenchenko et al., 2009; Mastitsky et al., 2010; Makarenko, 2012, 2014, 2015; Vezhnavets, Makarenko, 2016). All of them are registered on the territory of Polesie.

A larger number of alien species is registered in the rivers of the Black sea basin. *Dikergammarus haemobaphes*, which has invaded all studied waterways, is the most widespread. Two species – *Chelicorophium robustum* and *Echinogammarus trichiatus* – are found only in one habitat on the border with Ukraine; and their penetration into the territory of Belarus is just beginning.

At the present stage of studying, the borders of distribution have been established and new habitats have been specified for the alien species of amphipod crustaceans. In the studied rivers the alien fauna has occupied the mainstream of large rivers and to a lesser extent tributaries and an upper course. For the majority of the registered species the expansion of the acquired area is observed. In general, the area of alien fauna expansion relates to the region of Polesie and makes about 25% of all territory of Belarus. Dimensional characteristics for all species and their fertility have been established in the reservoirs of Belarus for the first time.

The work has been performed with a partial support of the Belarusian Republican Foundation for Fundamental Research - the contract B16MS-016.

DISTRIBUTION OF *CORNIGERIUS MAEOTICUS MAEOTICUS* (PENGO, 1879) IN THE SARATOV RESERVOIR

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The facts of discovery of invasive species *Cornigerius maeoticus maeoticus* (Pengo, 1879) from Ponto-Caspian basin in the Saratov Reservoir have been known since 1996 (Romanova et al., 2016). *Cornigerius m. maeoticus* – Cladocera, habitant of the pelagic of the desalinated parts of the southern seas (the Azov, the Caspian), in plankton of rivers of the Azov-Black Sea basin, the Black Sea estuaries (Mordukhai-Boltovskoi, Rivier, 1986; Qualifier ..., 1995). We have first registered *C. maeoticus maeoticus* in summer 2003 as separate specimens in the middle zone of the Saratov Reservoir. Beginning with that moment given species is being registered regularly in the Reservoir during the vegetative period.

According to the observations of 2015 *C. maeoticus maeoticus* makes local accumulation in the lower reach of the Zhiguli Hydroelectric station (the Saratov Reservoir). The species is noticed in the spring-summer period (since May up to September) with maximum in July (2.265 thousand specimens/m³). At the same time in the upper reach of the Zhiguli Hydroelectric station (The Kuibyshev Reservoir) in the period under study in 2016 the given Crustacea has not been registered.

The analysis of the distribution of *C. maeoticus maeoticus* in the axial section of the Saratov Reservoir has revealed that it has been registered by the stations of monitoring in all zones of the Reservoir in July at the temperature of water 19–23°C making from 7 up to 23% of overall quantity of Cladocera.

Among the predatory Cladocera – representatives of the Ponto-Caspian basin in the Saratov Reservoir the following species *Cercopagis pengoi* (Ostroumov, 1891), *Podonevadne trigona ovum* (Zernov, 1901), representatives of p. Bythotrephes Leyding, 1860 are habitual. As well as native species (*Polyphemus pediculus* (Linnaeus, 1761), *Leptodora kindtii* (Focke, 1844)) they make considerable in quantity and biomass part of zoo plankton.

In general, Caspian forms are extremely ecologically changeable and having the opportunity of dissemination in the Saratov Reservoir. In the present time they form numerous populations.

A number of authors consider bilge waters to be the reason of dissemination of this predatory Cladocera in the Reservoirs of Volga cascade. In our opinion the given species as many others (*Archeobdela esmonti*, *Syngnathus nigrolineatus*, *Perccottus glenii*, *Podonevadne trigona ovum*), is rather a casual introducer during the planned introduction of zoo plankton into the Volga Reservoirs.

INFESTATIONS OF NEW BIRD SPECIES TO EASTERN SIBERIA AND THEIR LINK WITH MODERN THE CLIMATE DYNAMICS

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Modern warming of a climate was very non-uniform. It was accompanied by growth meridian and strong attenuation zonal atmosphere circulation in northern hemisphere of the Earth (Zherebtsov et al., 2011, 2013). On a course of these processes the great influence was rendered by regional conditions. Therefore each large region always has the specificity in dynamics of a climate and well differs from next on middle ground temperature of air for second half XX and the beginning of XXI centuries (Mel'nikov, 2016). In the end of 50 – the beginning of 60th years of the last century has sharply strengthened meridian transmission to North Atlantic sector, and a little later (from the end of 60th years) the similar situation was observed in Pacific sector of northern hemisphere (Zherebtsov et al., 2011, 2013). Strengthening meridian atmosphere transmission was accompanied by development of extensive droughts in the Central Asia (1958–64), and then (1968–78) in East China and Mongolia. Now, in addition to them, droughts capture northern areas of the Irkutsk region and Transbaikalian krai. Extensive droughts were obviously characteristic for moderate widths of Northern hemisphere. It is bound to attenuation of zonal atmospheric circulation for which becomes even the temperature of adjacent regions and strengthening of warmup of the central regions of Asia (Mel'nikov, 2016). Here some loci with elevated temperature from 1.5°C to 2.2°C for 100 years were generated, at middle for Northern hemisphere 0,7°C for 100 years (Shimaraev et al., 2008; Shimaraev, Starygina, 2010; Zherebtsov et al., 2011; 2013; Latysheva et al., 2011; Berezhnich et al., 2012; Objazov, 2012).

These processes, along with the general warming of Northern hemisphere also have defined the general dynamics of bird fauna in Eastern Siberia (Mel'nikov, 2015, 2016). In first half XX centuries the general structure of their fauna included 376 species. In second half XX and the beginning of XXI centuries it already included 471 species. Hence, for this period in Eastern Siberia the bird fauna has replenished with 101 new species (21.4%). From them the greatest of amount species is fit on a category of casual birds – 55 species. The quantity of the species meeting only in the seasons of migrations, is insignificant – 9 and they are introduced northern, earlier small, birds. From total of new species, the number of the nesting birds includes 31 species from which not less than 25 species have considerably dilated geographic ranges to the north. However their number is low also them much them are marked here on a nesting ground only incidentally. Three more species are marked in the summer season, but their nesting is not positioned. Among nesting new species only at four gradual increase of number at northern limits of their diffusion (to several honeycombs of pairs) is marked. Hence, considerably having increased qualitative composition of bird fauna of Eastern Siberia, new species actually have not changed a total number of aboriginal fauna.

At the same time, it is necessary to note significant changes in structure of the population of birds of wetland ecosystems. The last is bound to the essential changes of their quality invoked by drying of shallow lakes, even very big on the area (Torejsky lakes). The most abyssal lakes which shoals take place now stages of initial successions of neritic vegetation were conserved only. Isolating of large limnetic systems has considerably increased also they began to differ more strongly on structure of habitats from each other. Strong changes of number of numerous and most mass species have descended for the account shorebirds and a waterfowl because of shift of optimum of their geographic areas in northern widths. Among them very mass species which have widely mastered northern regions of geographic areas, and, because of the large number, playing an important role in near shore ecosystems new to them are excreted some. First of all, it concerns fish-preying species – Great Cormorant *Phalacrocorax carbo*, Mongolian *Larus (vegae) mongolicus* and Mew *L. canus* Gulls, Grey Heron *Ardea cinerea*, Caspian Tern *Hydroprogne caspia*, Common Tern *Sterna hirundo* and to some other species which economic value has obviously raised.

DISTRIBUTION OF *HELIX POMATIA* L. (GASTROPODA, GELICIDAE) IN THE NORTH-EAST OF UKRAINE

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Helix pomatia – is a normal species of natural and urbanized biotopes in the West of Ukraine (Сверлова и др., 2006). It is found in Vinitsa, Odessa, Nickolaev, Kiev, Poltava regions, Krimea (Хлус, Хлус, 2003), Cherkassy, Kirovograd regions (Балашёв, Байдашников, 2010), in Zhitomir and Kharkov (Сверлова, Кирпан, 2004).

Till recent time Sumy region was not in the list of *Helix pomatia* dwelling place (Хлус, Хлус, 2003). The first find of *Helix pomatia* of such species which we know about was found in Sumy region in June 1988 (Мерзликин, 2005). At that time in the arboretum of Kyanitsa settlement (Sumy district) a great quantity of *Helix pomatia* was found. Perhaps they were brought there by guests of a tourist center, which started working there since 1973.

At the same time 15 adult specimens were caught and released 4 km from there in territory of a biological stationary of Sumy State Pedagogical University, located in the outskirts of Vacalovschina village, Sumy district.

Then in different years small batches of adult mollusks (about 20 specimens in each batch) were repeatedly caught in Kyanitsa arboretum and released on the territory of the biostationary.

Next year *Helix pomatia* began to come across on the territory of the biostationary and by present time their sustainable population had already formed. Mollusks can be found in among bushes on the edge of the oak forest.

In summer, 2016, an adult specimen of *Helix pomatia* was found in the kitchen garden in village of Basovka (Sumy district) located in 28 km from Kyanitsa.

On the 5th of May, 2014, an adult specimen of *Helix pomatia* was found on the left bank of the Vorskla river in 1 km from the village Skelka (Akhtyrka district) among bushes in the bottom land oak forest. This is a favorite rest place of inhabitants of Kharkiv, Akhtyrka and Sumy, that's why they may be brought there by people (Мерзликин, 2014).

Since 2013 *Helix pomatia* have been found by us in five different places in Sumy.

In summer, 2016, an adult *Helix pomatia* was found in Trostianetsky arboretum in the town of Trostianets.

Thus, *Helix pomatia* population had been existing on the territory of Sumy region for about 30 years. At the present time this species was found by us in 5 places in the city of Sumy and 5 places of Sumy, Trostianets and Akhtyrka districts as well.

Future mollusks distribution is expected on the territory of Sumy region.

DIKEROGAMMARUS VILOSUS (AMPHIPODA, GAMMARIDAE) IN THE SOUTH-EASTERN BALTIC SEA

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Amphipod *Dikerogammarus villosus* (Sovinsky, 1894) is one of the most ecologically successful migrants of Ponto-Caspian origin. Since 1990, *D. villosus* demonstrated active dispersal in European inland waterways along of so-called Southern and Central invasive corridors, connecting the Black Sea, North and Baltic Sea basins. By the beginning of 2000's the species become widespread in European rivers, including the Oder and the Vistula. In the Baltic Sea (Szczecin Lagoon) *D. villosus* was firstly registered in 2002 (Gruszka & Woźniczka, 2008). Further the species dispersal noted in Polish coastal waters, and it was firstly recorded in the Gulf of Gdańsk in 2010 (Dobrzycka-Kraheil & Rzymkowska, 2010).

In Russian South-Eastern Baltic (SEB), the Gulf of Gdansk, *D. villosus* was recorded for the first time in summer 2013 at the western extremity of the Sambian Peninsula (our data). Already the first finding (23 individuals) showed a large enough settlement. In 2015 two specimens of *D. villosus* were firstly found on the Vistula Spit, in a coastal algal accumulations (A. Gusev, pers. comm.). To date, the invader is constantly occurring on a fairly large segment of the Russian coast of the Gulf of Gdańsk.

Material for this study was collected in 2013–2016, at 8 locations in littoral and sublittoral zone, from 0 to 10-meter depth. Totally 308 specimens from 90 samples were analyzed. The aim of the study to describe the distribution of *D. villosus* in Russian SEB and assess the status of invasive populations

D. villosus frequency of occurrence (FO) in 2013–2014 reach 28%, characterizing the species as not very numerous. In 2015–2016 FO has doubled (58%), reflecting the growing abundance of invader and its further spread along the coast. The preferred biotope of *D. villosus*, the same as in native area, were macrophytes' communities at a stony beds. The crustacean dwell from the water line to a depth of 3 m, and absent at 4–10 m depths. 25% of all adult specimens collected, were found in floating mats of red algae *Furcellaria lumbricalis*. We believe, the alongshore drift of these algae with attached dikerogammarus is one of the main vectors of its secondary dispersal in the coastal zone of the Baltic Sea.

Size range *d. villosus* – 18.4–4.5 mm. Males are larger than females. Female length 4.5–17.4 mm, males – 18.4–5.6 mm. The sex ratio in the population in all years was characterized by the dominance of females. Juveniles were marked yearly, in different dates (July, September, October). Ovigerous females were found only in January 2015, in a coastal algal accumulations.

It may be concluded, *D. villosus*, firstly recorded in the Russian SEB in summer 2013, to date is common for at least 50 km of coastline, it is a typical inhabitant of littoral and sublittoral habitats with the dominance of macrophyte algae, and could be regarded as fully established.

The study was funded by general budget of the Shirshov Institute of Oceanology RAS, Atlantic Branch (scientific theme № 0149-2016-0005).

ON THE DISTRIBUTION OF GOBIES (GOBIIDAE) IN WATERCOURSES IN THE SUBORDINATE SYSTEM OF THE CHEBOKSARY RESERVOIR

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In recent decades the fish of the family Gobiidae rapidly spread up the Volga reservoirs, already penetrated in Rybinsk. In the Cheboksary Reservoir at the present time found: *Neogobius melanostomus* (Pallas, 1814), *Neogobius gorlap* (Iljinin Berg 1949), *Neogobius fluviatilis* (Pallas, 1814), *Proterorhinus marmoratus* (Pallas, 1814) and *Benthophilus stellatus* (Sauvage, 1874).

In the Cheboksary Reservoir flows into 3 major tributaries – Oka, Sura, Vetluga, and about 40 small rivers. In different years surveyed 27 tributaries (16 from the right Bank and 11 from the left Bank), which flows into the reservoir in the range of 864 to 1178 km of the fairway.

Gobiidae prevalent at the mouths of tributaries to the reservoir: *N. melanostomus* was observed in 33.3% of cases, *P. marmoratus* is at 25.9%, *N. gorlap* – 22.2%, *N. fluviatilis* – 7.4%, *B. stellatus* – 3.7%. *N. melanostomus* and *P. marmoratus*, the most common types, *N. gorlap* marked to 1069 km of the fairway (the mouth of the Sura), sandy – to 1147 km o.t.f. (the mouth of the stream Sheskary), *B. stellatus* occurred only in the Oka river (906 km sh). Wellhead extensions, populated by fish, Sam. Gobiidae, with the exception of the mouth of the river Vetluga, are tributaries of the right Bank.

Among the major tributaries of the Cheboksary Reservoir the Oka River is the most populated by Gobiidae (our data and some authors). Here is found *N. melanostomus* and its colonization was carried out since the mid-1980s and 1990s in two areas: in the upper reaches of Moscow River, in the lower and higher – from the reservoir. *N. fluviatilis* was noted in the middle and upper reaches of the Oka, but in the lower reaches have not yet discovered. *P. marmoratus* has penetrated into the eye in the early 2000-ies and was currently settled up to 205 km o.t.f. of Oka River, the middle reaches were noted. *B. stellatus* noted since 2002 in the estuarine area (by our data) and in the middle reaches (up to 610 km o.t.f. of Oka River) on the territory of the Ryazan region (by the data of some authors). *N. gorlap* not yet discovered in Oka River.

Gobiidae raised in separate tributaries of the Oka: *N. melanostomus* observed in the Tersha river in 24 km from the mouth (by our data), in the lower portions of Prony and Pairs (Ivanchev, Ivancheva, 2010), noted in Shatura lakes connected with the river Bol. Ushma – a tributary of the Klyazma River (Pillow, 2004). The special place occupies Moscow River (a tributary of the Oka River), which was formed and for a long period of time, there are populations of *N. melanostomus* and *N. gorlap* (by the data of some authors).

River Sura and Vetluga located on 167–200 km downstream than Oka, but check them Gobiidae is not much. In Sura *N. melanostomus* penetrates on 28 km from the mouth, in the estuarine area are also present by *N. gorlap* and *P. marmoratus*. All three species of gobies fish observed in Vetluga spur of the Cheboksary reservoir, but above did not rise.

In the tributaries, the Vetluga and the Sura rivers Gobiidae was not detected.

A range of Gobiidae in the small rivers – tributaries of the reservoir – may be significant. *N. melanostomus* marked in Bolshaya Yunga River. in 10 km from the mouth (3 exemplars in 2011). In Tsivil and Maliy Tsivil rivers – the right-Bank tributaries of the Kuibyshev Reservoir (the mouth is located near the dam Cheboksary HPP) in 2014 marked *N. melanostomus* 22 km from the mouth (92 exemplars), *N. gorlap* – in 54 km from the mouth (3 copies).

Thus, the most common type of Gobiidae in the tributaries of the Cheboksary Reservoir is *N. melanostomus*. The Gobiidae able to live in streams with fast currents, such as the Oka, Tersha, Bolshaya Yunga, Tsivil and Maliy Civil rivers. In some cases, their distribution cannot be explained by drifts in the result of shipping, and is directly related to the active search for new habitats.

GENETIC VARIABILITY OF *DREISSENA POLYMORPHA* (PALLAS, 1771) POPULATIONS IN LATVIA

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The zebra mussel *Dreissena polymorpha* is a successful invasive bivalve native to the brackish and freshwaters systems of the Ponto- Caspian regions. The first introduction of the species *Dreissena polymorpha* in Latvia was in the Gulf of Riga in the 1845. Mussels were negative impacts on biota that inhabit the pelagic zones of lakes or rivers. Because of their high fecundity and ability to settle on almost any solid substratum, zebra mussels usually out-compete the resident species and cause severe damage to waterworks.

The main aim of this study is to examine the populations' genetic structure of invasive species *Dreissena polymorpha* in Latvia and in the Baltic region.

Genetic monitoring can provide crucial information on genetic diversity, connectivity, fitness, and viability of populations. Furthermore, the origins of invasive species, their expansion routes, and predictions of future evolutionary trajectories can be resolved.

For the present study of zebra mussel population genetic structure, was used highly polymorphic microsatellite markers. Microsatellites have emerged as the most popular and versatile marker type for ecological applications.

Five polymorphic microsatellite loci for zebra mussels were developed and tested in this research. Allelic diversity was high at all described loci, ranging from 10 to 15 alleles per locus.

The mean number of alleles per locus varied in the different populations. The within population genetic variation indices: number of alleles (NA), expected (He) and observed (Ho) heterozygosity, and the fixation index (FIS) were estimated in GenAlEx 6.41.

The samples were screened for abnormalities (null alleles, scoring errors, etc.) in the software MICRO-CHECKER 2.2.3, using 1000 bootstrap replications to generate the expected homozygote and heterozygote allele size difference frequencies.

Bayesian clustering as implemented in STRUCTURE 2.3.2, was used to provide another estimate of origin and population structure of the data.

This study has been supported by the National Research Programme 2014-2017 „EVIDEnT” Sub-project 2.4. „Non-indigenous species distribution and impact on freshwater ecosystems”.

NATURALIZATION OF ALIEN PLANT SPECIES IN EUROPEAN RUSSIA

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Naturalization is the most important stage in species establishment in new environment, and some biogeographical patterns of naturalization are known (Richardson, Pyšek, 2012; van Kleunen et al., 2015). The territory of the European Russia (ER) is a unique polygon for studying the features of naturalization on the latitudinal gradient. Due to the large extent of the territory of the ER, its alien flora has a some peculiarities: a) the ER alien flora includes species whose primary ranges are partially located in the territory of the ER and b) most alien species have different invasion status in different Regions of the ER, thus many species have a change in their florogenetic or invasive status. The analysis of ER alien flora is based on the materials of the AliS database (Morozova, 2002, 2003), which contains 1) information on the findings of alien species of vascular plants in the territory of ER from different publications; 2) morphological, biological and ecological characteristics of species, 3) information on the invasion status of species in the regions of European Russia, 4) information on the nature of the species's presence in a particular Region (natural or alien). This database is now puted in Internet GIS (Morozova, Borisov, 2010). The collected material includes about half of the ER Regions and clearly is not exhaustive, but it has sufficient information and it is a collection of information on alien species of ER available to date. For ER the differentiated nature of naturalization and the spread (resettlement) of alien species was marked. 41% of all alien ER plants were naturalized in at least one of the regions of the ER, among them there is not one species that would be naturalized in all regions. 35 species (4%) were naturalized in more than half of the regions, 42% of species were naturalized only in one of the regions. The main feature in the naturalization of species in ER includes a different invasion status along the latitudinal gradient for most species (an increase in invasive status); although for some species the trend is different. For example, *Heracleum sosnovskyi* and *Lupinus polyphyllus*, which are widespread invasive species in the regions of southern taiga and broadleaved-coniferous forests, in the forest-steppe in the Voronezh and Ulyanovsk Regions have only local distribution and belong to the category of "naturalized" species. The main regularities of naturalized species are following. 1. In the group of naturalized species, perennial herbaceous plants predominate over annual-biennial plants, but a decrease in the proportion of herbaceous perennials from north to south is observed. Comparative analysis of species distribution types revealed a) multiplicity of vectors, b) predominance of anthropochoric and zoochore types for species at the stage of naturalization, c) a significant increase, and in some cases, the predominance of anemochoric mode in the case of successful species dispersal (at the stage of invasive species). Among the naturalized species, plants with the Euro-West Asian and American type of range predominate. An explicit north-south gradient has groups of species of European origin and of Euro-West Asian type of range (in the southern regions their proportion decreases), as well as species with a Mediterranean area (their proportion increases from north to south). 2. The regional participation of naturalized species was assessed by the ratio of naturalized species (including invasive species) to the entire number of alien species of the region, which reflects both the influence of the alien species themselves and the potential possibilities of a particular region for naturalization. For ER Regions a trend of increasing in this index from north to south was marked. 3. Deliberate species predominate among naturalized species, with an increase in their share in the south. This circumstance can be related to both more favorable climatic conditions in the southern regions and the dependence of naturalization on climate (Morozova et al., 2008), and to a decrease in the proportion of unintentionally recorded species in the southern regions. The latter is due to the fact that for a rather large part of alien species the southern regions of European Russia are in the area of their natural ranges; respectively, such species are introduced only for the northern half of the ER.

THERMAL ADAPTATIONS OF AMUR SLEEPER *PERCCOTTUS GLENII* AND LAKE MINNOW *PHOXINUS PERCNURUS*

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The thermal reactions of a number of species remain poorly studied, despite the fact that the thermoadaptation characteristics of freshwater fish inhabiting the European part of Russia, including in the Upper Volga region, have been studied for a long time and in detail (Golovanov, 2013; Golovanov, Kapshaj, 2015). This applies, for example, to such species of fish as the species-invader Amur sleeper *Perccottus glenii*, as well as the lake minnow *Phoxinus phoxinus*. These species are of considerable interest, since Amur sleeper is one of the most successfully dispersed species across the territory of not only Russia but also Europe, and the lake minnow, unlike the common minnow *Phoxinus phoxinus*, on the contrary, has an interrupted range and, therefore, a fragmented distribution in the lakes of the European part of Russia (Reshetnikov, 2002).

In this connection, experiments were conducted to determine the parameters of the final selected temperature (FST) and the critical thermal maximum (CTM) for fingerlings, yearlings and second-year fish Amur sleeper in the summer, autumn and winter seasons of the year. In addition, the values of FST, CTM and lethal temperatures (LT) were determined for the three age groups of the lake minnow in the autumn season. Standard methods for studying thermal selection and thermal resistance of fish have been used (Beitinger et al., 2000; Golovanov, Smirnov, 2007; Golovanov et al., 2012; Golovanov, 2013a, b; Golovanov, Kapshaj, 2015).

In the summer and autumn-winter seasons, the FST values of Amur sleeper were $30.0 \pm 0.1^\circ\text{C}$ and $27.9 \pm 0.1^\circ\text{C}$, respectively (Kapshaj, Golovanov, 2013). At the same time, the thermal resistance indicators for the summer and autumn periods of the year were at a heating rate of 9°C/h : CTM – $34.8 \pm 0.2^\circ\text{C}$ and $30.2 \pm 0.2^\circ\text{C}$; LT – $36.4 \pm 0.2^\circ\text{C}$ and $31.2 \pm 0.1^\circ\text{C}$ (Golovanov et al., 2013; Golovanov, Kapshaj, 2015).

The FST values for the second-year fish lake minnow after two 12-day experiments turned out to be $\sim 22\text{--}24^\circ\text{C}$, which was slightly higher than in the common minnow ($16\text{--}17^\circ\text{C}$) in the autumn season (Mavrin et al., 2010). The values of CTM at a heating rate of 8°C/h did not differ significantly from the fingerlings ($31.6 \pm 0.2^\circ\text{C}$) and three-year fish ($31.8 \pm 0.2^\circ\text{C}$) of the lake minnow. In second-year fish, the values of CTM, after staying in the temperature gradient for 12 days, amounted to $34.9 \pm 0.1^\circ\text{C}$. The values of LT in three age groups (fingerlings, second-year and three-year fish) were 33.5 ± 0.1 , 35.6 ± 0.1 and $33.7 \pm 0.1^\circ\text{C}$, respectively. The highest values of CTM and LT were observed in second-year fish, which is obviously due to the preliminary acclimation of fish to a higher temperature during the selection of the FST zone. At the same time, the values of CTM in all age groups were lower, then values of LT, which agrees with the data obtained earlier (Golovanov, Smirnov, 2007; Golovanov et al., 2013).

Thus, the research of thermal adaptive features in aboriginal species and invasive species allows expert determination and prediction of their distribution in different water bodies in remote seasons of the year. The thermal selection and thermal resistance indicators obtained experimentally indicate possible ranges of the ecological-physiological optimum and pessimum of species living in rivers, lakes, reservoirs and other temporary reservoirs, for example, in ponds.

The study was carried out with the support of the Program of the Presidium of the Russian Academy of Sciences: I.21P Biodiversity of Natural Systems. Biological resources of Russia: assessment of the state and fundamental principles of monitoring. 2.5. Influence of anthropogenous regulation of the level regime of reservoirs and temperature on the dynamics of the number of fish of different ecology and the Presidential Programs "Leading scientific schools" SSc-2666.2014.4 and SSc-7894.2016.4 "Ecological aspects of adaptations and population organization in fish".

THE ALIEN SPECIES OF FISH IN THE RESERVOIRS OF THE EUROPEAN NORTH-EAST OF RUSSIA

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Last decade all over the world special urgency by a problem of biological invasions was gained, which one as all cases of infiltration of alive organisms in ecosystems disposed outside their initial (usually natural) area are understood. These species (ASLO, 2000; Intital risk ..., 1999) can attack a population, species both communities of faunas and floras, frequently resulting to irreversible modifications of ecosystems. The stranger fishes in basin of the White Sea as a result of realization acclimatization of activities (Far East – *O. gorbusha*, Pechora river – *C. peled*), directional (*S. lucioperca*) and random (*P. glenii*) introduction, and also self-moving Caspian (*A. sapa*, *A. aspius*) or Baltic (*A. aspius*) species have appeared.

Acclimatization. Far East – *O. gorbusha* in basins White and Barents of the seas is acclimatized. It in pools Kola peninsula, Kareliya and Arkhangelsk area, it is marked for European shores of Norway, Sweden, Iceland and Spitsbergen, meets in watershed of Pechora river, in east reaches up to Yamal peninsula is widespread. The biological effect of an acclimatization in enough high number naturalized *O. gorbusha* as trade plant is expressed. At the same time remains to a debatable problem on its competitive interspecific relationships with native species – Atlantic salmon and salmon trout. Pechora *C. peled* – to varied pools of basin of the White Sea, where successfully has mastered a new area is delivered. As a result of a broad ecological toughness there was a formation of three ecological forms – lake, lake-river and river. The strength of alimentary relations *C. peled* with native species of fishes due to an almost full divergence of their feed spectrums during acclimatization was practically missed. The scheme of lake architecture the division of white fish facilities with shaping of own parent herd is designed.

Introduction. *A. aspius* – has a restricted area in pools of the Arkhangelsk area and meets only in a series lakes of the Baltic basin (lakes of Monastyrskaya and Nosovsko-Luzskaya systems). It in the Severnaya Dvina river as a result of directional introduction in Sukhona River from lake Kumbenskoe has appeared. It in lake Vozhe of the Vologda area was acclimatized, whence in lake Lacha and further in Onega river was spread. The *P. glenii* – as a result of random (not targeted) introduction by the aquariumists-fans at the city Mirnyi also is issued in lake Plesetskoe is delivered. It by considerable number, intensive feed and high rate of growth is characterized. The further expansion of rhythane on pools of area with a trade structure species of fishes by separation of gummos embryonate calf by the waterfowls is probably.

Self-moving. Last decades in Severnaya Dvina River the species of fishes living in basins of the Caspian and Baltic seas have penetrated. *A. sapa* is the unvaluable trade fish of the Caspian complex. Severnaya Dvina River has appeared, fast augmenting the number. In a trade statistician for a long time in a structure of the catches as junior *A. brava* or *B. bjorkna* was actuated. Now (*A. sapa* meets practically on all Severnaya Dvina river, having spread up to the segments of a wellhead beach, where it can constitute a severe alimentary competition to the White fish of Severnaya Dvina River. (*A. aspius* – predatory quoter carp fishes which in Dvina after (*A. sapa* have appeared. The strength while is insignificant.

It is necessary to mean, that stranger species can plot irreplaceable injury not only biological diversity of locales, but also social and economic concerns of the man. In this connection, the problem of biological invasions is expedient at the present stage for considering as one of aspects of security of ecological safety of country.

ADVENTIVE PLANTS SPREAD IN THE FLORA OF DONETSK COAL BASIN

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Adventive fraction of the flora of Donetsk coal basin, often referred to as Donbass (within the limits of Donetsk and Lugansk regions before 2014) has significantly increased in the recent decades. In the «Synopsis of the flora of south-east Ukraine» (Kondratyuk et al., 1984), among 1817 species of Donbass flora there were 101 species of adventive plants (5.6% of the total species number). At present, among 2070 species of the flora of our region there are 447 adventive plants (21.6%) which belong to 260 genera and 69 families (Ostapko et al., 2010). A lot of adventive species naturalized in new habitats, intervened natural plant communities and occupy stable positions in the flora of natural reserves (in terms of occurrence, population numbers and occupied area). Their spread in nature reserves can be explained by intensification of transport movement, industrial development, horticultural, agricultural and floricultural uses of alien species, etc. In addition to discontinuity of plant cover due to intensive land use of Donbass region, vegetation naturalness and phytocenoses' composition stability are low. Thus, naturalization of alien plants seems to be the only reason for increase of local floral diversity.

Among adventive species are those of insignificant environmental and economic harmfulness. They are registered in local habitats, not occupying great areas with high population numbers. Due to a number of reasons, namely low ecological adaptation, 33 species (7.4% of adventive fraction) are presumably extinct (e.g. *Acorus calamus* L., *Echinochloa microstachya* (Wiegand) Rydb., *Gagea villosa* (M. Bieb.) Sweet, *Kickxia spuria* (L.) Dumort., *Peganum harmala* L. etc.). Unstable under new habitat conditions, 160 species (35.7%) occur from time to time spontaneously in some localities and then disappear (such as *Bromus secalinus* L. *Phacelia tanacetifolia* Benth. *Solanum alatum* Moench, *Stachys aspera* Michx. etc.). Some species (155 plants, 34.8% of adverts) are sporadically registered as single specimens or small populations and are non-expansive (namely *Lepidotheca suaveolens* (Pursh.) Nutt., *Galium spurium* L., *Picris rigida* Ledeb. ex Spreng., *Centaurea cyanus* L., *Bidens frondosa* L. etc.). Other species, showing tendency to wider spread, greater population areas and numbers are considered by us progressing; these are 48 species (10.5%) of the regional flora (e.g. *Veronica opaca* Fr., *Mercurialis annua* L., *Petrosedum reflexum* (L.) Grulich., *Hedera helix* L. etc.). There are 38 species (8.5%) in the flora of Donbass which are capable of changing the ongoing processes and structure of biocenoses, competing the native species and reducing the vegetation cover naturalness. Their populations are great in areas and numbers, occurring mainly in degraded lands. The most expansive species registered over last decades are *Amaranthus retroflexus* L., *Ambrosia artemisiifolia* L., *Cyclachaena xanthiifolia* (Nutt.) Fresen. and *Grindelia squarrosa* (Pursh.) Dunal., *Ailanthus altissima* (Mill.) Swingle, *Padellus mahaleb* (L.) Vassilcz., *Ulmus pumila* L. *Phalacrolobos annuum* (L.) Dumort. and *Pterotheca sancta* (L.) K. Koch have spread widely over the last 5–6 years, being seldom registered in the past. At present, these two species are widely present in urban flora and registered in the «Donetsky Kryazh» and «Zuevsky» Republican Nature Reserves. The populations of *Echinocystis lobata* (Michx.) Torr. et A. Grey, *Oxybaphus nyctagineus* (Michx.) Sweet, etc. are known from single habitats, but their population numbers and areas are great, i.e. these plants show local expansion.

In Donbass, we expect further sensible growth of adventive fraction and population area, associated with the war. This is seemingly due to the intensive goods traffic, large-scale vegetation disturbances under fire, in the places of military disposition and weaponry traffic.

THE CURRENT DISTRIBUTION OF THE SOSNOWSKY'S HOGWEED (*HERACLEUM SOSNOWSKYI*) IN RUSSIA

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Sosnowsky's hogweed is distributed in its native area in east Ciscaucasia (Dagestan, east of Kabardino-Balkaria), in mountain systems of Large Caucasus and Lesser Caucasus (Georgia, South Ossetia), in northern Armenia and in the north-east of Turkey.

It was introduced into the culture on the territory of the european part of the USSR for the first time in 1947. Then they started massive cultivation of this unpretentious and growing quickly in spring species as silos and fodder culture on significant part of Non-Black Earth Zone. The widest introduction of this culture was realized in 1960–1970 years. Sosnowsky's hogweed was introduced to the Far East of Russia from Komi Republic (Syktyvkar) and was naturalized on Sakhalin island at first (1965) and then permeated to the territory of the Mountain-taiga station of FEB RAS. The weed was sent to Kamchatka as silos culture routinely and thickets of this plant of more than 3 m in height were observed on experimental plots of Kamchatka agricultural station in Sosnowka locality in 1985 year.

The first feral naturalized plants of the giant hogweed were registered in Moscow Region in 1948 and up to 1970s this process increased and was noticed ubiquitously. As a result of the destruction of agro-industrial complex the distribution of Sosnowsky's hogweed became uncontrolled. The plant occupied wastelands, verges, edges of the forest, ravines, valleys of creeks and rivers in the secondary area of distribution. It is located now in warm soils near Paratunka river in Kamchatka near pools, wells and pipelines using thermal water. Sosnowsky's hogweed supplants aboriginal species of plants almost completely. The large height of the weed (more than 4 m) allows it to compete successfully with grasses, bushes and young trees.

The weed is spread by seeds, which are distributed with the help of wind, birds, water flows, on car tires, hoofs of livestock, shoe soles. The seeds are usually carried to new agricultural territories with silos or manure from farms. Shallow plowing without weeding may result in dividing of the rhizome of the weed in many small parts which are spread then by farm machinery around arable and germinate.

The current distribution of the Sosnowsky's hogweed in Russia has reached global dimension and is evaluated now as ecological catastrophe. It is naturalized in Volga, Southern Urals, republics of Karelia, Komi, Mordovia, as well as in many provinces of the Central and North-Western Regions of Russia. The weed is registered in Novosibirsk region. It is known from Altai where it grows on verges and edges of the woodland belts along Chuiski Track. The plant is observed in Ussuriysk (Primorsky Krai). The first nidus of invasion in Petropavlovsk-Kamchatskiy was registered in 2010.

The data that Sosnowsky's hogweed is capable to form hybrids with aboriginal Apiaceae species such as *Heracleum sibiricum* (the fact was established in Murmansk) and *H. lanatum* (Kamchatka) appeared. The possible danger from these hybrids towards animals and people needs further investigation. The map of current distribution of the giant hogweed on the territory of Russia is under preparation stage.

The investigations are realized with financial support of Russian Science Foundation, Project No 16-14-10323.

SOME LIFE-HISTORY TRAITS OF THE ALIEN GAMMARID *PONTOGAMMARUS ROBUSTOIDES* IN THE DAUGAVA RIVER (LATVIA) AND ITS RESERVOIRS

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Amphipods in particular Ponto-Caspian (e.g. Pontogammaridae) are one of the most successful invaders in fresh and brackish European waters. In Latvian inland waters a Ponto-Caspian gammarid *P. robustoides* initially was introduced as a valuable fish food in the Soviet time. It was realized in the several nearest lakes to Riga and in the Ķegums Reservoir of the Daugava River in the 1960s. Currently, *P. robustoides* is occurred and dominant gammarid in the Daugava River and its reservoirs. In 2016 the study was done in the Pļaviņas Reservoir (seasonally from May till September), in the reservoirs of the Riga, Ķegums Daugava River as well as in the river upstream to Pļaviņas Reservoir and downstream to Riga Reservoir (in July). The qualitative samples of gammarids were obtained by hand net (25x25 cm, 500 µm). The measurements of water physico-chemical parameters were performed simultaneously by multiprobe HACH DS5. One of the main of this study was to find out establishment success of *P. robustoides* in the Daugava River and its reservoirs analysed the life history parameters. In order to identify *P. robustoides* establishment success there were compared some life history parameters with data of *P. robustoides*, *G. varsoviensis* and *G. pulex* from Central Europe and adjacent territories according to publication Grabowski, M., K. Bacela, and A. Konopacka. 2007. How to be an invasive gammarid (Amphipoda: Gammaroidea) – comparison of life history traits. Hydrobiologia 590: 75–84. Result showed that the life history traits of our *P. robustoides* are not so high as for Central Europe, but are higher than for native gammarid (for example, partial fecundity index is 2.54 and length of breeding period is at least 5 month in the study area, but 5.10 and 7 respectively in Central Europe) indicated about species higher reproductive potential. Nevertheless, there are necessary to continue investigations compared life history parameters of *P. robustoides* and native gammarids of Latvian freshwaters.

The study was supported by the national research program "The value and dynamic of Latvia's ecosystems under changing climate – EVIDEnT" project "Non-native species distribution and impact on the Baltic Sea and freshwater ecosystems" sub-project „Non-indigenous species distribution and impact on freshwater ecosystems”.

NEW DATA ON A TURTLE *TRACHEMYS SCRIPTA* (SCHOEPFF, 1792) INVASION IN MOSCOW

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A single northernmost common species of the turtles in European part of Russia is pond turtle (*Emys orbicularis* (Linnaeus, 1758)). A north distribution area border in Russia passes in Smolensk, Kursk, Lipetsk, Penza regions (Kuz`min, Semenov, 2006). More and more information and photographic materials appear about its emergence in Tula region (Ryabov et al., 2002) and Moscow. A significant role in its distribution belongs to the humans. However it is not single turtle species, which appears in the latitudes close to Moscow and the region. Information about the presence of red-eared slider (*Trachemys scripta elegans* (Wied-Neuwied, 1839)) in the reservoirs of Moscow published in the newspapers (Semenov, 2010). This North American species has acclimatized in the reservoirs of Europe (Semenov, 2010) and Asia (Ramsay et al, 2007). However, can this species acclimatize in the latitude of Moscow (55.49° – 56.02° N)?

In August 2011 adult red-eared slider at a territory of the Natural-Historical Park “Izmailovo” in a water channel connecting clearing pools of the storm sewage and a Serebryanka river (Moscow, Eastern Administrative District, Ivanovskoe district, 55.77° N) is found. Second observation of the animal took place in May 2012. Further, the turtle was regularly observed in the same place until June 2016. That is, it overwintered for five winters and acclimatized in the water channel. It is necessary to consider the live environments in the reservoir. A small flow is from clearing pools in the observation place of the red-eared slider. It is possible that here the water temperature is higher than in the Serebryanka river. In winter, the farther clearing pool did not completely freeze. The water channel completely or partly froze. The turtle survived in habitats of cold winters. The air temperatures decreased up to: -24°C in February 2012, -17°C in January and March 2013, -24°C in January 2014, -19°C in January 2015 (the data from <http://www.meteoinfo.ru/archive-forecast/russia/moscow-area/moscow/>). At the same time, the number of sunny days with the air temperature above +20°C reached 50 in 2012, 54 in 2013, 79 in 2014 and 62 in 2015. In this water channel *T. scripta elegans* has not enemies. Here there is enough food – aquatic plants, invertebrates and small fishes. So *T. scripta elegans* is a high order consumer. The bushes grow near a water channel bank. Their branches are inclined to the water, and the roots descend directly into the water. This bank is a good place for a turtle shelter.

Thus, the new case of the new species acclimatization, turtle *T. scripta elegans*, is identified. It is new species-invader of a herpetofauna of Moscow. The animal withstands cold winters and freezing of the water channel. Distribution of this species may lead to the transformation of freshwater communities in the city, since *T. scripta elegans* is the high order consumer.

GENETIC VARIABILITY OF THE LOCUS COI MT DNA IN THE INVASIVE POPULATIONS OF THE FLORIDA CRAB (*RHITHROPANOPEUS HARRISII* (GOULD, 1841): (DECAPODA, PANOPIDAE)) IN THE NORTHERN PART OF THE BLACK SEA

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The variability of the mtDNA COI locus in the Florida crab (*Rhithropanopeus harrisii* (Gould, 1841): (Decapoda, Panopidae)) from the populations of the coast of the northern part of the Black Sea was studied. The material for the study was the specimens collected from three Crimean populations: the Karkinitzky Bay, Kerch Strait, the Chyornaya River, as well as from the Estuary Suhoi, port of Illichyevsk (Odessa Region, Ukraine). For the analysis of genetic variability, a fragment of the *cyt c* locus (COI) mtDNA with a length of 523 bp was used. For comparison, the haplotypic data were used for European, North- and Central American marine and freshwater populations of *R. harrisii* taken from GenBank (NCBI). The haplotypes of the Florida crab from European and American populations distributed over two clusters. The first cluster united all European haplotypes both from populations of the Atlantic coast, and the Baltic Sea (Poland), the Black Sea (Bulgaria), and also one American haplotype from the sea desalinated area (New Jersey). The second cluster is mainly formed by haplotypes from freshwater populations of the USA (Texas) and one desalinated marine population (Louisiana). Among the analyzed samples of *R. harrisii*, the two new haplotypes registered in GenBank under the numbers KP890666 and KP890667 were found. All the investigated Black Sea haplotypes were included in the group with European haplotypes. The constructed median network quite matches the revealed two-cluster structure of the Florida crab haplotype distribution. Analysis of the data on the Black Sea populations of the Florida crab demonstrated a strong decrease in the level of genetic variability. The analysis of the structure of the communities of the decapod of the Crimean peninsula allowed discussing the causes of the invasive success of the Florida crab (*R. harrisii* (Gould, 1841): (Decapoda, Panopidae)) in this region. Detailed results can be found in the article Slynko Y.V., Pakunova E.N., Statkevitch S.V., Slynko E.E. Genetic diversity of invasive populations of the florida crab (*Rhithropanopeus harrisii* (Gould, 1841): (Decapoda, Panopidae)) // Russian Journal of Genetics. 2017. Vol. 53, No 5. P. 623–629. DOI: 10.7868 / S0016675817050113. A report based on these data was not previously done.

This work was supported in part by the program of the Department of Biological Sciences of the Russian Academy of Sciences “Biological Resources of the Russian Federation”.

SPECIFIC FEATURES OF THE DISTRIBUTION AND PHYTOCENOTIC CONFINEDNESS OF THE RUNNING WILD WOOD INTRODUCED SPECIES IN THE SOUTHERN NON-BLACK EARTH ZONE OF THE RUSSIAN FEDERATION

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To estimate the distribution of species have been used net mapping. The territory of the Bryansk region has been divided into 390 cells according to a degree grid, a base cell with dimensions of 5 degrees in latitude and 10 in longitude, and a cell area of about 104 km². In 123 cells, detailed floristic studies have been performed.

Acer negundo L. It has been registered in 177 cells. In all large settlements, but disturbed habitats: along roads, railroad embankments, on wastelands. *A. negundo* in the settlements forms the communities of the association ***Chelidonio–Aceretum negundi***. In the river valleys maple occurs in association communities ***Salicetum fragilis***, ***Salicetum albae***.

Amelanchier spicata (Lam.) C. Koch. It has been registered in 60 cells. The widespread garden plant, planted on private plots and cottages. It occurs in settlements, summer cottages and parks; spreads along the roads. *Amelanchier spicata* forms a shrubage in pine-green forests. The communities dominated by *Amelanchier* in pine forests have been referred to the community ***Pinus sylvestris–Amelanchier spicata*** [***Vaccinio–Piceetea***].

Robinia pseudoacacia L. It has been registered in 51 cells. It occurs in forest belts, at settlements, in ancient parks. In places of landings seed renewing has been noted. In places of landings communities of ***Chelidonio majoris–Robinetum pseudoacaciae*** association have been formed.

Sambucus racemosa L. It has been registered in 42 cells. It occurs on the broken pine woods, at housing. In the broken pine forests sometimes forms a powerful underbrush of ***Vaccinio vitis-idaeae–Pinetum Sambucus racemosa***.

Amorpha fruticosa L. It has been registered in 3 cells. It occurs in pine forests.

Aronia mitschurinii Skvorts.et Maitulina. It has been registered in 8 cells. Single plants near roads in forests and meadows.

Fraxinus pennsylvanica Marsh. It has been registered in 25 cells. It occurs in floodplain forests, where it forms the second storey. It shows the high resistance to anthropogenic transformation of floodplain forests, without reducing seed productivity, potencies for vegetative reproduction, occupying releasing ecological niches.

Hippophaë rhamnoides L. It has been registered in 31 cells. Actively breeds vegetatively, potent one-way thickets (***Artemisio vulgaris–Hippophaetum rhamnoidis*** association) in forest belts, on the valley of the Desna River within large and shallow settlements points.

Lonicera caprifolium L. It has been registered in 1 cell. Now it is actively settled in parks and squares, also form an underbrush in the secondary small-leaved woods.

Parthenocissus vitacea (Knerr) Hitchc. It has been registered in 42 cells. It is actively naturalized in habitats of the abandoned farmstead parks, squares, in rural settlements. As the groundcover plant forms extensive monodominant thickets in parks, for example estates Lubin Hutor (Novozybkovsky district). The potential threat to a biodiversity, leading to degradation of a ground cover and grass tier has been represents, it needs constant control of distribution.

Physocarpus opulifolius (L.) Maxim. It has been registered in 41 cells. It is actively «built» in an underbrush of the city small-leaved woods and forest belts. It forms the local cenopopulations, which are actively reproduced in the seed and vegetative way. The features of the plant's habitus promotes degradation of a ground cover and decrease in a biodiversity.

Sambucus ebulus L. It has been registered in 1 cell. It forms extensive thickets and monodominant communities in the places of abandoned estates.

The research has been carried out with the support of the RFBR grant № 16-54-00036.

BLACK LISTS OF ALIEN SPECIES AND EU LEGISLATION: PRIORITIZATION AS A KEY PRINCIPLE

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As legislation, research and management of invasive alien species (IAS) are not fully coordinated across countries or different stakeholder groups, the recently adopted EU regulation 1134/2014 aims to provide a framework for many European countries. Prioritization of species and introduction pathways is seen as an important component of the management of biological invasions. Producing lists of prominent IAS that attain high level of concern and are a subject of priority monitoring and management is a key activity in this field. These lists represent a convenient starting point for setting priorities in prevention, early warning and management systems. It is important that these lists be based on transparent and robust criteria so as to accommodate interests and perception of impacts by groups of concerned authorities and stakeholders representing sectors as diverse as, e.g. forestry, horticulture, aquaculture, hunting, and nature conservation, and to justify possible trade restrictions. Similar principles should be applied in prioritization of pathways linked with IAS.

Therefore, the European Union's recent IAS legislation and national IAS strategies need to put the protection of its biodiversity before the short-term economic interests of member states.

Nevertheless, several categories of lists must exist to accommodate different management approaches. Example can be taken from forestry where many species are controversial because of their positive economic but negative environmental impacts. Based on the example of black locust (*Robinia pseudacacia*) we present a stratified approach to its management ranging from full eradication in sites of conservation interest to tolerance in urban environment.

INVASIVE SPECIES IN THE MAKROZOOBENTHOS OF THE VOLGA RESERVOIRS

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Distribution of invasive species in the macrozoobenthos of Volga's reservoirs was studied in the summer of 2015. A total of 25 species were found (20% of all benthic species), among them 13 crustaceans, six mollusks, four oligochaetes, one polychaete and one leech. An increase in the number of invasive species downstream of Volga's cascade from the Upper Volga to the Middle and Lower was noted. The smallest number of species (1) was found in the uppermost reservoir – Ivan'kovo, followed by Uglich – two, Rybinsk – seven, Gorky – ten, Cheboksary – 13, Kuibyshev – 13, Saratov – 11. Oligochaetes and mollusks prevailed within invaders in the Upper Volga reservoirs; mollusks in the Gorky; crustaceans in the Cheboksary, Kuibyshev and Saratov. The majority of invaders are of Ponto-Caspian origin, distributing up the cascade. The distribution of benthic amphipods of *Corophium*, *Dikerogammarus*, *Pontogammarus*, *Stenogammarus* genera as well as *Paramysis ullskyi* Czerniavskyi, 1882 mysids and *Pterocuma sowinskyi* (Sars, 1894) comma shrimps is limited to the Middle and Low Volga reservoirs. Eurytopic amphipod *Gmelinoides fasciatus* (Stebbing, 1899), an invader originating from Lake Baikal is dominant in the Gorky and Rybinsk reservoir, where it reaches its highest abundance and biomass – 1960 ind/m², 2 g/m². Two new invaders were first found in the Gorky reservoir in the summer of 2015: *Corbicula fluminea* (O.F. Müller, 1774), a bivalve of Asian origin and *Quistadrilus multisetosus* (Smith, 1900), oligochaete known from North America waters. This oligochaete species was first found in the Rybinsk reservoir in 2013 and was not observed in other reservoirs of Volga's cascade since then. In 2015, *Q. multisetosus* was found to have high values of the frequency of occurrence – 56% and abundance – 2440 ind/m², 0.72 g/m² in the Rybinsk reservoir. An invasive leech from the Caspian Sea – *Archaeobdella esmonti* Grimm, 1876, first observed in the Rybinsk reservoir in 2009, has become completely naturalized in this waterbody demonstrating the highest values of abundance, biomass and frequency of occurrence (80 ind/m², 2 g/m², 50%) here. In 2015 invasive polychaete *Hypania invalida* (Grube, 1860) was found only in the Middle and Lower Volga reservoirs reaching maximum values of abundance, biomass and frequency of occurrence (1560 ind/m², 8.4 g/m², 69%) in the Kuibyshev reservoir. Invasive bivalves *Dreissena polymorpha* and *D. bugensis* of Caspian origin dominating in macrozoobenthos communities and being the keystone species in habitat formation are most often encountered in the Middle and Low Volga reservoirs forming mass settlements. Highest abundance of *D. polymorpha* – 1960 ind/m², 1059.6 g/m² in the Gorky reservoir was noted, *D. bugensis* – 21950 ind/m², 21900.0 g/m² – in the Saratov reservoir. Invasive gastropods *Lithoglyphus naticoides* (C. Pfeiffer, 1828) and *Theodoxus astrachanikus* Starobogatov in Starobogatov, Filchakov, Antonova et Pirogov, 1994 are intermediate hosts of parasitic trematodes and broadening of their range facilitates appearance of new sources for fish infestation and distribution of dangerous parasitic infections of humans and animals. The mollusk *Lithoglyphus naticoides* has penetrated into the Upper Volga basin to 2015 and was found in the Uglich reservoir, while the highest values of its abundance were registered in the Cheboksary reservoir – 2760 ind/m², 83 g/m² at 69% frequency of occurrence. The range of *Theodoxus astrachanikus* is limited to the Kuibyshev and Saratov reservoirs.

MODELING OF COMPETITIVE RELATIONS BETWEEN REINTRODUCED EURASIAN BEAVER (*CASTOR FIBER* L.) AND ALIEN CANADIAN BEAVER (*CASTOR CANADENSIS* KUHL) IN THE NORTH OF THE EUROPEAN RUSSIA

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Seven Canadian beavers, *Castor canadensis* (Cs), were introduced into Finland in 1937. The purpose of the introduction was the restoration of the almost disappeared Eurasian beaver, *Castor fiber* (Cf) (Lahti, Helminen 1974). At that time, zoologists recognized only one species of beaver. However, in 1973 research (Lavrov, Orlov, 1973) showed the species independence of the beavers of the New (Cc = 40 chromosomes) and the Old World (Cf = 48 chromosomes). Hence Cs became an alien species for Eurasia. During the next 50 years, from Finland the Cc migrated to Russia and began to expand its range. The process of invasion and replacement of one beaver species by the other has occurred on the Karelian Isthmus of the Leningrad oblast and in the north of the Arkhangelsk oblast. Currently, the number of Cs in Finland and Karelia is 12–14 thousand individuals. In recent years, the issue of competitive relationship of two beaver species is being actively discussed by both Russian and international experts. Numerous studies have shown that in the same orographic, edaphic and hydrological conditions of Karelia, the engineering activity of two species of beavers does not differ (Danilov, Fedorov, 2015). But both species differ significantly in fertility. Analysis of the existing data on the fertility of beavers in two continents has shown that the average fecundity of Cf is 3.8 (SE = 1.0) (2.4–5.5), whereas for Cs it is 5.2 (SE = 1.4) (2.7–9.2) (Rosell, Parker, 1995). In another review (Parker et al., 2012), only minor differences in life history, ecology, and behavior were noted; and there was a complete overlap between the niches of these two species. In general, our brief analysis of the literature data shows that there is no consensus on the competitive relationship between two beaver species. In connection to this, the inevitable question arises whether two species of beaver can co-exist, or does competition between them leads to a possible competitive exclusion one species? We created the discrete-time two species model in order to predict population dynamics when both species use the same food resources. The purpose of this presentation is to demonstrate model estimates of competitive relations of two beaver species and to predict their population dynamics for cases of both species introduced into some natural reserves of European Russia.

Results from this model indicate the competitive replacement of Cf by Cc in all studied reserves. From the results, it also follows that the most vulnerable habitats for competitive replacement of Cf are located near the northern and southern boundaries of its range (Laplandskiy and Khoperskiy Reserves). It is shown that if 12 individuals of Cc are introduced into these reserves, competitive replacement of Cf will begin in 50 to 75 years, respectively. For the Okskiy and Darvinskiy Reserves, the competitive replacement of Cf will begin approximately 85 years later, and for Prioksko-Terrasnyi and Central-Forest reserves it starts about 100 years later. It follows from the results above that the invasion of Cc into the Cf range will apparently have a diffusion character. In general, it can be argued that peripheral and vacant habitats will be the most vulnerable to the introduction of Cc into the modern range of Cf, and pessimal habitats will be less vulnerable. With further increase in Cc numbers, Cf can be preserved as local populations only within the current range of this species.

Data collection on the territory of the reserves was supported by RFBR grants 15-04-06423 and the program of the RAS "Rational use of biological resources of Russia"; mathematical models of population dynamics were developed with financial support of Russian Science Foundation grant № 16-14-10323.

ALIEN AND INVASIVE SPECIES (TOP 100) OF THE RUSSIAN FEDERATION: LOCAL AND GLOBAL VERSIONS OF INFORMATION SYSTEMS

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The presentation describes a methodology for selecting target species of highest priority for control of species invasions in Russia, including a system of basic interactions between alien and native species as well as basic principles and strategic objectives for biodiversity conservation "Aichi Biodiversity Target 9" at the National and International levels. Based on the developed methodology, the list of 100 most "aggressive" (invasive) species (TOP 100) was first compiled. The species from this list can be regarded as the targets for control. Information on the target species distributions, their life strategies (preferable habitats, ability of adaptation to abiotic and biotic environmental factors), pathways and vectors of invasion, effects on the native species and ecosystems, potential impacts on human health and economic activity was collected and generalized. List of TOP 100 includes aquatic organisms: bacteria – 1 species, chromists – 4 species, fungi – 1 species; ctenophores – 2 species; cnidarians – 2 species, round worms – 1 species, flat worms – 1 species, arthropods – 11 species; mollusks – 10 species, ascidians – 1 species, fish – 5 species; and terrestrial organisms: chromists – 1 species; mosses – 1 species, vascular plants – 25 species, fungi – 4 species, insects – 16 species, amphibians – 1 species, reptiles – 1 species, birds – 2 species, mammals – 12 species. Species descriptions were incorporated into the global version of WEB information retrieval system. Online GIS maps library was created on the basis of the licensed version of ArcGIS Desktop Pro 10.4.1 with information about current invasive species distribution and history of their introductions into Russia. Beside this, the database contains information about the degree of species adaptations for different regions and the location of native ranges for invasive species (if a native range expands, at least partially, to the Russian territory). Geographical information systems along with a valid database are necessary to automate accumulation of information on invasive species and to monitor alien species all over Russia.

The conceptual, logical and physical database models were developed for target species to adequately describe invasive processes in Russia with consideration to Darwin Core International standards and protocols for storage, disposal, and data exchange through the international portal GBIF (gbif.org). At conceptual level, problem-oriented database consists of geographic, taxonomic, biological, invasive and bibliographic blocks. Vocabularies and recommendations are suggested for the extension of term list of Darwin Core International standard (<http://www.gbif.org/resource/82958>).

General functional structure was determined for the local and global versions of information systems. The local version of the information system is implemented using Biosystem office software, InterBase SQL-Server and ArcGIS Desktop Pro. The WEB-oriented information system for storage, analysis and presentation of data on invasive species was developed with consideration of the principle of "thin clients" – Web-browsers. In accordance with this principle, a minimum set of required resources is availability of connection to the Internet and Web-browser. The local version of the database was developed based on the analysis of our own and literature data that allowed us to establish invasion pathways and vectors for 1540 alien species of different taxa (plants, animals, microorganisms, etc.) including TOP 100 the worst invasive species in Russia.

The work is supported by the Russian Science Foundation No. 16-14-10323.

ALIEN SPECIES OF VASCULAR PLANTS IN URBANIZED AREAS OF THE NORTH OF WESTERN SIBERIA

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Invasion of alien plant species is mainly in the cities as points of concentration of economic activities. Here the relation of alien species into new territories, the most noticeable and significant. Since 2012 we studied urban flora in the Yamalo-Nenets Autonomous okrug. The studies were conducted in the cities of Novy Urengoy (Korotchaev), Noyabr'sk, Salekhard, Nadym, Labytnangi, Gubkinsky and Tarko-Sale. At the same time at Nadym is organized the annual monitoring of urbanoflora.

In the cities of the Yamalo-Nenets Autonomous okrug at different times was, for the most part for the first time to the okrug, all currently known adventive species vascular plants (177 species). Range leading in number of species of adventive fraction families: Poaceae, Compositae, Fabaceae, Brassicaceae, Rosaceae, Caryophyllaceae, Polygonaceae, Apiaceae, Lamiaceae. In the studied cities and towns the bulk of the alien flora is non naturalized and poorly invasive species (ephemero-phytes and colonophytes). However, the number of species showing a stable trend for the change in the degree of naturalization. So, *Origanum vulgare*, *Coriandrum sativum*, *Fragaria vesca*, *Dianthus barbatus*, *Berteroa incana* etc. were collected once. Others, such as *Dactylis glomerata*, *Lolium perenne*, *Urtica dioica*, *Silene tatarica*, *Pimpinella saxifraga*, *Chamomilla suaveolens*, *Senecio vulgaris*, *Sonchus arvensis*, *Arctium tomentosum* etc. successfully naturalized. Wide distribution are shown a few alien species, such as *Hordeum jubatum*, *Leucanthemum vulgare*, *Plantago urvillei*, *Melilotus officinalis*, *Cirsium arvense* etc.

There are the following ways of invasion of alien species of vascular plants in anthropogenically transformed habitats: 1) road transport, equipment and materials for the construction of roads and pipelines (*Phleum pratense*, *Puccinellia distans*, *Polygonum aviculare*, *Chenopodium album*, *Barbarea vulgaris*, *Potentilla argentea*, *P. supina*, *Rosa glabrifolia*, *Rubus idaeus*, *Lathyrus pratensis*, *Melilotus officinalis*, *M. albus*, *Trifolium hybridum*, *T. repens*, *Pimpinella saxifraga*, *Galium mollugo*, *Chamomilla suaveolens*, *Leucanthemum vulgare*, *Senecio vulgaris*); 2) vegetable goods (*Dactylis glomerata*, *Festuca pratensis*, *Lolium perenne*, *Secale cereale*, *Urtica dioica*, *Chenopodium album*, *Amaranthus retroflexus*, *Stellaria media*, *Chelidonium majus*, *Descurainia sophia*, *Potentilla norvegica*, *Medicago sativa*, *M. falcata*, *Melilotus albus*, *M. officinalis*, *Trifolium medium*, *Carum carvi*, *Pastinaca sativa*, *Plantago urvillei*, *Anthemis tinctoria*, *Chamomilla suaveolens*, *Lactuca tatarica*); 3) with the soil for ornamental plants and their seeds (*Lolium perenne*, *Lupinaster pentaphyllus*, *Trifolium medium*, *Epilobium bergianum*, *Eryngium planum*, *Convolvulus arvensis*, *Linaria vulgaris*, *Centaurea cyanus*, *Cichorium intybus*, *Lactuca tatarica*, *Sonchus oleraceus*); 4) soil waste, including food waste (*Brassica napus*, *Lepidium densiflorum*, *Potentilla paradoxa*, *Rubus idaeus*, *Melilotus officinalis*, *Solanum tuberosum*, *Cirsium arvense*, *Sonchus arvensis*); 5) train; 6) probably air transport (*Silene tatarica*); 7) escape from culture (*Dianthus barbatus*, *Fragaria vesca*, *Coriandrum sativum*, *Origanum vulgare*, *Cosmos bipinnatus*, *Helianthus annuus*).

The work is executed at financial support of Russian Foundation for Basic Research (project No. 16-44-890088). The part of field research – Department of Science and Innovation of the Yamal-Nenets autonomous region (grant № 01-15/4, 25.07.2012).

COMPOSITION AND FEATURES OF NATURALIZATION OF ALIEN FLORA IN THE NORTHWESTERN PART OF THE VOLGA UPLAND

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The study area – the north-western part of the Volga Upland – locate in the south-eastern part of the East European Plain in the middle course of the Volga river between the latitude 55.6° and 53° N and longitude 43° and 47.4° E. The north-western part of the Volga Upland is geomorphologically limited by the watersheds of the Volga river and the Pyana river in the north, of the Sura river and the Volga river in the east, of the Moksha river and the Oka river in the west and of the Moksha river and the Khoper river in the south; a part of its southern boundary goes along the right-hand bank of the Sura river in its upstream, in the north-west it borders upon the Oka-Don Lowland; administratively it is the south of Nizhny Novgorod region, the most of the Republic of Mordovia, the south-west of Chuvashia, the north-west of Ulyanovsk region, the north of Penza region and a small patch of the Republic of Tatarstan. The study area is about 181 000 km².

1505 vascular plants species are known in the flora of the north-western part of the Volga Upland. Of them, 408 species from 255 genera and 66 families are considered as alien plants. Higher spore plants are not present in the alien flora, *Gymnospermae* are presented by one species (*Larix sibirica*), the rest 407 species are flowering plants with 241 among them being *Magnoliopsida*. The following families are most rich in species: *Compositae* (63 species), *Poaceae* (52), *Brassicaceae* (39), *Rosaceae* (33), *Chenopodiaceae* (23), *Fabaceae* (17). Among biomorphs of the alien flora annual and biennial monocarpic herbs (242 species; 59.3%) are the most numerous.

Formation of the alien flora in the north-west of the Volga Upland practically equally depends on intentional and accidental types of invasion. Adventive plants in the north-west of the Volga Upland inhabit mainly anthropogenically transformed habitats. Alien species mostly grow on traffic routes. Such natural habitats as forests and meadows contribute most to dissemination of adventive flora. The majority of alien species have penetrated the flora under analysis from more southern areas of Eurasia, from both Americas and the Mediterranean.

To estimate the degree of adaptation of each alien species to the vegetation cover of a new region, A.A. Notov and V.A. Notov suggested using such parameters as *the degree of the species stability* on the territory under investigation, *the occurrence of the species* in the studied region, and *the ecology-phytocoenotic features* of the species. If a certain number value is assigned to every level of each parameter, the sum of these numbers will show the «invasive status» of each alien species. On the basis of such estimation eleven groups were discovered in the alien flora of the Volga Upland: from badly naturalizing species (e.g., *Adonis aestivalis*, *Atriplex hortensis*, *Vitis vinifera*, *Glycine max*, *Ornithopus sativus*, *Potentilla collina*, *Sanguisorba minor*, *Cucumis melo*, *Crambe tatarica*, *Diplotaxis tenuifolia*, *Erysimum canescens*, *Hirschfeldia incana*, *Rapistrum perenne*, *Althaea officinalis*, *Gossypium hirsutum*, *Lavatera trimestris*, *Malva neglecta*, *Chaerophyllum aureum*, *Sphallerocarpus gracilis*, *Valerianella dentata*, *Ambrosia psilostachya*, *Coreopsis tinctoria*, *Helminthotheca echioides*, *Solanum physalifolium*, *Orobanche ramosa*, *Veronica filiformis*, *Plantago depressa*, *Cruciata laevipes*, *Rubia tatarica*, *Juncus trifidus*, *Bromus commutatus*, *Cynosurus cristatus*, *Digitaria sanguinalis*, *Elymus sibiricus*, *Eragrostis suaveolens*, *Hordeum bogdanii*, *Lolium multiflorum*, *Setaria italica*) to those which have successfully invaded indigenphytocoenoses and formed numerous stable extending populations (invasive status 1, for instance *Lupinus polyphyllus*, *Oenothera biennis*, *Echinocystis lobata*, *Acer negundo*, *Heracleum sosnowskyi*, *Bidens frondosa*, *Sambucus racemosa*, *Elodea canadensis*).

INVASIVE DECAPODS IN THE BASIN OF THE LOWER DNIESTER RIVER

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Two kinds of invasive decapods – *Macrobrachium nipponense* (De Haan, 1849) and *Rhithropanopeus harrisi tridentata* (Maitland, 1874) – were marked in the waters of the lower Dniester Basin within the Pridnestrovie.

Macrobrachium nipponense lives in the Kuchurgan cooling pond Moldovan Power Station. Into the reservoir it has been introduced in 1986 from the cooler reservoir of Berezovskaya Power Station. The favorable conditions contributed to the formation of the reservoir sustainable shrimp populations. The body length of the shrimps of Cuciurgan reservoir without claw varies between 3–8 cm with an average length of 5.37 ± 0.02 cm with a biomass 0.2–4.85 g with a medium value of 2.0 ± 0.013 . The populations of freshwater prawns of Cuciurgan reservoir is dominated by male species.

In 2013 *M. nipponense* was found in the mainstream of the Dniester River near the town of Tiraspol. Thus, after 27 years since the artificial introduction of shrimp in Cuciurgan reservoir, it could not only acclimate in the reservoir, and create a stable population, but also to adapt to low temperatures, which gave her the opportunity to penetrate the Turunchuk river and rising upstream, there the Dniester, to reach the city of Tiraspol, passing the distance of 70 km or 2.5 km per year.

In 2016, in Kuchurgan reservoir was caught one individual of the mud crab *Rhithropanopeus harrisi tridentata*. Previously, this type was not observed in reservoirs in the territory of Moldova.

How could a crab get into the Cuciurgan Reservoir? In our opinion, the most likely route of penetration of crab in the reservoir could be his drift along with the stocking material, namely *Liza heamatocheilus* from Hadzibeevsky estuary, which is located 6.4 kilometers north-east of Odessa.

Which are the perspective for a sustainable population of the mud crab in the Kuchurgan reservoir and its invasion into the Dniester, as was the case with the freshwater shrimp *Macrobrachium nipponense*? As a consequence of the fact that the mud crab is a eurythermal and euryhaline species, and taking into account the increased level of salinity Cuciurgan reservoir (1,6–1,9‰), we can assume that the *Rh. harrisi tridentata* could in the long term adapt to the conditions of existence in the reservoir and form a stable population here.

Can we prevent it from getting into the Dniester? In our opinion, the mud crab in the short term will not be able to acclimate to the Dniester, because this will prevent the low salinity of the river. But in the case of its penetration into the Dniester, poor mobility of these crabs than large migratory species and larval drift are major impediments to its movement upstream. Perhaps Cuciurgan reservoir remains the only habitat of the crab on the territory of Transnistria.

INVASIVE ALIEN SPECIES DRAMATICALLY ACCELERATE EVOLUTIONARY PROCESSES

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Biodiversity is an important global issue. Biological diversity can be assessed as a variety of gene pools. The Russian geneticist A.S. Serebrovskii first formulated the concept in the 1920s as *genofond* (gene fund), a word that was imported to the United States from the Soviet Union by Theodosius Dobzhansky, who translated it into English as “gene pool” (Graham, 2013, p. 71). The gene fund/pool is the set of all genes, or genetic information, in any population, usually of a particular species. The gene fund/pool of any species is formed in the process of adaptive evolution and is stabilized by all complex of abiotic and biotic factors of environment (Kolomiytsev, 1990). A large gene fund/pool indicates robust populations that can survive bouts of intense biological selection (biological selection – the high fidelity of self-reproduction or inheritance, variability and natural selection, – Kolomiytsev, Poddubnaya, 2007). Meanwhile, low genetic diversity can cause reduced biological fitness and an increased chance of extinction. Parameters of ecological factors on the planet constantly change, and together with them the inhabiting it organisms change also. Charles Darwin (1859) described this process, he thought evolution is slow, evolution is slow on long time scales, it usually moves at a “background rates”. That is, if the rate of change of parameters is “normal”, then the gene fund/pool is formed “normally” and species compositions through time is more strongly influenced by interactions among species (Red Queen hypotheses). Accelerated biotic response (relative to background rates) is the result random perturbations to the physical environment (abiotic factors like meteor strikes and climate change) that change the ground rules for the biota (Court Jester hypotheses) (Barnosky, 2001).

In the 20th century a new factor appeared – invasions – the spread of species (as a result of human activities) threatening biological diversity. Biotic invasion is considered one of the five top drivers for global biodiversity loss (Millennium Ecosystem Assessment, 2005). Invasions of plants, fungi, animals, bacteria, the diffuse organism (virus, viroid) occur in very short periods of time and so it acts catastrophically, or as it was estimated earlier (Elton, 1958; Vermeij, 1996; Mooney, Cleland, 2001) dramatically. The latter must be recognized as correct because this factor is often beyond the control of a person in the context of globalization. Analysis of data on 4 species of invertebrates, 10 fish, 1 amphibian, 1 reptile, 4 rodents, 4 predators and 1 ungulate (Povolzhskiy Journal of Ecology) shows that invasive species participate in three evolutionary processes: 1) rapidly change the environments of native species and act as transformers, 2) affect native species, triggering the processes of homogenization of biota and the loss of biodiversity (Odendaal, Haupt, Griffiths, 2008), and 3) they themselves change quickly adapting to the parameters of new habitats. These processes are described as evolution in response to an invader, the indirect evolutionary consequences of mixing behavioral and trait shifts, niche displacement, adaptive morphological adjustments, etc. Invasive species may drive local native species to extinction via competitive exclusion, niche displacement, or hybridisation with related native species.

Alien species are usually overadaptive in a new environment (Tsvetkova et al., 2013; Poddubnaya et al., 2016). Invasive species from different taxa have in different ways altered the evolutionary trajectory of native species with which they interact. Extinction by competition is a slower process than extinction by predation, and invasive predators may have the most dramatic effects, as the extinctions they cause represent an irreversible removal of evolutionary potential (Mooney, Cleland, 2001).

Addressing insufficient biodiversity protection “it is more correct to speak not about preservation of the gene pool, and about maintaining natural rates of gene pool progression, that is about the prevention of species and intraspecific structures involvement in the accelerated microevolutionary processes of anthropogenous transformation” (Kolomiytsev, 1990). Monitoring of rates of change of the ecological features of animals is one of actual ecological and evolutionary problems.

CHANGES IN MUSTELID COMMUNITIES FOLLOWING THE INVASION OF THE AMERICAN MINK *NEOVISON VISON*

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Invasions of predatory species are considered to be the most stringent and obvious from the point of view of observers. New predators primarily exert a depressing effect on the population of the preys, and then the changes inside the guild, caused by the impact of the new predator, are or may occur. Confirmation of the latter requires special studies, which in most cases are difficult to implement. Therefore, at the present time, the data obtained for other purposes are important, but they allow us to solve the questions that are of interest to us. Our investigations were carried out in the south of the Primorskyi Krai (43°14' N 133°24' E) in 1978–1992 and the Khabarovskiy Krai (48°00' N 136°50' E) in 1990–1991 and 2010–2011 and in the Vologda region (60°05' N 40°27' E – 60°08' N 40°45' E), Karelia (66°17' N 33°39' E and 64°35' N 30°36' E), the Republic of Komi, the Ural (59°56' N 58°41' E – 59°31' N 58°41' E) in 1992–2016.

In the south of the Russian Far East, the mink lives on all rivers and most streams in the research area, as well as on the sea coast. The greatest density of the mink population is observed in the middle sections of rivers. Here it is possible to register up to 6 family plots per 10 km of the river bed, with each individual site covering a length of a 1.2–2 km river bed. Low numbers of mink are in the lower parts of rivers, where floodplain forests are now completely destroyed. It does not occur in the sources of rivers, as well as in small, often drying up streams. In winter time there is a certain redistribution of the population of the species. In the north-west of Russia, the American mink also lives in practically all water bodies (rivers, streams, ponds, bays, gulfs). Individual sites of minks cover 2–5 km sections of the river; here it is possible to register up to 5 family sites per 10 km of the river if there is no otter on this reservoir, and 1–3 sites if the otter lives on the river.

The American mink firmly entered the new biocenosis approximately 30 years after the introduction (for example, Heptner et al., 1967; Poddubnaya, 1995; Poddubnaya, Kolomiitsev, 2016), as evidenced by the natural change in the abundance of the species (Poddubnaya-Kolomiitsev' rule) (Prochorova et al., 2016) that began in the south of the Primorskyi Krai in 1980th. After that, the **territorial distribution of the local species of mustelid changed** – the Siberian weasel, the stoat, the European polecat, young the European pine marten and the sable became less frequent in coastal areas. Some areas that before the introduction of mink were occupied by young otters became little available or even inaccessible to the latter. **Changes occurred in the trophic connections:** the occurrence, the total mass and the calculated biomass of hydrobionts in the diet the Siberian weasel, stoat, European polecat, young the European pine marten and the sable decreased. In some areas, the number of species-preys the Siberian weasel and stoat has increased, and participation in nutrition (biomass) of the main group – mouse rodents is somewhat less. The food of the American mink has a character similar to the European pine marten and the sable. **The number of ferrets has decreased, and the European mink is disappearing at all** (Poddubnaya, Kolomiitsev, Senina et al., 2016), in some places of common habitation of European pine marten and American mink, a decline in the marten population has been observed. The cases of killing the Siberian weasel by the American mink (Poddubnaya, Kolomiitsev, 2016), European mink (Maran, Henttonen, 1995), stoat, etc. are also recorded.

It is believed that as a biological species, the American mink is a more specialized predator form than the European mink, as shown by the more developed skull structure (Heptner et al., 1967). Although the American mink looks like the European mink, the closest relative of the American mink is the Siberian weasel from Asia (Harris, Yalden, 2008), and ecological studies have shown great similarity in the nutritional spectrum of the American mink and Martens (Poddubnaya, 1995, Kiseleva, 2012; Delhi, Poddubnaya, 2014). There is an opinion that the American mink is more aggressive than Eurasian species of mustelid (Kiseleva, 2016). All this and the over-adaptation of the American mink (Tsvetkova et al., 2013) lead to a change in the habitat of mustelid and their communities.

ALIEN ELEMENTS OF THE FAUNA OF PLANKTON INVERTEBRATES IN THE NORTH OF THE VOLGA UPLAND

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The fauna of plankton invertebrates in the North of the Volga Upland is studied from the very beginning of the XXIth century. And some alien species were found.

There are several alien species of south origin which distribution probably coursed by the reservoirs building on the Volga river. Copepod species *Eurytemora affinis* Poppe and *E. velox* (Lilljeborg) and rotifer *Keratella tropica* (Apstein) inhabit Cheboksary and Kuibyshev Reservoirs and their small and large tributaries. The cladoceran species *Diaphanosoma orghidani* Negrea occurs in the low course of the rivers Tsivil and Ilet' (the right and left tributaries of the Kuibyshev Reservoir respectively, the part of the Volga river), in the sections with reservoirs backwater influence.

The North American rotifer *Kellicottia bostoniensis* (Rousselet) was found in two floodplain lakes (Prisursky Nature Reserve, the basin of the Sura river lower course which is the Volga river right tributary) in the North of the Volga Upland in 2016 for the first time. The alien rotifer inhabits these localities together with native rotifer *K. longispina* (Kellicott) which occurs year-round. The density of *K. bostoniensis* is much lower (less than 1%) than that of the related native rotifer. It looks like *K. bostoniensis* just begins inhabiting this area.

The copepod species *Nordodiaptomus siberiensis* (Wilson) which is typical for Far East was found in two small rivers (Prisursky Nature Reserve, the basin of the Sura river lower course) in June 2016. It took place in two localities only, with low flow rate (less than 0.3 m/c) and forested catchments. Probably the species got into the rivers from nearby temporary pools with spring flood waters. As we got known, *N. siberiensis* was not revealed in the West Siberia and in the European part of Palaearctic.

The reported study was partially funded by RFBR and the Chuvash Republic according to the research project № 16-44-210356 p_a.

FEATURES OF THE DEVELOPMENT OF ZOOPLANKTON ALIEN SPECIES POPULATION IN DIFFERENT PARTS OF THE BALTIC SEA

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In the Baltic Sea there recorded 5 alien species of mesozooplankton – 4 species of plankton crustaceans and 1 species of ctenophores (Ojaveer et al., 2016). In the eastern Gulf of Finland (EGF) there observed 4 species of crustaceans *Acartia tonsa*, *Cercopagis pengoi*, *Evadne anonyx*, *Cornigerius maeoticus maeoticus*. Three species of crustaceans (*A. tonsa*, *C. pengoi*, *E. anonyx*) inhabit the South-Eastern Baltic (SEB) and according to (Schuka, Schuka, 2016) eggs of ctenophores *Mnemiopsis leidyi* found there. The copepods *A. tonsa* are believed to enter the Baltic Sea from the North Sea in the early XIX c. The three Ponto-Caspian cladoceran species, which were first recorded in the Gulf of Finland in the late XIX-early XX cc., probably invaded from the ballast water of ships and then expanded to other parts of the Baltic Sea.

A. tonsa was first recorded in the zooplankton EGF in 1934. The dynamics of *Acartia* abundance was not reviewed in the first decades of invasion, because there were no regular fees samples of zooplankton and the *A. tonsa* was not always distinguished from the native species *A. bifilosa*. Massive development of *A. tonsa* in the deep part EGF, near the island of Hogland, was confirmed by studies of the 1980s. *Cercopagis pengoi* regularly and in mass abundance is found in the deep part of the Bay (salinity is 4–5‰), starting from the time of introduction. The abundance of *Cercopagis* is unstable in the shallow, freshwater areas of the Bay and controlled by the inflow of brackish water. Cladocera *Evadne anonyx*, recorded in the late 1990s, are now dominant species in the deep water area EGF. However, the abundance of this species has been increasing gradually since the date of registration, not as rapidly as the abundance of *Cercopagis*. The populations of these two species consisted of juveniles, males, parthenogenic and gamogenic females. The copepods *A. tonsa* and two cladocerans have formed stable self-reproducing populations in EGF at the present time. The *Cornigerius maeoticus maeoticus* discovered by us in late August 2003 had a low density. In 2004, the *Cornigerius* number of individuals was higher and they were represented by juveniles, parthenogenic females and males. However, *C. maeoticus* could no longer be found in the plankton of the Gulf in the subsequent years to the present time. Probably, this species was unable to naturalize in the waters of the Gulf of Finland, despite its euryhalinity and eurythermic character. The large size of this predatory species, the possible lack of food, the mass development of other native and alien zooplankton predators (there are no available ecological niches) did not contribute to the successful development of this species in the waters EGF.

The growth in the numbers and proportions of alien species *A. tonsa* and *C. pengoi* has been observed in the zooplankton of SEB and the Vistula lagoon since the 2000s. Were marked the juveniles, males and females. *Cercopagis* has asexual and sexual generation. These species formed stable self-reproducing populations. Cladocera *E. anonyx* has low abundance in SEB and observed not regularly. All alien zooplankton species came to the SEB as a result of secondary expansion in the waters of the Baltic Sea, and to the Vistula lagoon through the Strait from the open Baltic Sea.

Thus, the expansion of the three Ponto-Caspian predatory cladocerans in the Baltic Sea (Gulf of Finland) occurred through the "invasion corridor" of the Volgo-Baltic Waterway. Later, two species *C. pengoi* and *E. anonyx* were distributed in the Baltic Sea, including SEB. *A. tonsa*, in contrast, first penetrated the southern part of the Baltic Sea from the North Sea and then distributed throughout the waters. The invasion, distribution, increase in abundance of the thermophile complex of alien species in the zooplankton of the Baltic sea are largely conditioned by the climate change which results in the reduction of the frequency and intensity of the North sea waters inflow and is generally accompanied by a rise of air and water temperature.

THE MOST DANGEROUS INVASIVE SPECIES IN THE DONBASS

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The problem of bioinvasions is very important in regions with strongly transformed natural cenoses. The Donbass is heavily industrialised territory and one of the oldest coal-mining and metallurgical centres in Eastern Europe. Estimation of present-day invasion rate in the region is difficult because of very dissimilar study of different systematic groups. The most objective information can be received about vascular plants and pest insects. In the 1990s 241 species of phytophagous insects were registered in the Donbass, and only 22 species of them were invasive (Kolomoets, 1995). This number is low considering more than sesquicentennial history of afforestation in the Donbass and introduction of 290 species and forms of trees and shrubs during this period (Polyakov et al., 2012). Only in the last 20 years 20 species of phytophagous pests penetrated on the territory of the Donbass (Martynov, Nikulina, 2016). However control of populations of all invasive species is practically impossible. Not all naturalised species significantly influence the ecosystems. The effective system of ecological monitoring can be developed using priority species-targets which potentially able to transform natural and seminatural cenoses. Thirteen species of phytophagous insects can belong to priority species-targets in the region. These species are contingently divided into several groups: 1) species introduced in the middle of the 20th century and periodically forming outbreaks (*Hyphantria cunea* Dr.), 2) species introduced at the beginning of the 21st century and known as dangerous pests everywhere in areas of their feeding plants (*Cameraria ohridella* Desch. & Dem., *Prociophilus fraxinifolii* (Riley), *Aproceros leucopoda* Takeuchi, *Dasineura gleditchiae* Osten Sacken, *Megabruchidius dorsalis* (Fahr.), *Obolodiplosis robiniae* (Haldem.)), 3) species extensively expanding their ranges in the region but with unrevealed pest activity (*Leptoglossus occidentalis* Heidem., *Parectopa robinella* Clemens, *Phyllonorycter robinella* Clemens, *Phloeosinus aubei* (Perr.), *Liriomyza chinensis* (Kato)). All dangerous invasive phytophagous insects recorded by now in the Donbass are trophically associated with intentional introduced plants and not dangerous for natural cenoses. Among entomofagous insects only *Harmonia axiridis* (Pall.) recorded in all districts of the Donbass belongs to the group of dangerous invasive species.

The similar situation of increase the number of invasive species is noted for vascular plants in the region. In the 1980s 101 species (5.6%) among 1817 species of the Donbass flora belonged to invasive plants (Kondratyuk et al., 1984). To the present time 447 (21.6%) among 2070 species are invasive in the Donbass (Ostapko et al., 2010). Nineteen species of vascular plants are classified as dangerous invasive species-transformers, which are widespread on the territories of technogenic origin, wasteland and disturbed lands, penetrate into semi-natural and natural cenoses, and also are recorded in many specially protected natural areas: *Ambrosia artemisiifolia* L., *Conium maculatum* L., *Grindelia squarrosa* (Pursh.) Dunal, *Xanthium albinum* (Widder) H. Scholz. and migrants which were used for gardening and afforestation at different times: *Acer negundo* L., *Ailanthus altissima* (Mill.) Swingle, *Armeniaca vulgaris* Lam., *Clematis vitalba* L., *Elaeagnus angustifolia* L., *Lonicera tatarica* L., *Lycium barbarum* L., *Padellus mahaleb* (L.) Vassilcz., *Parthenocissus quinquefolia* (L.) Planch., *Petrosedum reflexum* (L.) Grulich, *Robinia pseudoacacia* L., *Salix fragilis* L., *Solidago canadensis* L., *Ulmus pumila* L. The negative influence of non-indigenous species on the composition and structure of the native flora is not limited by the discussed factors. Some related native and non-native species give hybrids. As a result the proportion of intermediate (mixed) forms increases, that is also a source of biological contamination of the Donbass flora.

NATURALIZED ALIEN FLORA OF THE WORLD: REGIONAL INVENTORIES AS A BASIS FOR GLOBAL UNDERSTANDING

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Despite decades of intensive research on plant invasions, the first global database of regional alien floras has been compiled only recently. The Global Naturalized Alien Flora (GloNAF) project was initiated in 2011, and the resulting database covering the whole world contains information on naturalized floras for over 840 terrestrial regions (van Kleunen et al., 2015). The data allowed to describe global biogeographic, taxonomic and phylogenetic patterns of alien plants and publish the first comprehensive account on the naturalized alien flora of the world (Pyšek et al., 2017).

The first paper based on GloNAF (van Kleunen et al., 2015) revealed that in total, ~13,000 plant species, which correspond to ~4% of the extant vascular flora, have become naturalized somewhere on the globe, and identified the regions that have accumulated the largest number of naturalized species (Europe, North America). It also allowed to test, in follow up papers based on this data, some of the central hypotheses in invasion biology (see Pyšek et al., 2017 for summary).

The process of compiling the database, however, also identified areas from where the data are missing or remain incomplete. The greatest such gap is temperate Asia where only 55% of the whole territory has been covered by data, that are missing mostly for parts of Russia (in sharp contrast to the majority of the other continents where the data coverage ranges from 90.2% to 99.5% of their territories). The lack of data on naturalized floras for some regions of the European part of Russia also results in rather low coverage for Europe as a whole, 63.8% of the continent area (Pyšek et al., 2017).

With respect to data availability, it is promising that the joint work of the GloNAF team members with external collaborators so far resulted in detailed accounts, including alien species checklists, on several regional floras; these were so far published for Turkey (Uludag et al., 2017), and are under preparation for individual states of India (Inderjit et al.) or about a half of regions of Russia (Vinogradova et al.). These works will contribute to closing some regional gaps in data availability, yet some areas of the world remain uncovered and we are in urgent need for collaboration with local experts. In this presentation we will highlight the opportunities for a broad international collaboration to improve the data coverage for the next edition of the GloNAF database, and summarize the requirements for data quality and comprehensiveness.

ANALYSIS OF MYCOBIOTA OF INVASIVE SPECIES OF VASCULAR PLANTS IN THE KAZAKHSTAN

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In 2009, the Government of Kazakhstan approved the "Regulations on the protection of the Republic of Kazakhstan from quarantine objects and alien species" (dated October 30, 2009 № 1730), regulating the protection of the state territory from quarantine objects and alien species.

Alien plant species intruding into the natural community, cause considerable economic and ecological damage. Researches of mycobiota of invasive vascular plants have not previously carried out in Kazakhstan and presented materials are filling this gap to some extent.

24 fungal species were found on three alien woody plants. There were 10 species on *Acer negundo* L. *Polyporus squamosus* (Huds.) Fr. caused white rot of the heartwood maple trunk. *Dotiorella negundinis* Ellis & Barthol. and *Cryptodiaporthe hystrix* (Tode) Petr. settled on dead branches and bark. Species *Cytospora pseudoplatani* Sacc., *Nectria cinnabarina* (Tode) Fr., *Tubercularia granulata* Pers. caused desiccation and death of the individual branches of the host, *Cladosporium epiphyllum* (Pers.) Nees, *Coniothyrium negundinis* Tehon & E.Y. Daniels and *Rhytisma acerinum* (Pers.) Fr. – leaf spots. Powdery mildew (*Sawadaea bicornis* (Wallr.: Fr.) Homma) on maple leaves is observed annually in most regions of Kazakhstan. The pathogens, characteristic for *Populus alba* L., were: agents of stem rot (*Phellinus igniarius* (L.) Quél., *Trametes versicolor* (L.) Lloyd), rust (*Melampsora tremulae* Tul., *M. magnusiana* G. Wagner), necrosis (*Tubercularia nigricans* (Bull.) Link) and leaf spots (*Drepanopeziza populorum* (Desm.) Höhn., *Fusicladium martianoffianum* (Thüm.) K. Schub. & U. Braun, *F. romellianum* Ondřej, *Cladosporium herbarum* (Pers.) Link). Powdery mildew (*Phyllactinia hippophaës* Thüm. Ex S. Blumer), scab (*Fusicladium hippophaës* Vasyag. & Byzova), sooty fungus (*Fumago vagans* Pers.) on the leaves, *Dothiorella berengeriana* Sacc. and *Dothidea hippophaës* Fuckel on dried and dead branches were discovered on *Hippophaë rhamnoides* L.

On alien species of herbaceous plants 28 species of fungi and fungal-like organisms were found. Mycobiota of *Anisantha tectorum* (L.) Nevski, widespread in Kazakhstan, had 6 fungal species: *Puccinia graminis* Pers, *P. recondita* Dietel & Holw. (agents of leaf and stem rust), *Ustilago bullata* Berk. (smut pathogen), *Septoria bromi* Sacc. and *Macrosporium utile* Kellerm. & Swingle (pathogens of leaf spots) and *Blumeria graminis* (DC.) Speer (the causative agent of powdery mildew). The most harmful – smut pathogen that infects the ovaries. Despite the fact that on *Conyza canadensis* (L.) Cronq. three species of fungi causing powdery mildew (*Sphaerotheca fusca* (Fr.) Blumer) and leaf spots (*Septoria erigerontis* Peck and *Ramularia erigerontis* Gonz. Frag.) were found, on a related species *Erigeron annuus* (L.) Pers. pathogenic fungi were not observed. The leaves of *Helianthus tuberosus* L. were affected by the pathogens of powdery mildew *Erysiphe cichoracearum* DC. var *latispora* U. Braun and spots agent *Diplodina helianthi* Fautr. On leaves of *Oenothera biennis* L. conidial stage of the pathogen of powdery mildew *Erysiphe howeana* U. Braun was marked. Pathogenic mycobiota of saltbush (*Atriplex tatarica* L.) had 5 species: powdery mildew pathogen *Leveillula cylindrospora* U. Braun, downy mildew – *Peronospora arborescens* (Berk.) De Bary, leaf spots – *Stagonospora atriplicis* (Westend.) Lind, *Diplodia herbarum* (Corda) Lev. and *Passalora dubia* (Riess) U. Braun. Rust (*Puccinia komarovii* Tranzschel ex P. Syd. & Syd.) and downy mildew (*Plasmopara obducens* (J. Schröt.) J. Schröt.) were common on *Impatiens parviflora* DC. Leaves of amaranth (*Amaranthus retroflexus* L.) usually affected by white rust (the causative agent *Wilsoniana bliti* (Biv.) Thines), downy mildew (*Peronospora farinosa* (Fr.) Fr.) and spots (*Ascochyta amaranthi* Allesch., *Alternaria amaranthi* (Peck) JM Hook). For *Cardaria draba* (L.) Desv. pathogens of downy mildew (*Peronospora lepidii-sativi* Gaüm.) and leaf spots (*Cercospora cardariae* Vasyag., *Septoria lepidii* Desm., *Phyllosticta lepidii* Thüm.) were characteristic. *Pustula tragopogonis* (Pers.) Thines. were marked for the first time in 2016 on *Ambrosia artemisiifolia* L.

MORPHOLOGICAL PECULIARITIES OF THE RACCOON DOGS (*NYCTEREUTES PROCYONOIDES*) INTRODUCED POPULATIONS FROM THE URALS

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From 1929 to 1955 were massive translocations of raccoon dogs in the European part of former USSR, Siberia and Middle Asia. In total 8850 animals introduced to 82 locations. In the beginning, the farm's animals used for introductions and later, animals from newly formed localities introduced. In the 1950s species distributed on the territory of Western Europe because of high ecological plasticity. In 1930 and 1940 raccoon dogs met in Finland, in 1945 in Sweden, in 1950 in Estonia, Latvia and Lithuania. Later, species was found in Poland (1955), Eastern Germany (1961–1962) and Norway (1983). The modern range of the raccoon dog includes Western and Eastern Europe and the Ural Mountains on the east.

Translocations of raccoon dogs for the Ural region were provided in Bashkiria and Chelyabinsk Province. Animals were introduced from the farm in the Novosibirsk Province to Bashkirskiy Reserve Area in 1935. Later, translocations repeated in 1953–1955 with animals from Kaliningrad Province and Arkhangelsk Province. The species have been distributed very widely all over Bashkiria. In Chelyabinsk Province translocations were made twice from Astrakhan Province but without any success because of introducing exhausted and sick individuals. In the south of Sverdlovsk Province species came by itself and first raccoon dogs were met in fur harvests from 1962. The species achieved the high density in Sverdlovsk province in the middle eighties.

In this study we analyzed autochthonous and introduced populations of raccoon dogs using craniological characters.

We analyze 5 metric and 21 non-metric traits of the skull from the two geographic localities: autochthonous populations of raccoon dogs from the Amur Province (N = 58, collected in 1968–1972; Museum collection of the Zoological Institute, Sankt-Petersburg) and allochthonous populations from the Sverdlovsk Province (N = 75, collected in 1987–1990; Museum collection of the Institute of Plant and Animal Ecology, Ekaterinburg).

Differences in skulls dimensions are not significant ($p < 0.05$) for autochthonous and allochthonous populations but we can see the tendency for increasing of the skull's size for translocated animals from Sverdlovsk Province.

Mean Measure of Divergence between Amur and Ural populations of the raccoon dogs were 0,501. In the previous research of craniological variability of raccoon dogs with the same methods phenetic distances between Europeans populations of raccoon dogs and the Far East population fluctuated from 0.69 to 1.13. So we can suppose that Ural population of the raccoon dogs shows more similarities to autochthonous population from Far East than European populations. High level of adaptive possibilities let the raccoon dog to form new population groups in translocation sites and outspread on the large part of Western Europe.

PHASES OF PENETRATION OF NEW SPECIES IN FRESHWATER ECOSYSTEMS

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Introduction of exotic species into areas where they do not naturally occur, are important cause of ecological disturbance and loss of biodiversity. The translocation of fish had become a big problem of global extent and in freshwater communities there are numerous examples of negative impacts of new species. Sometimes effect of biological invasion may be considered as ecological stress for the ecosystem. However, for other side, in many occasions of fish acclimatization had failed (success was only in 17%). Further, some fish communities appear a strong ability to resist invasions by introduced fishes related to interaction and structural complexity at the community level. Therefore, the success of invaders and effects of introduction **are difficult to predict**.

In this report only one moment will be observed – the sharply increasing of abundance of new species in freshwater ecosystems. This situation was observed in Karelian Syam-Lake after invasion of smelt (*Osmerus eperlanus*), when at the first time smelt have a burst phase (increasing in abundance) and sharply change trophic webs, but later the smelt abundance is sharply decreasing under influence of food competition with vendace (*C. albula*), predators and parasites. After the invasion of vendace in Pasvik-River we observed the changes in the structure of fish community: 1) vendace had become the DOMINANT SPECIES in the pelagic zone, decrease in the contribution of sparsely-rakered whitefish (*C. lavaretus*); 2) displacement of plankton-feeding densely-rakered whitefish; 3) big changes in the food nets of all community. Many carnivorous fishes (trout – *Salmo trutta*, pike – *Esox lucius*, perch – *Perca fluviatilis* and burbot – *Lota lota*) begin to eat vendace.

Different phases of introduction new species in ecosystem may be recognized as following: 1) LATENT or GIDE period – slowly increasing of invader abundance, distribution of new biotops, use the food supply, to prevent from predators, finding of spawning place etc. This period may be prolonged: for example; for *Clupeonella cultriventris* from Volga reservoirs – 5–10 years, for vendace in Pasvik-River – 10 years, for whitefish in Sevan Lake – 40 years.

2) BURST PHASE (or in the past – effect of acclimatization) – rapid increasing in population abundance and biomass. It last 3–5 years and depend the duration of life-span of invader.

3) FALL PHASE – sharply decreasing of abundance. The time of this phase is equal the burst phase – 3–5 years.

4) PHASE of STABILIZATION or phase of acception in the ecosystem may be long on tens years (as rule the food competition, predator and parasite put the new species in the “place”).

The appearance the new species may be considered as invasion or aggression, which may raze ecosystem to the ground. We are known the destructive results of incursion of comb-jelly *Mnemiopsis leidyi* in the waters of Caspian and Black seas, which destroyed all ecosystems from plankton up to fish. But from the another side, the acclimatization of Kamchatka crab.

Paralithodes camtschaticus in the Barentz Sea and self-settling of Caspian kilka *Clupeonella cultriventris* in the Volga reservoirs have not only negative results, but have and positive ones.

It is necessary to emphasize, that sometimes the ecosystems may control the invader and may remove the new species. At present we can't see dangerous from comb-jelly *M. leidyi*; the communities of the Black and Caspian seas have the organisms, which may control the abundance of comb-jelly. After the introduction new species the ecosystem pass different phases, and if we have a process of naturalization during the last phase of stabilization we observed the fluctuation of abundance new species with waves during 5–7 years (for vendace); the undulating of abundance depend of life-span new species and the undulation of food supply.

ANALYSIS OF THE ORIGIN OF THE FISH *PERCCOTTUS GLENII* POPULATIONS IN MOSCOW PROVINCE, RUSSIA, USING PARASITOLOGICAL APPROACH

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Native ecosystems are vulnerable to invasions, as documented by numerous occurrences in the past few decades in Holarctic and other regions of the planet. Invasive species also play an important role as vectors for alien parasites and pathogens, which are similarly transported with hosts into new ecosystems.

The fish *Perccottus glenii* (Odontobutidae) was introduced into Europe one hundred years ago from Eastern Asia, with several initial introduction points. We used parasitological analyses to verify homogeneity-of-origin of *P. glenii* populations in water bodies of the Oka river basin (the largest right tributary of the Volga) within the territory of Moscow province where this invasive fish was documented as having an aquarium-release origin.

Among others, we detected populations of *P. glenii* with the host-specific cestode *Nippotaenia mogurndae*. This supports a non-aquarium introduction of the host due to the complex life cycle of the cestode, requiring an intermediate host that is unlikely in a captive environment. *Nippotaenia*-negative populations were recorded in the upper and middle Moscow river basin (in accordance with reports about aquarium release), but *Nippotaenia*-positive populations were in its lower section, as well as in the Klyazma and Tsna river basins (indicating non-aquarium release). These three above-mentioned rivers are the first-order tributaries of the Oka.

Nippotaenia was detected in aquaculture farms that are (or were) cultivating Far-eastern commercial fishes (i.e., Egorievsk fish farm, Elektrogorsk town, and Baskak pond near the Osenki fish farm). We regard the aquaculture vector as the most probable reason for the appearance of *P. glenii* at those locations. Importantly, the Klyazma and Tsna river basins, and the lower part of Moscow River Basin, were colonized at least since the 1950s (Klyazma), and consequently could serve during long period as a source of secondary dispersal due to a connection from the Klyazma, Tsna, and Moscow rivers downstream to the lower section of the Oka River.

Thus, *P. glenii* populations within Moscow province are derived from at least two separate introduction events from different sources. This rejects the widely accepted point of view about a single introduction event for *P. glenii* in Moscow region. Our investigation extends knowledge regarding the number and geographic locations of initial introduction points for this rapidly spreading invasive species. It also highlights the importance of a complex comparative approach as a means to address seemingly intractable issues in invasion ecology.

This investigation has been published in *Hydrobiologia* (2017) 788: 65-73. DOI 10.1007/s10750-016-2987-0, and was supported by the Russian Science Foundation (project 16-14-10323).

THE MODERN STATE AND MORPHOLOGICAL VARIABILITY OF THE COMMON SAWBELLY *HEMICULTER LEUCISCULUS* (PISCES; OSTEICHTHYES) FROM THE BASINS OF TALAS AND CHU RIVERS

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It remains unknown when the common sawbelly *Hemiculter leucisculus* (Basilewsky, 1855) had been introduced to water bodies of the basins of the Talas and Chu rivers. Anyway, it was an unintentional introduction. The common sawbelly was not presented in fish lists for the both watersheds given by F.A. Turdakov (1963), but it was mentioned in the later other given by I.A. Pivnev (1985). Most probably, unintentional acclimatization with herbivorous fishes from Eastern Asia could be a pathway of the sawbelly invasions. In contrast of other invaders as the topmouth gudgeon *Pseudorasbora parva* and rosy bitterling *Rhodeus ocellatus*, sawbelly could not be revealed here for long time. Detailed description of morphological and biological features of that alien fish species in water bodies of the Kazakhstan was given by V.E. Karpov et al. (1992). We provided our investigation to glance the state of the common sawbelly about 25 years later.

The Talas, Ters-Asy and Chu Rivers with the Ters-Aschybulak and Tashutkol water reservoirs. Biylkol Lake as well as many inflows of the main rivers had been investigated. The same procedure of morphological description was applied (Pravdin, 1966) as well as morpho-pathological analysis and estimation of the index of unfavorable state (IUS) (Reshetnikov et al., 1999).

Population explosions of the sawbelly were observed in Voinskoe pond (Talas watershed) 2007 and twice in the Tashutkol water reservoir (Chu watershed) 1985 and 2016. Other years this species was not numerous there. The common sawbelly grows and matures faster than indigenous pelagic fish species and so is able to become dominant when piscivorous fishes are not numerous. This situation is typical for new water reservoirs or periodically dried ponds and reservoirs. If water bodies have rather stable water regimen, sawbelly let roach and other fishes be dominant there. Therefore all introduced populations of sawbelly many times passed through the bottleneck.

Maximal size of fishes from investigated samples was about 160 mm that close to previous data of V.E. Karpov et al. (1992). Condition factors varied slightly and corresponded to wellbeing state. IUS corresponded to the rather favorable ecological zone but some abnormalities were observed in liver of adult fishes. Morphological features varied significantly in each sample as well as in samples from different watersheds, but limits of variation did not exceed known data: DII-III 7-8; A II-III 11-14; L. 43-50; P 13-17; V I-II 7-8; gill rakers 16-20; vertebrae 37-43. There were observed individuals with differences in body form, position and form of fins, length of keel and caudal peduncle. Once was observed congenital malformation of pectoral fin and once – malformation of lower jaw.

Two life strategies of sawbelly were observed in the investigated water bodies. There fishes grew up to bigger size and can be numerous in new or disturbed water ecosystems where submerged water plants were abundant, and remained small and sparse in stable and about climax ecosystems.

This investigation was supported by the grant #2678/ GF 4 given by the Ministry of Education and Science of the Republic of Kazakhstan.

EPIGENETIC AND BIOCHEMICAL CHANGES IN THE INVASIVE MACROPHYTE *ELODEA CANADENSIS* (MICHX.) UNDER ABIOTIC STRESSES

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Invasive freshwater plants are currently spreading rapidly and this is likely to continue with further changes in global climate resulting in changes in physical and chemical conditions in freshwaters and possibly creating new suitable habitats for alien plant species. Temperature, salinity, pH and other factors are important environmental variables that are changing with the global climate. These factors are important factors for aquatic plant growth and development.

In this study the effects of temperature, salinity and pH on the epigenetic (luminometric methylation assay (LUMA)) and biochemical (protein analysis, antioxidant activity, membrane stability, chlorophyll fluorescence etc.) changes in the invasive aquatic plant *Elodea canadensis* (Michx.) were investigated.

Widespread waterweed *Elodea canadensis* (Michx.) is the only established species of the genus *Elodea* being a successful invader in different water bodies and streams of Latvia. In this study, the water plant *Elodea canadensis* were used as a model for investigation. *E. canadensis* was collected from natural water bodies than it was grown in experimental tanks in a simulated aquatic environment in the climate chambers for investigating the response of *Elodea canadensis* to water temperature, salinity and pH changes.

For *E. canadensis*, the epigenetic and biochemical traits were only slightly modified in response to salt, whereas the influence of elevated temperatures and pH level showed more important changes. The results showed that simulating short-term heat stress (26°C/18°C – day/night temperature of water) was observed crucial changes of biochemical processes, e.g. changes in total protein amount, cellular membrane stability etc. The decrease in Fv/Fm during high temperature stress shows that even short-term high temperature exposure have more destructive effect than increase in water salinity.

This study has been supported by the National Research Programme 2014-2017 „EVIDEnT” sub-project 1.4. “Functioning of food-webs”.

NEW DATA ON THE DISTRIBUTION OF ALIEN SPECIES OF HYDROPHYLIDAE (INSECTA: COLEOPTERA) IN THE EUROPEAN PART OF RUSSIA

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One of the leading factors in the transformation of natural ecosystems is the invasion of adventive organisms. A significant role in this process is played by anthropogenic transformation of natural systems, and biological invasions are among the most severe consequences of globalization. Alien beetles are the most numerous group among invasive arthropods of Europe. The fundamental research of the invasive process in Russia started recently. In this regard, the study of coleopteran invasion is an actual, intensively developing direction of research. Human activities account for the following causes of changing distribution: anthropogenic changes in abiotic environmental factors; intentional introduction and reintroduction of organisms and random drifts (ballast water, on imported agricultural products, etc.). For many organisms, the ways of resettlement are unknown, and ascertaining these ways is very important. The choice of the research area is made this way because, the European part of Russia is located on the transportation routes of cargo from different regions of the world, and is an important link in the chain of distribution of alien species of insects, including beetles.

The model group of this study is water scavenger beetles (Hydrophilidae). Four alien species of Hydrophilidae are found in the European part of Russia: *Cercyon laminatus* Sharp, 1873 [native range – East Asia]; *C. nigriceps* (Marsham, 1802) [Oriental region or North Africa]; *C. castaneipennis* Vorst, 2009 [native range unknown] and *Cryptopleurum subtile* Sharp, 1884 [Japan]. They all are sapro-coprophagous, inhabitants of decaying plant matter and excrements of mammals. Another species known from the North of Russia (the only specimens from Saint-Petersburg – *Cercyon fimbriatus* Mannerheim, 1852 [native areal – the Pacific coast of the United States and Canada], inhabits marine sediments. For «overland» species of the genus *Cercyon* and relative taxa acclimatization outside of the native areal are typical.

There are records of new alien hydrophilids in the European Russia. *Cercyon castaneipennis* – Saratov and Tambov Province; *Cercyon laminatus* – Saratov Province, Crimea; *Cryptopleurum subtile* – Saratov Province.

Water scavenger beetles penetrate into the European part of Russia from all parts of the world. The main donor regions are Europe, East Asia, North and South America and probably Australia. These are regions exporting products of animal and vegetable origin in particular cattle to Russia. Most species are adapted to flight, which promotes self-dispersion on neighboring territories. Some species (*Cercyon laminatus*) goes far northwards due to unintentional introduction during transportation of organic substrates.

Facts of the invasion of Palearctic species of Hydrophilidae in other regions are known too. For example, alien species are registered in the Neotropical region (*Cercyon depressus* Stephens, 1829; *C. haemorrhoidalis* (Fabricius, 1775); *C. quisquilius* (Linnaeus, 1760) et al.). Thus, by example of water scavenger beetles one can observe the processes of cosmopolitan invasion and the homogenization of the biosphere.

TINTINNID CILIATES AND POLYCHAETES OF THE NORTHEASTERN BLACK SEA AND ABKHAZIAN COAST: RECENT INVASIONS

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In coastal waters of the northeastern shelf of the Black Sea were established a fourteen introduced non-native species at different stages of naturalization – *Tintinnopsis tocaninensis*, *Tintinnopsis mortensenii*, *Amphorellopsis acuta*, *Eutintinnus tubulosus*, *E. apertus*, *E. lususundae*, *E. sp.*, *Salpingella decurlata*, *S. sp.*, *Rhizodorus tagatzi*, *Novaclusilis sp.*, (Ciliata: Tintinnida), *Oithona davisae* (Copepoda: Cyclopoida), *Polydora cornuta*, *Streblospio gynobranchiata* (Polychaeta: Spionidae). By results of research of ships' ballast waters it has been established, that main "risk groups" of invasions via water transport are tintinnid infusorians, neritic copepods, polychaetes and phytoplankton. Harmful invasions are polychaetes *S. gynobranchiata*, *P. cornuta*. A total of 58 introduced non-native species at different stages of naturalization were recorded in port waters of the northeastern shelf of the Black Sea: 45 Copepoda, including 44 casual taxonomical form, 2 Polychaeta, 11 Tintinnida (4 taxonomical form with non established status). The status of species was determined by work (Zenetos et al., 2005). The largest number of alien species (58) was recorded in the Novorossiysk Bay, in the port of Tuapse were disclosed – 18, in the Liman "Zmeinoye ozero" – 12, in the Sochi port – 6, the Gelendzhik Bay and the Sukhum port – in fours. The casual taxonomical form of copepods are found in the Anapa Bay and the Strait of Kerch – 9 and 2 respectively.

Tintinnid ciliates In recent years, on the Black Sea there have been frequent occurrences of single specimens and of local outbreaks of abundance of alien tintinnids. A total of 11 taxonomic forms of non-native species were established in the Novorossiysk Bay (Gavrilova, 2010; Selifonova, 2012), in fives – in the Tuapse and the Sochi ports and the liman "Zmeinoye ozero", 3 – the Gelendzhik Bay, 2 – the Sukhum port. Large numerical density of alien tintinnids *T. tocaninensis* (2.1 million. ind./m³), *Eutintinnus tubulosus* (4 million. ind./m³), *A. acuta* (0.9 million. ind./m³), *Salpingella sp.* (0.4 million. ind./m³) was noticed in the Liman "Zmeinoye ozero" (Selifonova, 2015). Non-native tintinnid ciliates *T. tocaninensis* and *A. acuta* were disclosed for the first time in Autumn 2010 in waters of the Novorossiysk port, in November of the same year – in the Tuapse port. In September 2016, *Novaclusilis sp.* and *E. tubulosus* were recorded in the Sukhum ports, *E. tubulosus*, *E. apertus*, *Novaclusilis sp.*, *R. tagatzi*, *A. acuta* – in the Sochi port, – *E. tubulosus*, *E. apertus*, *E. sp.* – in the Gelendzhik Bay. In Autumn 2015–2016 in the Novorossiysk port were found for the first time *R. tagatzi*, *Novaclusilis sp.*, *Tintinnopsis mortensenii*, what denotes at wide distribution of these species in the Black Sea (Gavrilova, Dovgal, 2016; Gavrilova, 2017).

Polychaetes In 2001, the biocoenosis of spionid polychaetes *S. gynobranchiata* was detected in the Novorossiysk port in the estuary of the Tsemess River (Murina et al., 2008). In 2003 this species of spionid was recorded on the coast of Turkey in the Aegean Sea (Cinar et al., 2005), in 2004 in the southern Caspian Sea (Taheri et al., 2008), in 2007 in the Sevastopol Bay (Boltacheva, 2008) and in 2011 in the Liman "Zmeinoye Ozero" (Radashevsky, Selifonova, 2012). In September 2016 this species has been found for the first time in the Sukhum port at depth 5 m. The abundance of species reached 0.4 thousand ind./m². All authors consider the appearance of this polychaetes in the Black Sea due transfer of larval stages with ships' ballast water. Spionid polychaetes *P. cornuta* was first recorded in the mud sediments of the port of Tuapse in August 2009. Distribution of this species along Romania coast was recorded in 1997 (Radashevsky, 2005), in the southern Crimea in 2005 (Boltacheva & Lisitskaya, 2007) and in the Liman "Zmeinoye ozero" in 2011 (Radashevsky, Selifonova, 2012).

RISK ASSESSMENT OF NON-NATIVE INVERTEBRATES IN THE RIVERS OF BELARUS USING FI-ISK TOOLKIT

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Risk identification is an important first step in evaluating the risk of non-native species to native species and ecosystem biodiversity (Copp et al., 2009). The FI-ISK (Freshwater Invertebrate Invasiveness Scoring Kit, Tricarico et al., 2010) was used for discrimination 17 alien macroinvertebrates on invasive (high risk) and non-invasive (low and medium risk) species in the main rivers of Belarus. The FI-ISK includes 49 questions, the answers on its divided on three categories: Yes, No, Don't know. The response in FI-ISK for alien species also has a certainty score (1 = very uncertain; 2 = mostly uncertain; 3 = mostly certain; 4 = very certain).

The values of the scores for alien species calculated by FI-ISK changed from 9 to 23. Mean value certainty score factor (CF) in responses is 3.92 ± 0.1 .

The Receiving Operator Characteristics (ROC) curve was used for determination a cut-off value, i.e., a threshold level to discriminate between invasive and non-invasive species. ROC analysis is based on binary classification, and reflects a ratio between true positive rate and false positive rate in classification of the object.

Since *a priori* categorization of the species is needed for this test, the own and some published data about different alien invertebrates species were used to categorize the species *a priori* as 'invasive' or 'non-invasive' on the rivers of Belarus.

The cut-off value calculated according to ROC curve for tested species is equal 18.

The area under the ROC curve was used for confirmation received cut-off value. This area should be greater than 0.5, and in our case was equal 0.523.

The Youden's index was used for estimate the differences between the true positive rate and the false positive rate. Maximal value of index is equal 0.6 and indicates that cut-off point is an optimal.

The list of species with high risk, according to ROC curve includes *Dikerogammarus haemobaphes*, *Dikerogammarus villosus*, *Pontogammarus robustoides*, *Chelicorophium curvispinum*, *Dreissena polymorpha*, *Lithoglyphus naticoides*, *Orconectes limosus*. The maximal values (22–23) pointed out for *Ch. curvispinum*, *D. villosus*, *D. polymorpha*, i.e., these species can be characterized as the most invasive. The species with medium risk (value 13–17) includes *Obesogammarus obesus*, *Chelicorophium robustum*, *Physella acuta*.

EXPERIMENTAL INVESTIGATION THE PROCESS OF INVASION SMALL AND LARGE CLADOCERANS INTO NATURAL ZOOPLANKTON'S COMMUNITIES IN THE PRESENCE AND ABSENCE IMPACT OF FISH

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We conducted experiment in June-August 2014 during 50 day in mesocosms (volume 300 l) that were filled with water containing natural bacterioplankton, phytoplankton and zooplankton collected from Rybinsk Reservoir. There was no additional feed intake and food resources were naturally produced. We established 4 variant of experience that was replicated in triplicate mesocosms. In the control (variant 1), the dynamics of bacterio-, zooplankton and phytoplankton were studied without affecting additional factors. In the variant of the experiment with introduction of alien species into the natural zooplankton community (variant 2), 2 species of Cladocera were infused into mesocosms: large (*Daphnia magna*) and small-sized (*Ceriodaphnia dubia*), at the rate of 20 individuals of each species for 1 mesocosm. Thus, we imitated the invasion of a small amount of invasive species, which, as a rule, occurs when they are introduced into new ecosystems. In experiments with fish (variant 3), 2 individuals of roach *Rutilus rutilus* L. with age 1+ and a size from 6.5 to 8.5 cm were infused in each mesocosm. In experiments with fish and introduction of alien species of Cladocera (variant 4), both roach and the same species of Cladocera as in variant 2 were infused to the mesocosms. The growth of phytoplankton was estimated from the concentration of chlorophyll "a". Samples of bacterioplankton, biogens and chlorophyll "a" were collected in each mesocosm 4 times: at the beginning of the experiment, 2 weeks after the start of the experiment, 10 days before the end of the experiment and at the end of the experiment. Every day during the experiment, the temperature, oxygen concentration, electrical conductivity and pH were measured in each mesocosm in the morning and in the evening.

Differences in temperature, oxygen concentration, electrical conductivity and pH between different mesocosms were not observed during the experiment. In each of the variants of the experiment, during the experiment, the concentration of chlorophyll "a" increased, with a fall in the concentration of total phosphorus, concentration of chlorophyll "a" was higher in all in variants of the experiment with fish. The abundance and biomass of bacterioplankton was also higher in the variants of the experiment with fish (variants 3 and 4). In general, in the experiment with introduction of invasive species in the absence of fish press (variant 2), the average proportions of *Daphnia magna* and *Ceriodaphnia dubia* from the abundance of zooplankton were approximately equal, whereas the proportion of *Daphnia magna* in the biomass of zooplankton was 3 times higher than proportion of *Ceriodaphnia dubia*. In addition, there was a high proportion of native cladoceran *Simocephalus vetulus*. In the experiment with introduction of invasive species in the presence of fish (variant 4), *Daphnia magna* was almost completely absent in plankton and probably because of its large size was eaten by fish, while the proportion of *Ceriodaphnia dubia* was significantly higher and increased significantly by the end of the experiment. On average, the proportion of *Ceriodaphnia dubia* from zooplankton biomass was 15 times higher than the proportion of *Daphnia magna* in variant 4 and 2.8 times higher comparison with variant 2.

Thus, the process of invasion large-sized Cladocera into natural communities is more successful in the absence of fish presses and native large cladocerans, which are stronger competitors than the invasive species. In the presence of a fish press, the introduction of small-sized Cladocera is more successful.

PRELIMINARY EVALUATION OF ASH SPECIES RESISTANCE TO INVASIVE CONSUMMERS

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Collection of ash (*Fraxinus*) species at the Main Botanical Garden RASc appeared to be "an ecological trap" for two aggressive Far Eastern invaders – emerald ash borer *Agrilus planipennis* Fairmaire (EAB) and ash dieback fungus *Hymenoscyphus fraxineus* (T. Kowalski) Baral, Queloz, Hosoya (ADB). Ash trees of the collection were planted in 1950-80s. Their most intensive recent dieback took place during the period of 2010–2014 when approximately 51% of trees died.

In 2014 during health evaluation of trees of 24 different ash taxons it was found that many of dead and weakened trees had EAB galleries and exit holes. The EAB killed all or the majority of trees of *F. americana* L., *F. americana* var. *iodocarpa* Fern., *F. angustifolia* Vahl., *F. excelsior* L., *F. excelsior* "Aurea" (Pers.) Schelle, *F. excelsior* "Diversifolia" Lingelsh., *F. lanceolata* Borkh., *F. nigra* Marsh., *F. ornus* L., *F. oxycarpa* Willd., *F. pennsylvanica* Marsh. and *F. rotundifolia* Mill. Only few EAB galleries were registered on weakened trees of *F. americana* var. *joglandifolia* (Lam.) D.J. Browne and *F. mandshurica* Rupr. *F. biltmoteana* Beadle., *F. bungeana* DC., *F. chinensis* Roxb. (= *F. rhynchophylla* Hance), *F. excelsior* "Argenteo-variegata", *F. excelsior* "Nana", *F. latifolia* Benth. (= *F. oregona* Nutt.), *F. quadrangulata* Michx., *F. profunda* (Bush) Bush (= *F. tomentosa* Michx. L.), *F. sogdiana* Bge. and *F. velutina* var. *glabra* Rehd. appeared to be free from EAB attack.

During repeated examination of collection at 2016 we failed to find any new signs of EAB presence. Many trees have recovered by sprouting. On some trees and young twigs we found symptoms of *H. fraxineus* infestation. With the help of molecular diagnostics an ADB disease was proved to infest *F. excelsior*, *F. ornus* and *F. mandshurica*. Single case of infestation was registered on *F. chinensis*. We did not find ADB on few survived trees of *F. pennsylvanica*, but in different locations in European part of Russia this species was proved to be extremely susceptible for ADB infestation (Baranchikov et al., 2016; Musolin et al., 2017).

Unfortunately testing of trees susceptibility to invasive organisms in arboreturns has an important limitation: a full range testing can be conducted only for the first serious invader. Work with the next invasive pest or pathogen will be limited by the number of survived tree species of collections and can demonstrate only level of their resistance.

The work was supported by the Russian Foundation for Fundamental Research (grant 17-04-01486a).

THE ROLE OF INVADERS IN FEEDING OF PREDATORY FISH OF THE KUIBYSHEV RESERVOIR: CASES WITH BURBOT AND PIKE-PERCH

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The composition of invasive species of the Kuibyshev reservoir currently stands 18 or 30.5% of the total number fish species inhabiting in the reservoir. Some of them (black Sea sprat) successfully naturalized and reached sufficient population and mastered by fishing. Other (black-striped pipefish, chinese sleeper, round goby, stellate tadpolegoby, Caspian bighead goby, monkey goby and western tubenose goby) species multiply and become common with local distribution. Invasive species, having increased in numbers, become competitors in the feeding with local species. The often become a food for carnivorous fish species, as well as themselves begin to prey and eat other native and alien species. Thus, there is the inclusion of new species in the long-standing food chains and their interaction with indigenous hydrobionts of the reservoir.

A study of burbot feeding in the Kuibyshev reservoir in different seasons of the year revealed that juveniles feed only invertebrates, including crayfish, amphipods, chironomids larvae, dragonflies and caddis flies and oligochaetes, leeches and mollusks. While food composition of the large commercial size burbots consisted of fish and in all seasons the Percidae perch dominated in diet, first of all is ruffe (Aristovskaya, 1935; Lukin, 1935; Makhotin, 1964). Reducing the population of ruff in the Kuibyshev reservoir has led to the fact that gobies gradually occupying its ecological niche using the released habitats of ruffe and switching to the consumption of its feed (Nikulenko, 2006; Kirilenko, Shemonaev, 2007; Ruffe, 2016). At the same time, there is a process of adaptation of predatory fish species of the reservoir and burbot in particular, to new feeding objects – goby. It was found that currently in the nutritional spectrum of burbot goby plays a significant role occupying 67.7% on the occurrence and 44.4% in the number of specimens.

Thus, the feeding of burbot in the Kuibyshev reservoir by invasive species, in particular by gobies, confirms their acclimatization in the reservoir and indicates that burbot can play the role of a biological meliorator and regulator of the number of invaders.

The study of the feeding spectrum of pike-perch the most numerous among predators of the Kuibyshev reservoir in different seasons of the year at the present stage of the reservoir's existence and its comparison with that in the 70s of the last century revealed that it significantly differs in the species composition, biomass and number of food items. In the second half of the last century the diet was dominated by Percidae. Currently, the main food item of pike-perch in the reservoir is black Sea sprat – one of the numerous species of the reservoir, amounting up to 76.2% in number and 79.5% by weight. They consume a perch, ruffe, bleak and pike-perch fry in a smaller amount. It was revealed that in the spring perch shows greater selectivity in feeding, and its range of food is much more diverse and includes juvenile carp (silver bream and roach) and perch fish (bersh, perch, pike perch and ruffe). This is explained by the fact that during the spawning period of fish in the spring, pike perch is accessible to the early juveniles of most fish species in the reservoir. In autumn the diet is dominated by black Sea sprat, numerous and quite accessible bleak and sabrefish that are pelagic inhabitants as pike-perch. Consuming invaders and those species of fish that are competitors in feeding more valuable commercial species, pike-perch in the reservoir controls their numbers and serves as a biomeliorator.

CHARACTERISTICS OF FORMATION OF THE SECONDARY RANGES OF PHYTOPHAGOUS ALIEN INSECTS IN THE TREE-SHRUB ECOSYSTEMS OF THE NORTHWESTERN CAUCASUS IN 2000–2016

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Currently at least 52 alien species of dendrophilous insects are recorded for Krasnodar Territory and Republic of Adygeya (Maslyakov, Izhevskiy, 2011). Since the beginning of this century representatives of 33 species of this kind were discovered here for the first time. Among them the local population of 21 species are recorded only from 2012 onwards (Karpun et al., 2015; Shiryayeva, 2015; Shchurov, Bondarenko, 2015). The bulk of experts from quarantine and phytosanitary services, as well as the forestry institutions, associate invasive pressure surge on the region with the simplification of the import regime for plant materials, primarily aiming arrangement of the big Sochi Olympic venues. Just here, in the strongly transformed ecosystems of humid subtropical Black Sea Coast of Krasnodar Territory, rich in alien plants, the largest number of dendrophilous alien pests have been naturalized, namely 43 species, including 17 ones during the last 5 years. Many of them threaten only the decorative exotic plants (palm trees, citrus, eucalyptus, bamboo), having no chance, as well as their fodder plants, to invade the natural forests west of Tuapse City.

However, here are imported also some dangerous pests of native forest plants – the colchic boxwood, oaks, pines, chestnut, dendritic junipers, and also some polyphagous species. With few exceptions, the most of adventive species entered Krasnodar Territory through the ports of Sochi and Novorossiysk, moving along the intensive freight traffic to large cities – transport hubs (primarily, Krasnodar). Naturally, the first populations of such invasive species were revealed in the vicinity of the marshalling yards, elevators or highways linking them. Further resettlement has not been prevented even by the presence of steppe zone, since it is covered with the dense network of the forest shelter-belts, shelter pluggings of many representatives of Asian and North American floras (*Ailanthus*, *Amorpha*, *Ulmus*, *Gleditsia*, *Robinia*).

Second, smaller, invader's flow moves to the foothills of the Caucasus Mountains from the northwest direction – from ports at Azov Sea, Don River and from the plains of the Eastern Ukraine, also along highways, mostly following the intense movement of agricultural products. Exactly this way has been utilized for the infiltration to the region by the sawfly *Aproceros leucopoda* Takeuchi, 1939 and the bug *Leptoglossus occidentalis* Heidemann, 1910. Pests able to overcome dozens of kilometers per season actively settle outside the forest zone, namely the bugs *Corythucha arcuata* (Say, 1832), *Halyomorpha halys* (Stål, 1855), the pyralid *Cydalima perspectalis* (Walker, 1859) and probably the gallfly *Dryocosmus kuriphilus* Yasumatsu, 1951. Several species firstly discovered only in the 2010–2011 biennium, for example, *Obolodiplosis robiniae* (Haldeman, 1847), *Dasineura gleditchiae* (Osten Sacken, 1866), *Parectopa robiniella* Clemens, 1863, and *Phyllonorycter robiniella* (Clemens, 1859), at the time of discovery already had been distributed widely. This allowed to assume their penetration in the North-Western Caucasus at the turn of the century, in fact, remaining undetected by professionals. Observations of the past years showed that some of the previously numerous alien phytophagous species nearly disappeared from the natural ecosystems of the region, for example, the bruchid *Megabruchidius tonkineus* (Pic, 1904) in the Valley of the river Kuban or the cerambycid *Callidiellum rufipenne* (Motschulsky, 1860) in Sochi.

The greatest threat to local ecosystems is caused by the adventitious phytophagous species, which find suitable feeding sites in the native flora, especially among the edificators of natural forests (*Quercus*, *Castanea*, *Pinus*, *Juniperus*). Effects of such invasions are compounded by polyvoltine development of the thermophilic insects in the Northwest Caucasus.

This study was partially supported by the grant from the Russian Foundation for Basic Research and Administration of Krasnodar Territory (project No 16-44-230780).

DISPERSAL OF INVASIVE CTENOPHORES *MNEMIOPSIS LEIDYI* AND *BEROE* SPP. IN THE EUROPIEN SEAS

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We analyse dispersal of the most aggressive invader ctenophore *Mnemiopsis leidyi* (A. Agassiz) that has colonized and continues to colonize new areas around the European seas and its predators ctenophores genus *Beroe*. Now the biogeographical distribution of *M. leidyi* in the southern and northern Eurasian seas covers a wide range of habitats from the brackish enclosed and semi-closed seas the Black, Caspian, Azov, Marmara and Baltic to the Mediterranean Sea with very high salinity and the North Sea with oceanic salinity, from temperate to subtropical, from high productive to oligotrophic environments. The need to understand factors, which could control its dispersal and blooms is an important issue. Species of family Beroidae are specialized predators on zooplanktivorous ctenophores including *M. leidyi*. We study representatives of genus *Beroe* both as species invaded in the area where *M. leidyi* blooming like in the case of the Black Sea and species which migrate in similar areas follow for *M. leidyi* dispersal in adjoining waters. For identification of Beroidae we used morphological and genetic analyses.

First *Beroe ovata* sensu Mayer was introduced first in the Black Sea in 1997 from North American waters (Seravin et al., 2002). Now it sufficiently controls population of *M. leidyi* in the Black Sea. Resulted from ecosystem began to recover Sea (Shiganova et al., 2014a). From the Black Sea *B. ovata* following for its prey *M. leidyi* spread north to the Sea of Azov (Shiganova et al., 2001) south to the Sea of Marmara (Tarkan et al., 2000), and Levantine Sea (Galil et al., 2011). Our genetic analyses showed that it is the same species (Johansson et al., submitted). In the Southern Aegean Sea (Gokova Bay) *Beroe ovata* also was introduced and now controls regularly *M. leidyi* population (Gulsahin and Tarkan, 2013). In other areas of the Mediterranean native *Beroe* species began to appear in the swarms of blooming *M. leidyi*. *B. forskalii* and *B. cucumis* sensu Mayer were recorded together with *M. leidyi* in the Levantine Sea (Galil and Gevili, 2013; Galil pers. com.). *B. ovata* were found in the northern Adriatic in aggregations of *M. leidyi* and native *B. forskalii* and *B. cucumis* sensu Chun in 2005 (Shiganova and Malej, 2009).

Similar events happened in the northern seas: in the Baltic and North seas *Beroe* species appeared in the areas of blooming *M. leidyi*. *B. ovata* sensu Mayer was introduced in the eutrophicated Great Belt of the Baltic Sea in mid-December 2011. Identification confirmed in our genetic analyses (Shiganova et al., 2014b; Johansson et al., submitted). In addition *B. gracilis* Kuenne from the North Sea were recorded in the *M. leidyi* blooming areas of Great Belt for the first time in the Baltic Sea (Shiganova et al., 2014b). Before *M. leidyi* invasion *B. gracilis* was indicated as endemic to the German Bight (south-east of the North Sea) (Greve et al., 1976). But after *M. leidyi* invasion it was recorded also in Norwegian waters of the North Sea (Ringvold et al., 2015; Hosia et al., 2011). Native *B. cucumis* Fabricius found in the north Atlantic waters. It was recorded in the northwestern North Sea, in the northern Norway (Falkenhaus, 1996), and in the Baltic Sea in Danish fjords in outbreak of *M. leidyi* (Shiganova et al., 2014b, Riisgård and Goldstein, 2014).

In the southern Norwegian waters representatives of *Beroe* were found in huge aggregations of *M. leidyi* during last years (Ringvold et al., 2015). Species identification in analyses ITS-1 and COI was considered as undescribed species, which also was found in the White Sea according to our genetic analyses (Johansson et al., submitted).

All *Beroe* species play important ecological role in controlling abundance of harmful zooplanktivorous ctenophores. After *M. leidyi* invasion they appear in the area of its bloom and rapidly decrease its abundance by grazing (Shiganova et al., 2014b). Time of development of *Beroe* spp. population depends on its prey *M. leidyi* development and coincide with its phenology, which can be different in different environments (Shiganova et al., submitted).

INVASIVE FUNGI IN THE FORESTS OF THE CONTINENTAL REGIONS OF NORTHERN EURASIA: CONCEPTS AND FACTS

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The problem of the active spread of invasive species (from significantly remote regions and from other continents) and their impact on natural local biota is acute all over the world and has long been actively discussed. Nevertheless, there are various interpretations of the term "invasive species", which creates obvious problems in the results interpreting of numerous publications. The range of opinions can be delineated by the following boundaries: some experts consider all the "alien species", occurring in human-modified habitats, but not in the natural (aboriginal) ecosystems; other consider them as aggressive "invasive species", which are actively introduced into natural ecosystems, and could transform them. A similar situation exists in mycology: different specialists understand this term in different ways.

Within this framework, the distribution and ecology of all types of macro- and micromycetes known at the present time in the continental taiga regions of Siberia is analyzed. In the literature, a large body of data has been accumulated on the study of pathogenic macro- and micromycetes because of their obvious economic and agricultural significance.

In this study, "invasive" alien foreign species that are actively introduced and settled in the environment, forests, and there affect the local biota and the like, destroying the local flora. In the maritime climate of Europe, the Far East, North America, there are a large number of examples of "invasive" fungi and mechanisms of their introduction into natural ecosystems, while for the continental regions of Siberia such examples are problematic. If we adhere to the "strict" definition of the term "invasive species" adopted by us, for example, the classic "alien species" – *Phytophthora infestans* (Mont.) De Bary, for Northern Eurasia, we do not consider it an "invasive species", because in the Siberian taiga regions, it occurs exclusively in human-modified habitats, but does not penetrate into natural ecosystems, much less damage to native species in the natural conditions of the taiga.

In contrast to the data from regions with the coastal climate of Europe, the Far East, and North America, for which there are many examples of "invasive species" (according to the boundary of the term in question in this paper), data analysis for macro- and micromycetes of taiga forests in Siberia does not allow us to name any species as "invasive". Harsh continental conditions of the region do not promote the introduction of "invasive species" into natural forests and their development and resettlement. At the same time, many species are referred to as "alien species", which can exist exclusively in anthropogenic habitats, on an alien substratum within Botanical gardens, in cities, on garbage cans, along railways and highways. In the north, the "alien species" develop on alien "southern" substrates, but when the substrate is depleted, the species disappears with it and is unable to transfer to "related" native aboriginal substrates.

THE EVALUATION OF INFLUENCE OF SOME ENVIRONMENTAL FACTORS ON EPIGENETIC ALTERATIONS AND DISTRIBUTION OF AMUR SLEEPER IN LATVIA

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Amur sleeper (*Perccottus glenii*, Dybowski, 1877) is a freshwater invasive fish species which has rapidly spread during the last two decades in many European countries. The total registered areal of *P. glenii* covers at least the central and eastern part of Latvia also. But despite the absence of the registered findings of *P. glenii* in western part of Latvia, we assume that the whole territory of the country potentially can be occupied to a greater or lesser extent by this species at present. The study of invasion success must be considered complete with the evolutionary genetics, as it might be correlated with the genetic and epigenetic polymorphism of populations, which directly influence the invasive species capacity for dissemination. Epigenetics, particularly a noticeable shift in methylation status, is often associated with the process of colonization of new environments. Different types of stressing environmental conditions may alter global methylation levels. One of the epigenetic mechanisms regulating the gene expression is DNA methylation. DNA methylation is involved in the control of gene expression; give the possibility of speculating that an evolutionary connection between environment, gene expression, and adaptation is possible.

Before being subjected to epigenetic analysis, the *P. glenii* individuals belonging to some ecological different aquatic ecosystems from Latvia were morphometrically investigated by 23 plastic parameters. It was known, that the plastic parameters of fish are most affected by environmental factors. The age of *P. glenii* was determined by scales. For study of influence of environmental factors of epigenetic changes of Amur sleeper (total DNA methylation) the luminometric methylation assay (LUMA) was applied to ecological studies for the first time. This method is based on digestion of genomic DNA with methylation sensitive and insensitive restriction enzymes (*HpaII* and *MspI*), followed by quantification of the resulting number of cut sites using a luminometric polymerase extension assay on a commercialized pyrosequencing platform. DNA was isolated from the muscles of samples, *HpaII/MspI* ratios were calculated and relative DNA methylation levels were detected in invasive fish Amur sleeper in first time and were compared with its others fish species. Total DNA methylation levels were detected and compared in *P. glenii* samples from ecological different aquatic ecosystems. It was shown, that in the same age, sex and size of *P. glenii* samples the total DNA methylation levels are different in ecological different lakes and under the anthropogenic influence the global relative DNA GC-methylation level may increase to 40%.

The role of epigenetic modifications in adaptation potential of Amur sleeper was discussed.

This study was supported by National Research Program "The value and dynamic of Latvia's ecosystems under changing climate – EVIDEnT", project Nr. 4.4. Biodiversity and its role among other ecosystem services, subproject Nr. 4.6. Freshwater ecosystem services and biodiversity

ALIEN SPECIES OF BIRDS IN THE PARKS OF KIEV

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The human impact on nature is intensified. This stimulates the birds to synanthropization. In Ukraine, as a result of excessive anthropic pressure, indigenous species that do not adapt cease to nest. The liberated ecological niches occupy alien species that are already adapted to live in a transformed landscape. Alien species of birds are introduced into the territory of Kiev at first of all by settlement in parks. The park's landscape is mosaic, saturated of woody plants and buildings. This gives the parks, as a habitat, similarities in different European countries. Kiev is located on a flat territory, on the border of the forest and forest-steppe natural and geographical zones (Google coordinates of the center of Kiev: 50.447632/30.524939). In the parks of Kiev, nesting are 4 alien for the fauna of Ukraine species of birds (of the 3 detachments).

Streptopelia decaocto (Frivaldszky) in Kiev was first noted in 1955, by the 1970s, settled almost everywhere, but at the end of the 20th century birds disappeared from almost all biotopes. In the early 21st century *Streptopelia decaocto* again inhabits the region. Now she nesting by single pairs on the outskirts of the city: in parks and in neighborhoods of individual's buildings. In natural biotopes and in the central part of the city there are no birds. On the territory of Kiev, the average nesting density of *Streptopelia decaocto* is less than 0.01 pairs/km², and in the its parks – 0.08 pairs/km².

Dendrocopos syriacus (Hemprich et Ehrenber), according to GV Fesenko, appeared in Kiev in the 1970s. Now it is a common widespread species nesting in transformed biotopes. In Kiev, settles in parks and old residential blocks, saturated with woody vegetation. Nests in the center of the city, and on its outskirts. The density of nesting in Kiev is on average 0.15, and in parks 0.40 pairs/km².

Phoenicurus ochruros (S.G. Gmelin.), subspecies (*Ph. o. gibraltariensis*) – representative of mountain fauna, cavity nesters. In Kiev for the first time one specimen of *Phoenicurus ochruros* was noted by A. Danilovich in 1924. According to M.A. Voinstvenskii and A.B. Kistyakovskii, *Phoenicurus ochruros* began to nest here in the 1970s. Now birds are nesting in cavities in the walls of buildings everywhere. Birds find in them an analogue of nesting stations of mountain landscapes. In Kiev for nesting *Phoenicurus ochruros* prefers parks. The density of nesting *Phoenicurus ochruros* in the parks of Kiev and in the city on average – 0.80 pairs/km². We celebrated *Phoenicurus ochruros* in Kiev in the winter: in February 1996, February 2013 and February 2017 in the courtyards of blocks of multi-storey residential buildings. They were males. Most likely, these were individuals of birds that flew from wintering sites, and with the subsequent return of colds, they having migrated back to warmer areas. The wintering grounds are now located closer than at the beginning of the 20th century. Birds winters even in the south of Ukraine. The most active birds carry out migrations between the nesting and wintering areas, depending on the weather conditions. Those birds who have familiarized themselves with the nesting conditions before the majority, have the opportunity to occupy the best nesting areas and begin the nesting season earlier. This behavior allows active males to be more competitive in creating a pair.

Serinus serinus (Pallas), according to N. Sharleman, single nesting couples were noted in Kiev for the first time in 1948 and 1949. Now this species is common in parks, and in the old neighborhoods of the city. The average density of nesting in Kiev is 0.18, and in the parks – 0.2 pairs/km².

DISTRIBUTION OF INVASIVE SPECIES IN THE PLANKTON OF WATERCOURSES OF URBANIZED TERRITORIES (ON THE EXAMPLE OF NIZHNI NOVGOROD)

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Recently, the processes of alien species dispersal have intensified in freshwater ecosystems. This is facilitated by, in particular, instability and disturbance of aquatic ecosystems by human activity (Lazareva, 2014). Thus, acquires the urgency of studying the spread of invasive zooplankton species in the watercourses of urbanized areas, which experience a strong anthropogenic press and are disturbed.

The research was conducted in 2014–2016 on the watercourses of Nizhni Novgorod: small rivers Levinka, Parasha, Rzhavka, Chernaya and Shuvalov canal, located in the city's lower part and the Starka, Kova and Rakhma rivers, which flows along the mountainous part of the city. Also, a wellhead site of the Oka River was examined. The watercourses are varied by flow velocity, pH level of the water, electrical conductivity, trophic status and pollution degree.

The invader species *Kellicottia bostoniensis* (Rousselet, 1908) – a rotifer of North American origin, and *Diaphanosoma orghidani* (Negrea, 1982) – a cladocera of Caspian origin, was identified in zooplankton of the watercourses of Nizhni Novgorod.

Rotifer *Kellicottia bostoniensis* is found in all investigated watercourses, both in the medial and in the thickets of macrophytes. The rotifer reached its greatest density in summer in eutrophicated watercourses with pond expansion and slow flow (up to 7,13 thous. ind./m³). In watercourses with high flow rates and low water level, density of invasive rotifers was extremely low (up to 0.02 thous. ind./m³). In the mouth of the Oka river rotifers were few (0.79 thous. ind./m³). In most of the watercourses a cohabitation of the invasive species and the native species *K. longispina* (Kellicott, 1879) was recorded. However, the density of *K. bostoniensis* in the summer months was predominantly higher than the density of *K. longispina*.

The *Diaphanosoma orghidani* was detected only in the summer months in the Shuvalov canal and in the mouth of the Oka River. In the Shuvalov canal, the crustacean preferred eutrophic sections of lake extensions with a slow flow, where it reached a maximum density (1.46 thous. ind./m³). In the river Oka, the density of crustaceans was higher in macrophyte thickets (up to 1.05 thous. ind./m³) than in the medial part of the river (up to 0.49 thous. ind./m³). In both watercourses the species-invader coexisted with native species *D. brachyurum* (Liévin, 1848). However, in the Shuvalov canal, the density of native species was higher than the density of the invader. In the Oka river invasive species dominated.

Thus, rotifer *Kellicottia bostoniensis* is widespread in the watercourses of Nizhni Novgorod, which differ in the complex of natural factors and the level of anthropogenic impact. It indicates a high ecological plasticity of the invasive species. A cladoceran crustacean *Diaphanosoma orghidani* was detected only in the river Oka and Shuvalov canal, where it preferred lake expansions with slowed flow and macrophyte thickets.

GENETIC CONSEQUENCES OF REINTRODUCTION OF STERLET IN THE BASIN OF THE RIVER SUKHONA

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The problem of the reintroduction of economically valuable organisms is of particular interest primarily in terms of morpho-biological, genetic and physiological properties that arise in the natural environment (Karpevich, 1998). And most importantly, how these characteristics correspond to the balanced or optimal for natural populations (Allendorf, Riemann, 1991). Therefore, the purpose of this work was to evaluate the biological (size, age, sex) and genetic parameters (at the loci Cyt b and 18S rRNA) of the population of the "dry" sterlet after its reintroduction into the river. Sukhona from the fisheries plant village of Kaduy of the firm "Diana". To solve the main problem, a molecular genetic approach was used, based on the analysis of the variability of fragments of one mitochondrial (cyt b) and one ribosomal (18S) DNA loci. During the molecular genetic analysis of the cyt b mitochondrial locus, 21 specimens of the "factory" sterlet (reference number K1-K21) and 29 "wild" sterlet specimens were analyzed - 15 individuals caught in the area of Totma and 14 fish caught near Etc. Poldarsa and v. Vostroe. At the locus 18S of the R-RNA II region, 13 "factory" and 14 "wild" individuals (7 specimens of Totma and 7 copies of Poldarsa) were analyzed. The majority of haplotypes, both "factory" and "wild" individuals differed from each other by no more than one pair of nucleotides. From this single nucleus, individuals from Kaduya (K3 and K13) and one from the Poldarsy region (P22) differed by 14, 10 and 7 nucleotides, and the individuals from the Totma area (T5) – 65 nucleotides, and Poldarsy (P25) And P27) by 97 and 100 nucleotides, respectively. Indeed, strongly differing wild individuals from the area of Totma (T5) and Poldarsy (P25 and P27) were characterized by numerous, both synonymous (transient) and non-synonymous (transversions) changes not observed in factory and other wild individuals. A number of wild animals, primarily from Poldarsy (6 individuals) had single marker replacements, which made it possible to reliably distinguish them from plant individuals. The lowest levels of variability (both haplotypic and nucleotide diversity, and the number of polymorphic sites and intrapopulation subdivision) are inherent in plant individuals, in wild individuals these indicators are several orders of magnitude higher. At the same time, it is characteristic that in the Totma region the levels of haplotype diversity are higher than in the Poldarsy region, and the nucleotide variety is vice versa. In fact, these are individuals of P25 and P27, which probably could have penetrated from the Severodvinsk herd, greatly enriching the Sukhona population with the nucleotide variety. At the same time, the fact that part of the herd from the districts of Totma is characterized by a lower intrapopulation subdivision and a reliable value of the neutrality test, drawing closer to the factory herd, attests to their undoubted kinship and unity of origin. Thus, on the basis of phylogenetic, genealogical analyzes and the presence of specific marker substitutions of nucleotides, that among the 29 analyzed wild specimens from the p. It was established that 8 specimens From Poldarsy and 3 copies. From Totma had unique specific qualities. Biological analysis of fish caught in the river. Drying of sterlet specimens indicates that all specimens have reached maturity. By age they do not refer to the generation of yearlings and two-year-olds released into the river in 2000, 2001 and 2004, since the maximum age of fish caught in both the Totma and Poldarsy ranges reaches 8+ and 7+, with the average age of the analyzed fish being 5+ and 6+. However, taking into account that in the period from 2004 to 2014, No stocking was made to the Sukhona, the most likely assumption would be the assumption that we are dealing with the second generation of fish released in the early 2000s. But the version about participation in the formation of the "dry" flock from individuals of the sterlet from the Northern Dvina remains equally probable. The revealed effects of a significant increase in the population from natural conditions in the population from the levels of genetic variability and stabilization of the biological structure are fundamentally at variance with the basic ideas of reducing genetic diversity and increasing the size-age imbalance in the introduction of factory animals into natural conditions (Odum, 1975, Hedrik, 2003; Muirhead et al., 2008). At the same time, the thesis about the possible significant influence of native fish on the considered indicators of our herd comes to the forefront, although, as we managed to establish, their number is disproportionately small. In general, it allows us to conclude that, in spite of the factory-based modernity of the herd of sterlet in the river, Sukhona, a significant influence on its formation is a few surviving aboriginal individuals.

EPIGENETIC ORIGIN OF ADAPTIVE SUCCESS OF INVADERS

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In the process of studying the variability, especially the morphological and genetic variability of a number of the most successful freshwater invaders in the Holarctic (topmouth gudgeon, Black Sea-Caspian kilka, pumpkinseed sunfish, pilengas, Florida crab), we found that, as a rule, they do not have new populations. Significant and significant structural genetic and morphological changes were observed. However, the levels of variability significantly changed in comparison with the initial populations. This led us to search for parameters that adequately reflect the nature of the observed variations. As a basis, we adopted the postulates of the epigenetic theory of evolution (ETE) – one of the modern evolutionary theories based on epigenetics data. As the basic unit of natural selection, the theory considers an integral phenotype in its development, and selection not only fixes useful changes, but also takes part in their creation. According to the concept of ETE, the general organization of the epigenetic system is transmitted from ancestors to descendants, which forms the organism in the course of its individual development, and selection leads to the stabilization of a number of successive ontogenes, eliminating deviations from the norm (morphosis) and forming a stable development trajectory (creode). The evolution of the ETE is to transform one creed into another under the disturbing influence of the environment. In response to the disturbance, the epigenetic system is destabilized, as a result of which it becomes possible to develop organisms along deviating developmental paths, multiple morphoses arise. Some of these morphoses receive a selective advantage, and during subsequent generations their epigenetic system develops a new stable development pathway. Having calculated the developmental trajectories of all the above species, we actually obtained pictures of the existence of multiple morphoses in the newly developed territories, while the variability levels were most often reduced in varying degrees of reliability. Accordingly, we concluded that the formation of multiple creeds gives the most significant adaptive advantages to species when developing new water areas.

COMPARISON OF THE RELATIVE STABILITY OF THE CHINESE SLEEPER JUVENILES *PERCCOTTUS GLENII* DYBOWSKI, 1877 AND PERCH *PERCA FLUVIATILIS* LINNAEUS 1758 TO PREDATOR EFFECTS

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The problem of the arrivals and naturalization of organisms beyond their historical ranges does not lose its relevance for more than half a century. The study of biological invasions is singled out separately in the "Ecological Doctrine of the Russian Federation", approved by the decree of the Government of the Russian Federation No. 1225-r of August 31, 2002. As noted in the Fifth National Report "Biodiversity Conservation in the Russian Federation" (2014), at the present time there is an increase in the intensity of invasions of alien plant and animal species. Therefore invasion of alien species is one of the main current and future threats to Russia's biological diversity. Amur sleeper *Perccottus glenii* Dybowski, 1877 (Actinopterygii: Odontobutidae) – one of the most massive alien fish species in Europe (Reshetnikov, Ficetola, 2014). Its introduction leading to a significant transformation of communities in European ecosystems. Undoubtedly, the identification of natural factors of control over its population is an actual problem of managing biological resources.

In order to compare the relative sustainability of Amur sleeper fry to the pressure of piscivorous predator juvenile the perch of similar sizes and ages were used as a "control species". This species is one of the most common in water bodies of the European part of Russia and are an ordinary object of feeding of predatory fish. Small pikes were used in all experiments as a model predator, since this species is typical for a wide range of water bodies, from pools on small rivers to lakes and reservoirs. Also, the pike is often found in the bays and shallows that are heavily overgrown with aquatic vegetation, in which Amur sleeper can occur.

Amur sleeper were eaten by pikes much more efficiently than perch ($p < 0.05$), in the overwhelming majority of performed experiments. This trend persisted in aquariums of different volume and shape, and also regardless of the presence of covers in the experimental environment. The obtained data suggest that the Amur sleeper and perch juveniles were used various behavioral strategies when interacting with a predator. When pike appeared in the environment perches tried to avoid its contact, focusing on group defense reactions and well-developed swimming ability. In turn, young Amur sleeper were preferred to hide around various objects (walls of the aquarium and own species), and trusting more its masking coloration than swimming ability. It can also be noted that the performed experiments did not reveal the existence of any expressed reactions of group defense in the Amur sleeper. All these facts well explain the higher availability of Amur sleeper juveniles for piscivorous predators at poor experimental conditions in comparison with perch. The experimental data confirm the field observations on the key role piscivorous predators on potential of settling the Amur sleeper of any reservoirs.

Much of this work was carried out in the framework of the RFBR project 17-05-00782.

MODERN PROBLEMS OF ALIEN PLANT SPECIES INVASIONS IN PROTECTED ECOSYSTEMS

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The studies have been carried out in the Voronezh state nature biosphere reserve, located in the forest steppe zone of the European part of Russia. The area has been protected since 1935 and covers 31 thousand hectares. The ecosystems are defined by extra-zonal and intra-zonal forest ecosystems (pine, aspen, birch and alder forest), meadow, marshy and aquatic ecosystems on river terraces and river-valleys as well as on watershed zonal communities, which are oak forests.

The reserve is surrounded by a large number of localities; the area is fragmented by rail and road networks. Before reservation conditions were introduced, the area had been experiencing a considerable human impact. In addition, until the 1980s the reserve had been undertaking economic activities, such as deforestation, lightly managed plantings, grazing, haying, etc. During the period from 1930 to 1950, some invasive alien species of trees and shrubs were introduced. In the middle of the 1980's, after the reserve had been designated a biosphere reserve by UNESCO, the area was zoned and economic impacts on protected ecosystems were almost completely stopped. The plant community of the reserve is currently undergoing different stages of demutational succession.

Out of the 1042 species that are registered in the reserve, 176 are alien. This represents 16.9% of the total flora. 24% of the alien species are ephemerophytes, 28% – colonophytes and 48% are species that have become naturalised in protected natural communities.

Flora monitoring showed that 23 of the alien species registered at the initial stage of the nature reserve creation are no longer represented in the composition of vegetation; the losses in autochthonous flora were 32 species. Cessation of agricultural activities resulted in some ephemerophytes ceasing to exist on the territory; hardy-shrub invasive plants have also got absent from the composition of vegetation as they failed to overcome the reproduction barrier and get naturalized in the ecosystems of the reserve.

However, despite the cessation of human impact, alien species continue to invade the protected area. More than half of the species (44 out of 80) registered on the territory of the reserve in the period from 1999 to 2016, are alien. The contemporary time period is characterized by the following features of the invasion process in the flora of the reserve:

- 1) Among the alien species appearing in the reserve, the ornamental plants leaving the culture are dominating, as well as fruit trees and shrubs grown in settlements near the border of the reserve and on the territory of forest service cordons.
- 2) After the practice of feeding wild ungulate animals during the winter season was recommenced in 2011, forage crops and weeds started appearing on the territory again. These are mostly annuals that behave like ephemerophytes.
- 3) Among the alien species registered in the reserve, 15 species belong to the transformers, according to their naturalisation rate. In 2013, plant communities formed by alien tree species were first recorded in the reserve: on the area of 0.6 hectares, *Acer negundo* L. forests were registered; 0.9 hectares are occupied by communities dominated by *Robinia pseudoacacia* L.

DISTRIBUTION OF THE ALIEN SPECIES MUD CRAB *RHITHROpanopeus harrisii* IN THE COASTAL ZONE AND INLAND WATERS OF CRIMEA

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Since the beginning of the 20th century there has been a significant increase in the number of non-native species turning up in areas well beyond their natural range of distribution. Global in character, this phenomenon has affected the Black Sea to a considerable extent, where in recent decades; annually increasing numbers of new species of fauna have appeared.

One such non-native species in the Black Sea is the mud crab *Rhithropanopeus harrisii* Gould, 1841 (Decapoda, Panopidae). *Rh. harrisii* is a small (< 26 mm carapace width), euryhaline crab typically associated with sheltered estuarine habitats. This crab has high fecundity, a long planktonic larval period, and can tolerate a broad range of salinities and temperatures, which probably contributes to its success as an invader (Fowler et al., 2013).

In its native range, this species inhabits fresh to brackish waters along the East Coast of North America from New Brunswick, Canada, to Veracruz, Gulf of Mexico (Roche & Torchin, 2007). In Europe the invasive species was first found in 1874 in the Netherlands (Wolff, 2005), in the Black Sea area it was first observed in 1939, in the Azov Sea crab entered in 1948 (Williams, 1984).

In this study, we assessed the current distribution of *Rh. harrisii* along the coast of Crimean. This crab can successfully colonize many different habitats such as freshwater lakes, bays, estuaries and ports. It is found chiefly in brackish-water areas, but also in fresh waters. It lives in shallow water on muddy and sandy substrata, where it needs some kind of shelter (natural or man-made) on the seabed, e.g. stones, shells, dense vegetation.

Rh. harrisii has been widely recorded in coastal waters of Crimean, including the Gulf of Karkinitzky in the Black Sea, in the coastal zone of Cape Kazantip in the Azov Sea. This crab is very common in the Chernaya River mouth, which flows into the Sevastopol Bay, and also in the freshened northern part of the Sasyk-Sivash Lake.

Currently, no studies have quantified the impacts of *Rh. harrisii* on communities where it is introduced. But anecdotal evidence suggests that it may alter species interactions and cause some economic damage, notably through competition with native species and alteration of food webs. On the Coast of Crimean, in the regions, where it has reached very high densities, the crab has displaced a native species of crab *Brachynotus sexdentatus* and causes economic loss to fishermen by spoiling fishes in nets.

MITONUCLEAR ECOLOGY: WHAT ARE THE CONSEQUENCES OF RAPID EVOLUTION OF ROACH *RUTILUS RUTILUS* MITOCHONDRIAL DNA IN TERMS OF HYBRIDIZATION WITH BREAM *ABRAMIS BRAMA* IN THE AREA OF SECONDARY CONTACT

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Allopatric hybridization of roach (*Rutilus rutilus* L.) and bream (*Abramis brama* L.) is often observed in the areas of secondary contact as a result of species dispersal. The level of interspecific hybrids may even exceed the frequency of occurrence of parental species (Hayden et al., 2010). Due to biological variety and the tendency for roach and bream to cross in response to environmental changes it is necessary to monitor their habitats assessing the genetic integrity of species and the effects of remote hybridization. Studies of hybrid zones using the mitochondrial marker *cyt b* indicate that hybridization between these species occurs exclusively in the direction of the female *bream* - male *roach*, due to presence of ethological prezygotic isolation. Study of the behavioral characteristics of spawning activity has shown that hybrids prefer to interbreed with male roaches, but not bream (Matondo et al., 2011). The terminal manifestation of such asymmetric hybridization during grading may be the fixation of mtDNA and polyphyletism, the complete replacement of mtDNA of one species by another genome with preservation of external characteristics (Abramson, 2007; Borkin, Litvinchuk, 2013). In the present study, we aimed at finding the presence of postzygotic barriers preventing the gene flow in the direction of hybridization female *roach* – male *bream*.

Inheritance of species-specific markers for nuclear (ITS1 ribosomal DNA, rDNA, microsatellites, RAPD) and mitochondrial (*cyt b*, mtDNA) genomes of roach (*R. rutilus*) and bream (*A. brama*) in the offspring of return and interhybrid crossings was studied. The analysis of the ITS1 segregation has demonstrated that the reduction in viability of alloplasmatic backcrosses, combining the nuclear genome of *A. brama* and cytoplasm of *R. rutilus*, underyearlings is an indication of nuclear-cytoplasmic incompatibility of genomes. According to the classical model of Bateson (1909), Dobzhansky (1937) and Meller (1942) the conflict between genomes is caused by association of genes functionally diverged in two different species within one genome (Dickman, 2012). The high rate of evolution genes of cytochrome c-oxidase (mtDNA) of roach (Ludanniy et al., 2006), may be the cause of the disruption of co-adaptation with nuclear genes of bream that encode COXI and COXIII subunits. The incompatibility of genes of IV complex between mtDNA of roach and the nuclear genome of bream leads to disruption in the functioning of the electron transport chain of mitochondria, a decrease in the efficiency of respiration, and a significant loss backcrosses' viability (Ellison, Burton, 2006). The absence of restoration of morphological characteristics of bream in backcrosses with introgression of roach's mtDNA indicated that in the direction of crosses female *roach* – male *bream* species they will not be able to maintain stability against the introgressive hybridization, i.e. there will be a blurring of species boundaries. High viability of reciprocal variant of alloplasmic backcrosses with *A. brama* cytoplasm demonstrates good compatibility of bream mtDNA and roach nuclear DNA (nDNA). Underyearling backcrosses with introgression of bream mtDNA have morphological characteristics of roach and can be represented in offspring by both females and males. If the recombinations, that occur between the parent sequences of ITS1 rDNA (Wyatt et al., 2006) or the alleles of microsatellite loci (Stolbunova, 2012) in F1 hybrids of roach and bream, breaks allelic associations affecting the viability or fertility of females with introgression mtDNA of bream, polyphyletism does not proceed. In the same time, recombination can retard species formation or persistence in numerous ways that researches are only now beginning to understand (Ortiz-Barrientos et al., 2002).

DISTRIBUTION, SYSTEMATICS, MORPHOLOGY AND FEEDING OF SUCKERMOUTH ARMORED CATFISHES (SILURIFORMES: LORICARIIDAE) IN VIETNAM

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An armored catfish (Loricariidae) is one of the largest families within order Siluriformes. It includes 83 genera with over 700 valid species native to South and Central America waters (Armbruster, 2012). Presently, loricariids are considered the main group of invasive fish species being a serious threat to tropical and subtropical freshwater ecosystems (Liang et al., 2005; Godwin et al., 2016).

First finding of armored catfishes in the South-East Asia happened over 25 years ago, first in the Philippines and later in Indonesia and Thailand (Weber, 1992; Kottelat et al., 1993). First encounters of armored catfishes in Vietnam took place in 2003, 2004 in the southern part of the country in the Mekong River delta (Welcomme, Vidthayanom, 2003; Serov, 2004). One specimen was caught in the northern part of the country in the Cai River in 2006 (Levin et al., 2008). In the Central Vietnam, self-sustaining populations of armored catfishes were found in the Dinh River in 2010 (Zworykin, Budaev, 2013) and in Eakao water reservoir in 2015 (Stolbunov et al., 2015). Now, armored catfishes (*Pterygoplichthys* spp.) inhabit the basins of all relatively large rivers in Central Vietnam between N 11°53'–N 13°3.8', E 107°28'–E 109°17' (Stolbunov et al., 2017).

Taxonomic status and systematics of armored catfishes remains problematic. Species identification keys for genus *Pterygoplichthys* are mainly based on differences in coloration patterns and, partly, on the values of certain meristic and plastic features: number of rays in fins and body proportions (Weber, 1992; Armbruster, Page, 2006). We may assume that collected armored catfishes (82 specimens) represent three species *Pterygoplichthys pardalis* (Castelnau, 1855), *P. disjunctivus* (Weber, 1991), *P. anisitsi* Eigenmann & Kennedy, 1903 according to differences in coloration patterns. However, we believe that fish cryptic coloration may not be considered a species criterion. In addition, there is a possibility that the intensity and pattern of coloration vary due to habitat conditions. Another possible reason for the observed high diversity of coloration patterns is that first armored catfishes to be initially introduced into Vietnam waters (as well as Taiwan and other countries) were hybrids *Pterygoplichthys disjunctivus* × *P. pardalis* was (Li-Wei Wu et al., 2011; Godwin et al., 2016).

Morphological differences and a number of morphology development anomalies were found in different armored catfishes' populations from Vietnamese waters (Stolbunov et al., 2017). Phenotypic differences in loricarids from contrasting habitats have been established.

Study of their diet in Vietnam waters revealed that they act as typical detritophage-collectors. Single individuals prefer sites with elevated concentrations of animal food characteristic of facultative zoophages. Loricarids may provide significant food competition for native fish species: detritophages and benthophages at high population density (Stolbunov et al., 2017).

THE ROLE OF ALIEN SPECIES IN THE FORMATION OF THE FOOD RESOURCES STRUCTURE FOR FISH IN THE EASTERN PART OF THE GULF OF FINLAND

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The bottom communities of the eastern part of the Gulf of Finland have been investigated at 15 stations for the last twenty years. In recent years, the alien species of invertebrates have become increasingly important in the benthic habitats of this area. Every year the list of registered alien organisms grows (Antslevich et al., 2009). Until 2009, an increase in the number of species of brackish-water complex (crustaceans, mollusks, polychaetes) was overseen. In recent years, the growth of the community biomass has been observed due to a widespread increase in the abundance of polychaetes *Marenzelleria* sp. This is the dominant species in this area.

In 2016 the dozens of alien species were noted. The polychaetes *Manayunkia aestuarina* and oligochaetes *Paranais frici*, *Tubifex newaensis* and *Potamothrix moldaviensis* were registered in massive quantities. The most abundant alien amphipod in the southwestern part of the investigated Gulf water area was *Chelicorophium curvispinum*.

Alien species were found at all stations in all the areas studied of eastern Gulf of Finland without exception. The minimum contribution was less than 1% of the total biomass and was observed in the west of the Shallow-water area. On a station in the northeast of the Shallow-water region, 100% of the species were alien. In total, the contribution of non-native species varied from 4% of the total biomass in the Koporskaya Bay, up to 13% in Luga bay, 30% in the Shallow-water area and 90% in the Deep-water area. The average contribution of alien species to the total abundance of macrozoobenthos on soft grounds in the eastern part of the Gulf of Finland in August 2016 was about 51% of the abundance and 68% of the biomass of benthos. On the hard bottom, the biomass of alien species was usually more than 99.9%.

At present, in the eastern part of the Gulf of Finland, alien species could strongly affect the habitat of other species and largely form the forage base of benthophagous fishes. Such large-scale changes in the composition of bottom communities can lead to non-predictable consequences and therefore need further observations.

THE SEASONAL INVADER *OITHONA BREVICORNIS* GIESBRECHT, 1891 (COPEPODA: CYCLOPOIDA) IN THE AZOV SEA AND TAGANROG BAY

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During the autumn of 2010–2016 a new species, *Oithona brevicornis* Giesbrecht, 1891 (Copepoda: Cyclopoida) demonstrated massive growth in the Sea of Azov and the Taganrog Bay.

According to the field research data of SSC RAS, increase in the salinity of the Sea of Azov since 2010 to 14‰ that continues at present facilitates spreading of marine species from the Black Sea. The new *Oithona brevicornis* species that we registered for the first time in the Sea of Azov in 2010 reached high counts during autumn amounting on the average in 2010 to 1800 ind./m³, in 2011 to 40860 ind./m³, in 2012 to 3529 ind./m³, in 2013 to 6760 ind./m³, in 2014 to 7464 ind./m³, in 2015 – no data, and in 2016 to 3400 ind./m³. The species reaches maximum abundance in September–December (Shiganova et al., 2012). During summer of 2010–2016 we registered *Oithona brevicornis* presence in the central and north-eastern Sea of Azov at low density levels of 3–50 ind./m³. During winter of 2011–2016 *Oithona brevicornis* disappeared from the Sea of Azov and Taganrog Bay waters. Evidently, low water temperature is lethal for the species; therefore, its spreading in the basin is seasonal. Water temperature values were in the range of 12,6–20,5°C, salinity – 9–13,6‰.

Warm-water eurybiontic *Oithona brevicornis* Giesbrecht, 1891 (Copepoda: Cyclopoida) was regularly registered during autumn of 2010–2016 in the Sea of Azov and the central part of the Taganrog Bay thus resulting in a change within the structure of copepod zooplankton community and indicating an expansion of the northern boundaries of the species' habitat.

Cyclopoid copepods of the *Oithona* genus in the Black Sea were initially identified as *Oithona brevicornis* Giesbrecht, 1891 (Zagorodnyaya, 2002; Gubanova & Altukhov, 2007). Subsequently, a detailed analysis of the species morphology resulted in its indication as *Oithona davisae* Ferrari F.D. and Orsi, 1984 (Temnykh and Nishida, 2012). However, reliable taxonomic status of the immigrant species is uncertain due to the lack of data in GenBank, and thus requires additional molecular genetic analysis of samples from various study areas (Shiganova et al., 2015).

THE INVASIVE CRAYFISH OF THE FAMILY ASTACIDAE IN THE RESERVOIRS OF THE LENINGRAD REGION

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There are two crayfish species from the family Astacidae: *Astacus astacus* and *Pontastacus* (A.) *leptodactylus* inhabit the reservoirs of Leningrad region. In the water bodies of the Leningrad region, in particular on the Karelian isthmus in Ladoga lake, occur another species of crayfish of the same family, *Pacifastacus leniusculus* from genus *Pacifastacus* (Kozak et al., 2015).

The distribution of the signal crayfish (*P. leniusculus*) is the widest in Europe. The signal crayfish was found in the water bodies of 25 countries. The water bodies of Sweden, Austria, France, Germany, Poland, and Finland were the first, where this species successfully acclimatized. In Finland signal crayfish was imported from California in 1967–1969 and was stocked in 12 small lakes in Southern and Central Finland and the Ahvenanmaa Island (Westman, 2000). In the 90-s of XX century the signal crayfish was also successfully acclimatized in the reservoirs of Lithuania (Cukerzis, 1989).

In Russia this species have been registered only in the Kaliningrad region in Synavinskyi opencast and rivers (Gusev, 2012) and in the Pskov region (Borisov, 2012). In 2012, according to the monograph (Kozak et al., 2015; Schletterer et al., 2012) the *P. leniusculus* was marked in the place, where the Burnaya river falls into Ladoga lake and also in the Neva estuary, Svir and Volkhov rivers and Ilmen lake. Firstly *P. leniusculus* penetrated by the streams and with the direct human participation into the Saimaa Lake in Finland. Then he spread along transboundary system the Vuoksa River and finally this species fell into the Ladoga Lake. In the Ladoga Lake there is a special temperature regime, which appears as limiting factor in the signal crayfish distribution.

In 2011–2012, in the Ladoga Lake a spate of "crayfish plague" was that led to the death of natural crayfish populations in some areas of the lake. It is indirect proof of the penetration of aggressive invasive alien crayfish species in the lake.

The detaile research and specific assessment will require for each water bodies creation methods of isolation of natural crayfish populations from a invasive alien species.

THE POTENTIAL GROWTH RATE OF ALIEN FISH POPULATION IN THE RESERVOIRS OF LARGE RIVERS PONTO-CASPIAN BASIN

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Global climate change and anthropogenic impacts have led to the expansion areals of many inland fish species. To understand the process of developing new reservoirs by foreign fish species, it is important to analyze the change in the dynamic properties of their populations within the newly acquired range. One of these important indicators is the potential growth rate, or intrinsic growth rate of the population. It characterizes the hereditarily determined ability of the species to grow in abundance in these habitats. This parameter is equal to the maximum specific rate of exponential growth in numbers. It characterizes the hereditarily determined ability of the species to grow in abundance in these habitats. The purpose of this work is to generalize the information on the influence of latitude to the potential growth rate of the populations of alien fish species in the reservoirs of the major rivers of the Ponto Caspian Basin. This dynamic parameter characterizes population increment per individual and calculated by the formula $r_N = (\ln N_{t_2} - \ln N_{t_1}) / (t_2 - t_1)$, where N_{t_1} and N_{t_2} are population numbers at time points (years).

The potential population growth rate of the 4 species of invaders was analyzed in 5 reservoirs of the Dnieper and Volga, located in the range 47–58 degrees north latitude.

It is established that the cold-loving species population index is below the smelt in the Kuibyshev reservoir in comparison with the smelt in the Rybinsk reservoir. Therefore, when it moves away from the native range to the south, it decreases.

The south populations' potential rates of kilka, black-striped pipefish, stone moroko were higher in comparison with the more northern ones.

This index realization depends both on the reservoir latitude location, morphometric and hydrological regime and abundance of predators (ichthyophagous).

There is a tendency for a decrease of the kilka population potential rate far north away this invader native areal. But it is masked the reservoir's morphometric and hydrological regime (for example this parameter is lower in the stream-type Dneprodzerzhinsk Reservoir than in the some northern lake-type Kremenchug one).

The assessed potential rates for the population abundance increase of the black-striped pipefish (1.3 and 1.6 per year in the Kremenchug and Dneprodzerzhinsk reservoirs respectively) illustrate low invasion potencies of this species. But it is recompensed the species reproductive habitat (the caring for offspring) perhaps.

This parameter for stone moroko is higher in the southern stream-type Dneprodzerzhinsk Reservoir, where fluctuations of water level was lower (0.5 m), than in the northern lake-type Kremenchug Reservoir (5.5 m). Both reservoirs are in the same climatic zone, but all abiotic conditions (latitude location, morphometric and hydrological regime) were more favorable for the stone moroko in Dneprodzerzhinsk Reservoir.

Latitude location is a main abiotic parameter: the potential rate of heat-loving or eurybiotic species is lower in northern water bodies and of cold-loving species in southern ones. Morphometric and hydrological regime of reservoir can mask this regularity.

FEATURES OF RUSSET SQUIRREL'S POPULATION IN PENZA REGION: GENETIC STRUCTURE, COLONIZATION HISTORY AND RESULTS OF INTRODUCTION

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Repatriation of previously disappeared species in a homeland (i.e. reacclimatization) or artificial settling of species in suitable habitats located outside their native area (i.e. introduction) is a trend line of conservation biology and increasing of biodiversity.

In 1988 thirty individuals (15 both males and females) of Russet Ground Squirrel (*Spermophilus major* Pallas, 1778) was released on territory of Penza Region (about 140 km from nearest wild colony). Ground squirrels start to disperse actively in northwestern and eastern directions and colonized suitable habitats.

According population genetic theory population's potential to successful adaptation in a new or changed conditions depends on the amount of genetic diversity in population.

Thus, the goal of study is estimation introduction success of Russet Ground Squirrel on the territory of Penza Region based on genetic structure and polymorphism level analysis of spatially partitioned population.

Sample collection was performed using noninvasive methods in 2010–2011 in 9 colonies of Russet Ground Squirrel on the territory of Penza Region ($n = 42$). Four primer systems of microsatellite DNA (STR1, IGSbm, Ssu16, Ssu17) were analyzed. Genetic structure and polymorphism level in population were estimated on gamete fixation indices (FST), observed and expected heterozygosity, standard diversity indices, gene flow and genetic distances using *Arlequin 3.5.2* software.

Observed and expected heterozygosity values in local populations of Russet Ground Squirrel in a zone of introduction do not differ significantly ($p = 0.05$). It shows stability of autonomous genetic processes in local populations.

Values of modified Garza-Williamson index (less than 0.5) point that most of Russet Ground Squirrel's local populations in Penza Region have passed through a "bottle neck" statement reasoned not by depression of population but by a "founder effect" which accompanies active dispersion of individuals during colonization of new suitable habitats.

Gamete fixation index' values on four microsatellite loci strive for zero. It shows high level of gene exchange between local populations (0.150 ± 0.043 , $n = 6$) and confirms that Russet Ground Squirrel's population in a zone of introduction is on the stage of formation of its genetic structure.

Analysis of regression relations between geographical and genetic distances' values among local populations of Russet Ground Squirrel in Penza Region shows that genetic distances between settlements in a zone of introduction do not depend on geographical distances. These interpopulation relations on our opinion are reasoned by short divergence time of local populations and thus, relatively high level of gene exchange between them.

Migration flow (M) values between Russet Ground Squirrel's settlements in a zone of introduction is about 2.735. It points on alleles' frequencies alignment in local populations and also lets to consider a hearth of Russet Ground Squirrel habitation in Penza Region as unified spatially partitioned population

Thus, polymorphism level of Russet Ground Squirrel's population in a zone of introduction on the territory of Penza Region is relatively high. It points on fine adaptive abilities of invader's population and on a successful introduction of Russet Ground Squirrel.

Study was supported by the financial support of Ministry of Education and Science of the Russian Federation to the Penza State University for scientific research in 2017–2019 (Project 6.7174.2017/8.9).

VARIABILITY OF LEAVES' CHARACTERISTICS WITHIN GENUS *REYNOUTRIA* HOUTT

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Reynoutria sachalinensis (F. Schmidt) Nakai, *R. japonica* Houtt. and their hybrid *R. ×bohemica* Chrtek & Chrtková are the naturalized taxa in Europe. The latter had originated in the secondary distribution range of its parental species. Specimens of *R. ×bohemica* were collected in 5 local naturalized populations (= clones) in Moscow, 9 populations in the Moscow Region, 2 populations in Luxembourg, 2 populations in the Czech Republic. Clones from culture in the Southern Coast of Crimea are collected too. The analysis includes also samples of *R. japonica* var. *japonica* from Japan (natural distribution range), *R. japonica* var. *compacta* from the exposition of the Main Botanical Garden of the RAS, *R. sachalinensis* from 3 local populations (from the exposition in the Main Botanical Garden RAS, Zvenigorod and Moscow) and from the vicinity of Yuzhno-Sakhalinsk (a natural distribution range).

In the secondary distribution range, *Reynoutria* taxa flower in the autumn. Therefore the features of their leaves are mainly used as diagnostic features.

All species have petiolate leaves, the upper side of leaves is glabrous, leaves are hypostomatic.

Reynoutria sachalinensis differs well in the heart-shaped base of the leaf: the angle between the middle vein and the axis from the base of the petiole to the edge of the leaf blade is obtuse one ($> 90^\circ$; mean 97.7 ± 2.7) for all specimens. The taxon differs well on micromorphological features: on the underside of the leaf blade there are two groups of trichomes: 1) short in the middle vein and 2) long along the secondary veins or outside the veins.

Reynoutria japonica var. *compacta* is well distinguished by the dense texture and in the shape of leaves. The leaves of this plant are leathery and rounded, and often the width of the leaf even exceeds its length.

The shape of the leaves of all other samples varies so much, that on this basis it is difficult to distinguish *Reynoutria japonica* var. *japonica* from *Reynoutria ×bohemica* in their secondary distribution range.

In the natural distribution range of *Reynoutria japonica* var. *japonica* its leaf base is wedge, the angle between the middle vein and the axis from the base of the petiole to the edge of the leaf blade is acute for all samples ($< 90^\circ$; mean $63.4 \pm 4.5^\circ$).

The most samples from the European part of their secondary distribution range were preliminary attributed as the hybrid complex *Reynoutria ×bohemica*. The shape of the leaf blade for these taxa varies from a slightly heart-shaped (angle $\approx 97^\circ$) to a circular-wedge shape (angle $\approx 73^\circ$). The shape of the leaf blade varies even within a single clone (thickets in the valley of the river Sur, Luxembourg). Leaves appearing at the end of the vegetation season (on lateral shoots or on the tips of the axial shoots) often differ considerably in shape from the leaves locating in midsection of the axial shoots.

The micromorphological signs of the underside of the leaves in all the samples, except *Reynoutria sachalinensis*, are practically uniform. Plants with conical hairs along the middle vein were observed only in one population (Moscow). All other samples (including *R. japonica* var. *compacta*) have glabrous median nerve (even in the base of the leaf blade) and papillae those located outside the nerves.

We have identified individual, intraclonal and interclonal variability of the shape of the leaf blade and of micromorphological features of the leaf (presence / absence of trichomes on the underside of the leaf). The presence of conical hair on the median nerve is not a diagnostic feature and is noted only for single clones of a hybridogenic complex *R. ×bohemica*.

ADVANCED APPROACHES TO DATA VIZUALIZATION ANALYSIS AS A TOOL FOR EXPLANATION OF THE ALIEN PLANT SPECIES DISTRIBUTION PECULIARITIES

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Traditional methods of non-native plant species groups analysis connected with their distribution and microevolution are informative for definition only the basic tendencies which can be detected in their structures. A plenty of data does not allow to generalize the information and to reveal peculiarities of the processes studied. At the same time, determination of internal, latent regularities of plant migration and processes of naturalization demands using of new modern methods. The most perspective approaches to analyze huge volumes of non-uniform data are the multivariate statistics methods. Prospects of these methods are defined by possibility of revealing interrelations among wide complex of floristic, biological data and environment characteristics which can be easily visualized. They give us an opportunity to visualize different data, for instance, the regional alien plant element structures or ecological niches differentiation among various plant species and natural-and-climatic or environmental variables. These methods enable to create models of different processes which are characteristic for plant invasions. They express current statistical interrelations and distances among different objects of study. It is possible to use any suitable data for analysis with factor, discriminant analysis and canonical correspondence analysis by different ways. Any correlation coefficients connected with characteristics of biodiversity, plant communities, species, populations, life forms etc. can be used for solution of different ecological tasks using multivariate statistics methods.

The distances among group of species, species and their morphological, genetic and other features expressed by different mathematical equations may give us a possibility to prognosticate a future situation due to the model creation. The data were processed by means of modern computer programs Microsoft Excel XP, Statistica 4.7, Statistica 6.0, Canoco for Windows 4.02, CanoDraw 3.1., CanoPost 1.0., Professional GIS-card 2008 etc. The use of multivariate statistics methods allows to construct historical classification and forecasting models simulating distribution and microevolution of non-native plant species.

Our experience with alien plant species study in different regions (Russia, Ukraine, the Czech Republic, Germany, Poland, Slovakia) which was connected with researches of species groups and single species distribution showed good results for understanding of peculiarities of their spread. During colonization alien plants demonstrate different group strategies. These strategies depend on species biological characteristics, flora transformation level, parameters of environment.

THE DYNAMICS OF EMERGING AND EXPANSION OF THE INVASIVE SPECIES IN THE SOUTH-WEST OF THE CENTRAL RUSSIAN UPLAND

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Under the valuation of the state and the perspectives of the research into flora, A.K. Skvortsov and V.N. Tikhomirov (1978) mention that “a special attention should be drawn to the study of the adventive plants and learning the modern tendencies of flora’s evolution”. N.A. Minyaev (1966) considers the modern historical stage of development as “a phase of anthropochores’ expansion” and determines its thousand-year duration. The modern strategy of the invasive species’ expansion in the South-West of the Central Russian Upland cannot be examined outside of temporal parameters. Therefore we have analyzed the dynamics of the emergence of the invasive species in the region for the last 160 years. To achieve this, a critical analysis of the herbarium specimens in Herbariums MHA, MW, BSU, BELZ, OHHI, CCR has been performed, all the available literature on this issue has been studied, the authors’ own data has been summarized.

It has been determined that the process of the emergence of the invasive species in the South-West of the Central Russian Upland can conditionally be divided into three main stages: 1. The stage of the emergence of the first invasive species (1850–1959); 2. The stage of the intensification of the plants’ influx (1960–1989); 3. The modern stage (1990–2019), which is characterized by the enlargement of the taxonomic and the typological specters of the invasive species brought and their intense expansion in the region.

At the first stage the South-West of the Central Russian Upland was being invaded mostly by the annual species. In this period only two shrubs appeared in the region: *Crataegus monogina* Jacq. (registered on chalky outcrops) and *Lonicera tatarica* L. (in forests). Despite the duration of the first period (over 100 years), during this time the number of the adventive species increased only from 1 to 7. The second stage, which lasted for 30 years, is characterized by the emergence of the species the following genera: *Acer* L., *Amaranthus* L., *Anisantha* C. Koch., *Acorus* L., *Chamomilla* L., *Diploaxis* DC., *Epilobium* L., *Lepidium* L., *Lolium* L., *Sambucus* L., *Senecio* L. *Acer negundo* L., firstly registered in 1968, became the most aggressive of them: during the last 50 years it has spread throughout the region. According to the herbarium labels and the historical data, its emergence in the region was connected to the creation of the windbreaks and to the necessity of embedding of the erosive areas, ravines, taluses by planting these plants near them. At the first stage 14 species from 6 families were brought to the region.

At the third, modern stage of emerging and expansion of the invasive species there is a significant increase not only in their total number, but also there is a significant extension of the number of genera, families, specters of plant life forms. The analysis of the herbarium specimens, the literature data and our own data allows us to conclude that all these changes are primarily connected to the intensification of the modern anthropogenic factors: increase in the number and variety of anthropogenically transformed ecotopes, recultivation of the technogenic landscapes by introduced species, transport communication intensification, emergence of the new species which are used for the landscaping in the region for the first time.

In the systematic structure it should be noted that the role of the invasive species has grown at the expense of the representatives of the families *Asteraceae* (by 56,3%), *Poaceae* (by 42,9%), *Brassicaceae* (by 25%). This alteration of the species’ which belong to the invasive fraction of the flora ratio is the reflection of the modern strategy on naturalization of aliens in the South-West of the Central Russian Upland. The increase in the number of the specimens of the all analyzed life-form groups in time is also quite discernible. In spite of the overall numerical growth of a number of life-forms, their role in composing the modern invasive fraction of the region’s flora can be reduced due to other groups.

POPULATION DYNAMICS OF BAIKAL INVASIVE AMPHIPODS *GMELINOIDES FASCIATUS* (STEBBING, 1899) AND *MICRUROPUS POSSOLSKII* SOWINSKY, 1915 IN SHCHUCHIY BAY OF LAKE LADOGA

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Shchuchiy Bay (61°05' N, 30°05' E) is located in the northwestern part of Lake Ladoga. Sewage discharge from Priozersk pulp and paper mill had destroyed an ecosystem of the bay completely (Slepukhina et al., 1993). The ecosystem started to restore after the closing of the pulp and paper mill in 1986. New ecosystem formed in the bay in late 1990-s (Raspopov et al., 2003). There are two invasive Baikal origin amphipod species (*Gmelinoides fasciatus* (Stebbing, 1899) and *Micruropus possolskii* Sowinsky, 1915) inhabiting the bay. Their distribution in the water bodies of the European part of Russia is associated with acclimatization measures carried out in 1960–1970 with the aim of increasing fish productivity (Zadoenko et al., 1985). *Gmelinoides fasciatus* was first recorded in Lake Ladoga in 1988. In 1989, it was recorded in the littoral zone of Shchuchiy Bay (Panov, 1994). The species colonized the entire littoral zone of the Europe's largest lake (Panov et al., 1999), became the dominant component of macrozoobenthos in all types of littoral biotopes (Kurashov et al., 2006) and led to a significant transformation of the littoral ecosystem (Kurashov et al., 2012). *Micruropus possolskii* was first recorded in Lake Ladoga in Shchuchiy Bay in 2012 (Barbashova et al., 2013). We also found this species in several littoral biotopes along the western shore of the lake.

We carried out observation of Baikal invasive amphipods populations in Shchuchiy Bay from May 2013 to February 2017. A station located near a bulk stone dam separating the southern part of the bay from the main water area at a depth of 0.7–2 m. Ground at the station compose of silted sand and plant remains.

During the observation period, the number of crustaceans ranged from 120 to 11720 ind./m², their biomass was from 0.35 to 29.50 g/m². These constituted from 2% to 74% of the number of macrozoobenthos and from 2% to 82% of its biomass. The number of *M. possolskii* ranged from 0 to 700 ind./m², its biomass was from 0.04 to 4.76 g/m². Population density and biomass of *G. fasciatus* fluctuated on a large scale: from 40 to 11260 ind./m² and from 0.06 to 27.23 g/m². The mean number and biomass of *M. possolskii* were 175 ± 31 ind./m² and 0.97 ± 0.18 g/m², the same indices of *G. fasciatus* were 1418 ± 358 ind./m² and 5.39 ± 1.17 g/m². Portions of invasive amphipods in the composition of bottom biocenoses were different. *G. fasciatus* constituted from 26% to 100% of the number of amphipods and from 3% to 100% of their biomass. The portion of *M. possolskii* in the amphipods composition was significant (up to 74% of the number and 97% of biomass) in the summer of 2013. Since October 2013, the ratio between *M. possolskii* and *G. fasciatus* had been stable. The portion of *M. possolskii* decreased and did not exceed 33% of the amphipods number and 37% of their biomass. Since 2016, the role of amphipods increased. Their portion in macrozoobenthos increased from 13% (2013) to 27% (2016) in average. The portion of *M. possolskii* in amphipods composition increased up to 50% of the number of crustaceans and 60% of their biomass.

Significant changes in the quantitative development of invasive species allow conclusion that relations between invaders are still not stable. Influence of invasive amphipods is one of the factors affecting the ongoing transformation of the Shchuchiy Bay ecosystem.

DISTRIBUTION OF TWO INVASIVE GOBIIDAE SPECIES IN THE EASTERN GULF OF FINLAND

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Annual coastal fish community monitoring was conducted on shallow water biotopes of the eastern part of the Gulf of Finland in 2010–2016. Coastal shoals were investigated using of the beach seine. Thirty five fish species recorded in samples include five invasive species among them. Two Gobiidae species are the most abundant and widely distributed invaders – tubenose goby *Proterorhinus marmoratus* (Pallas, 1814) and round goby *Neogobius melanostomus* (Pallas, 1814).

The first record of tubenose goby in the lower Neva River occurred in 2006, and in 2007 a few specimens were caught in the Neva Bay (Antsulevich, 2007). In the period of our investigation tubenose goby was recorded annually since 2011. Nowadays tubenose goby is widely distributed on shallow water vegetated biotopes of the Neva Bay and below the northern coast to the eastern part of the Viborg Gulf and below the southern coast to the western part of the Kopora Bay. Goby shows preference to mixed sandy and stony bottoms with well-developed underwater vegetation primarily consisting of *Cladophora* and *Phragmites* species. Also it wasn't been recorded beyond the oligo-haline zone. The max salinity for goby occurrence in samples was rated no higher than 3‰.

In general, the species is not abundant on shallows in the first half of summer, but in August and September it may be numerous in samples. The average abundance of tubenose goby in the end of summer on sites below northern coast amounts 4 ind./100m². The max means of abundance for northern coast were identified for sites “Cape Flotsky” (29 ind./100m²) and “Zelenogorsk” (25 ind./100m²) in 2015. The average abundance of tubenose goby in the end of summer on sites below the southern coast amounts to 27 ind./100m². The max mean of goby abundance for the southern coast was identified for site “Grafskaya Bay” (162 ind./100m²) in 2016. Also numerous goby is on the outer north sites of Kotlin Island (the average abundance amounts to 45 ind./100m²; max – 84 ind./100m²). In samples tubenose goby was presented by numerous fry and adults up to 62 mm length (Sl).

The round goby first registration in the Russian part of the Gulf of Finland occurred in 2012 on the shallows of the Luga Bay during the present monitoring. The first records for the Estonian outer part of the gulf dated from 2005, as the first registration for the southeastern Finland (Archipelago Sea). During 2012–2016 some specimens were collected by different sampling methods. Primarily fertile round gobies were caught with gill nets and traps in the Kopora Bay (12 adult specimens till now). Also catches occurred in the Luga Bay, Narva bay, near Seskar Island and in the outer area near the northern hand of the FPFC Dam. In 2015–2016 numerous young-of-the-year fry was caught with the beach seine in the Kopora Bay (10 ind./100m²) and some on the south bank close to the FPFC Dam (1 ind./100m²).

During the last decade we observe intense and successful naturalization of two Gobiidae species in the Eastern Gulf of Finland – tubenose goby and round goby. Given both the gobies are relatively widely distributed in the new habitat and populations include numerous fry and adults the further increase of abundance and occupied area may be apparent.

THERMAL SENSITIVITY AS AN ELEMENT OF THE SPECIES GENETIC MEMORY OF THE EXAMPLE OF REPRESENTATIVES CYCLOPOIDAE

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Most of the modern research on the problem of invasive species is devoted to the study of the ecology of these species in new habitats, their relationships with native species, and so on. Species that in past historical epochs have penetrated both from the north and from the south are present now among the species of copepods inhabiting the reservoirs of the temperate climatic zone. Although they initially had significant differences in the features of their temperature physiology, it did not stop them from adapting to local climatic conditions and occupy certain ecological niches in the same reservoirs. However, for most Cyclopoidae species, the values of preferred, tolerant and resistant temperatures are not known. At the same time it can be assumed that the invader species of the "new wave", the invasion of which we are witnessing in the last 20 years, should have the features of temperature physiology similar to the features of the current inhabitants of temperate water bodies so that they can naturalize a foothold in the new habitat. The same applies to potential species of invaders. We determined for the first time the values of the Critical Thermal Maximum (CTM), the Final Preference Temperatures (FPT), and the avoided temperatures for the four cyclops species inhabiting the temperate climate basins. Two species from northern species belonging to the genus *Cyclops*, which has a Palearctic origin – *Cyclops insignis* and *C. kolensis*, have been selected. Two species from genera of southern origin were taken. These are *Thermocyclops crassus* and *Eucyclops serrulatus*. *Cyclops insignis* is a winter species in plankton present from November/December to April/May, common in Europe. Reproduces almost exclusively under ice. *C. kolensis* – the most common form of cold-loving cyclops, little variable. The species is large, winter, stenothermal and cold-loving. It is considered a northern invader in the river Volga. *Eucyclops serrulatus* is one of the most common cyclopids, despite the southern origin. With respect to temperature, it is characterized as a eurythermal species, extremely flexible and capable of successfully reproducing throughout the year in a wide range of temperatures. This flexibility contributes to its wide distribution and frequent occurrence. *Thermocyclops crassus* – the smallest species of cyclops. This summer heat-stenothermal cyclope is an ordinary inhabitant of lakes, rivers, reservoirs. The analysis of the temperature conditions in the nature and the values of the temperature characteristics of the species studied by us in the experiments show that the northern Palearctic species in nature live in a narrower temperature range than species having a southern origin. This range is limited to low temperatures of habitat (1–8°C in *C. insignis* и 1–14°C in *C. kolensis*) and breeding (3–7 and 2–14°C respectively) temperatures during the winter-spring period. In species of southern origin, the temperature range of habitat is 1.5–4 times wider (0–34°C in *E. serrulatus* and 4–33°C in *Th. crassus*) and they active from early spring to early winter, or all year round. In the experiment, species of northern origin also show low values of the final preference (8.6–13.6°C in *C. insignis* and 11.2–15.0°C in *C. kolensis*) and avoided (>22°C in both species) temperatures, but their wider range (4–5°C) compared to those of southern origin. FTP in the *E. serrulatus* was equal to 19.4–20.6°C, in *Th. crassus* – 26.6–26.8°C. The FTP range is 1.2–2.2°C in both species. It turns out that species of northern origin select higher temperatures under experimental conditions than those in which they live in water bodies. The reasons for this are not yet clear. Species of southern origin, on the contrary, choose a narrower temperature range than that in which they occur in water bodies. But these selectable temperatures are at the top of the temperature range at which the species lives in nature. The results obtained make it possible to conclude that the process of acclimatization to temperate climate conditions in species of southern origin is more successful than that of species of northern origin. Perhaps this is due to the mechanisms of thermoadaptation at the biochemical level, which requires further research in this direction.

TRANSLOCATION OF THE HALOPHILIC BRINE SHRIMP *ARTEMIA* SP. LEACH, 1819 IN THE HYPERSALINE LAKES IN THE SOUTH OF WEST SIBERIA

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The range of numerical characteristics fluctuations of the brine shrimp *Artemia* Sp. since 1977, i.e. since the beginning of research work on hyperhaline lakes in the Altai Territory, has been quite significant, and in its dynamics it reflects the variability of biological and climatic habitat factors, and the dynamics of harvesting *Artemia* Sp. cysts reflects the intensity of fishery. For the specified long-term period the number of brine shrimps varied within 0.31–48.04 thousand specimens/m³. The highest density of brine shrimps was registered in 1991–1992, 1998–2000, in 2002, 2006–2007, 2015–2016, the lowest in 1993–1994 and 2004.

The dynamics of the cyst number can be considered objective only since 1989, since the beginning of the period of using the standardized methodology of predictive studies.

The brine shrimp *Artemia* Sp. in hypersaline lakes in the south of Western Siberia belongs to parthenogenetic populations, despite rare appearance of males in the assemblage structure. For a long period of research in the Altai Territory, the lakes were clearly dominated by females. The largest percentage of males (10.2) was observed in 2007, during the remaining years this value did not exceed 5%. The sex ratio is not a population characteristic, but rather of a separate generation as a result of the prevailing biotic conditions of a particular period.

Development of 3–4 generations is typical for large in area hypersaline lakes, depending on environmental conditions. The first nauplii in reservoirs appear in the early spring period at a water temperature of 3–4°C. In the initial period of the brine shrimp life a mass mortality occurs, among the remaining individuals, a low mortality rate is observed. The duration of development and maturation of the brine shrimp is significantly influenced by the temperature regime. Reproductive individuals are observed from the middle of June. The main peak of the total number of brine shrimps is in the summer months (June–August). *Artemia* Sp. population distribution across the water area is uneven in space and time.

When analyzing the correlation coefficients between the numbers of the brine shrimps *Artemia* Sp. of different age and environmental factors, reliable relationships between the density of nauplii and the number of females are revealed ($r = 0.67$, $p \leq 0.05$). In addition, the number of brine shrimps of different age correlates with the number of phytoplankton (r – from 0.48 to 0.92, $p \leq 0.05$). The number of reproductive individuals correlates with the number of individuals of the pre-adult development stage (females – $r = 0.71$, males – $r = 0.63$, $p \leq 0.05$).

In the vertical and horizontal distribution of brine shrimps and cysts, heterogeneity is observed. According to our data, cysts possess the greatest cluster forming ability, due to their "stickiness". When predicting the volumes of possible cysts, the most important is the identification of the production layer of the water column, as well as the moving processes of the main cyst mass during the growing season. The horizontal distribution depends mainly on the wave activity. The vertical distribution depends on the temperature and mineralization of water, determining its density, hence, the buoyancy of cysts.

In the southern lakes of Western Siberia, only in deep Lake Bolshoye Jarovoye of the Altai Territory, the stratification of brine shrimps and cysts in depths is observed. In the spring period, during the warming of water, they rise from the depth of 8.0–9.0 m. In June and July, their main mass is in the upper layers of water (1.0–2.0 m). The process of their sinking begins from August. In this case, the 4-meter layer is identified as "borderline"; the density of the brine shrimps and cysts in it varies depending on vertical movement.

ICHTHYOCENOSIS STRUCTURE OF DIFFERENT LANDSCAPE ZONES IN WATERBODIES OF THE UPPER OB

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The water resources of the Altai Territory and the Altai Republic are located in different landscape and geographical zones, from a steppe to highlands, and are characterized by a diverse typology. The main watercourse of the region is the Ob, formed at the confluence of the Biya and the Katun. Throughout its entire stretch, up to the transient region of the Novosibirskoye Reservoir, the main objects of fishery are: the bream (*Abramis brama orientalis* Berg), the roach (*Rutilus rutilus lacustris* Pallas), the Prussian carp (*Carassius auratus gibelio* Bloch), the carp (*Cyprinus carpio* L.), the pike (*Esox lucius* L.), the ide (*Leuciscus idus* L.), the zander (*Stizostedion lucioperca* L.) and the perch (*Perca fluviatilis* L.). The Chinese sleeper (*Perccottus glenii* Dybowski) has spread everywhere in the bottomland water bodies and distributaries of the Ob, being an undesirable immigrant. In total, 30 fish species live in the watercourse, most of which are not widespread.

In the Altai Territory there is a vast forest-steppe zone where there are about 20 thousand hectares of highly productive lakes. All reservoirs of this zone are marked as having periodically a sharp decrease in the oxygen dissolved in water. The main fishery objects are: the roach, the Prussian carp and the perch. Special attention should be paid to the Gilyovskoye Reservoir within the boundaries of Loktevsky and Tretyakovsky Districts of the Altai Territory, which is noted as the largest artificial reservoir in the southwestern part of the Altai Territory. Reservoir ichthyofauna was formed with fish of the middle and upper reaches of the Aley. The bighead carp, an introduced species, is also remarkable (*Hypophthalmichthys nobilis* Richardson); there are 15 fish species in the reservoir in total.

Other large landscape areas are low mountains and middle mountains of the Altai Republic. The region has a large length of watercourses and significant areas of lakes that are of fishery importance.

The largest waterways of the Altai Republic are the Katun (674 km), the Biya (306 km), forming the Ob, and their largest tributaries: the Chulyshman (227 km), the Argut (108 km), the Chuya (245 km). The length of small rivers of the republic is estimated at 1043 km, the lake water area is about 60 thousand hectares. The most significant fishery lakes are: Lake Teletskoye (23,000 hectares) within the boundaries of Turochaksky and Ulagansky Districts, Lake Ulagan (672 ha), the lake of Kosh-Agachsky District (1550 ha) and Lake Taimen'ye (256 ha).

The ichthyofauna of the Altai Republic reservoirs includes 32 fish species and subspecies belonging to 25 genera and 10 families. Of these, 15 species belong to the fishery species: the rainbow trout (*Oncorhynchus mykiss* Walbaum), the taimen (*Hucho taimen* Pallas), the common whitefish (*Coregonus lavaretus* L.), the peled (*Coregonus peled* Gmelin), the Arctic grayling (*Thymallus arcticus arcticus* Pallas), the Northern pike, the Prussian carp, the Siberian dace (*Leuciscus leuciscus baicalensis* Dybowski), the Altai osman (*Oreoleuciscus potanini* Kessler), the burbot (*Lota lota* L.) and the perch. The introduced species are the trout, the peled, the common whitefish, the bream, the carp, the zander as well as the ninespine stickleback (*Pungitius pungitius* L.), that is an undesirable immigrant. The Siberian sturgeon (*Acipenser baerii* Brandt), the sterlet (*Acipenser ruthenus marsiglii* Brandt), the lenok (*Brachymystax lenok* Pallas) and the nelma (*Stenodus leucichthys nelma* Pallas) are in the list of rare and endangered species.

PATHWAYS FOR INVASIONS OF ALIEN PLANT SPECIES

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“EU IAS Regulation” contains several actions related to pathways of invasions. The evidence to support pathway prioritisation and management is being addressed through the Non-Native Species Information Portal (NNSIP) and other projects, including the classification of 37 broad introduction pathways and hundreds of sub-pathways (www.gov.uk/government/publications).

Several decades ago there were transportation corridors which perform a role of the main pathway for alien plants invasions. For example, the list of alien species found in the Moscow railways (~300 km) includes 620 alien taxa (57% of total 1087 species). A few new species for former USSR territory were found there, as well as many new species for Moscow province. The number of the taxa is significantly higher than provided for the “railways flora” in other regions.

351 alien species can be characterized as occasionally contaminated, 269 – as escaped from cultivation. A group of casual alien plants consists of 222 spp. (36%); a group of naturalized plants prevail (48%); 41 invasive species s. str. (7%) and 59 transformers (9%) are recorded. Several important differences compare to indigenous component are recorded: the list of 13 leading families does not include *Cyperaceae*, ranks of *Caryophyllaceae* and *Scrophulariaceae* are lower, while *Chenopodiaceae*, *Apiaceae* and *Boraginaceae* are higher in ranking.

Railways are not only “donors” of alien species, they are also their recipients. In fact, railways could serve as a refuge for “the escapees”: e.g., *Asclepias syriaca* grows over 30 years within the section of railway Kursk-Moscow located near Institute of Medicine Plants. *Galega officinalis* was also recorded for the spot 10 years ago, and now this species forms the dense population of about 200 m². *Sedum hispanicum* and *S. album* appeared along the railways from flower gardens located near railroads.

There is the correlation between plants' life form and pathway. In the group of woody plants “the escapees” predominate (10 times more species than within the group of occasionally contaminated plants). Within the group of herbaceous perennials occasionally contaminated plants have 2 times more species than in the group of “the escapees”. Within the group of annuals occasionally contaminated plants are 3 times more numerous in species than “the escapees”.

Significance of transportation corridors decreases these days; intentional introduction is evaluated as the main pathway of invasion. Plants using for roadside embellishment (*Robinia pseudo-acacia*, *Acer negundo*) or as green fodder (*Galega orientalis*, *Lupinus polyphyllus*) became weeds in masse. The importance of introduction institutions for invasions is inconspicuous. For example, a checklist of the flora for the territory of the Main Botanical Garden of the Russian Academy of Sciences (Moscow) enumerates 856 species. The plant species listing is found to have been augmented by 54 taxa of the native flora, 284 escapees from cultivation and 34 alien weeds, resulting in 1.8 times as large a total as 65 years ago. The only species definitely escaped from the Garden's territory is *Adenocaulon adhaerescens*; *Geum macrophyllum* is another possibility.

Intentional introduction is often accompanied by a casual penetration, and alien species are accidentally imported with soil. For example, this is a way of penetrating into Europe of species growing within plantations of American cranberry (*Oxycoccus macrocarpos*). The estimation of stability for alien species in the secondary distribution range and effectiveness of their controlling in Belarus and Kostroma district were carried out. Among 23 new for flora of Belarus alien species after three years (2011–2014) of methodical work to eliminate them 3 species have reduced their populations, 7 – maintain the stabile low abundance, 10 – retained consistently high number, and 3 species have increased population size and moved into natural plant communities. As a result of intensification of control measures in 2015–2016 the abundance of invasive alien species reduced seriously. Although, *Persicaria sagittata* and *Lycopus uniflorus* demonstrated resistance to the control measures: their projective cover within plantations and wet peatland forest' communities could reach 40%.

INVASIVE SPECIES *ERIGERON* SPS. SECT. *CONYZA* (LESS.) BAILL. IN EUROPE

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The section *Conyza* (Less.) Baill. includes the following species naturalized in Europe: *Erigeron canadensis* L., *E. bilbaoanus* J. Rémy, *E. bonariensis* L. (= *E. ambiguus* DC), *E. sumatrensis* Retz. (= *E. floribundus* (Kunth) Sch. Bip.). Diagnostics of alien species often can be difficult because of possible hybridization with other closely related alien taxa. Hybrids can have more invasiveness than parental alien species. We founded presumably hybrid plants *Conyza* × *rouyana* (with intermediate characteristics) in Italy (Rome and Pompeii) in 2016. The table of diagnostic characteristics was made on the base of researched morphological parameters (micro morphological characteristics were studied by digital microscope Keyence VHX-1000 and scanning electron microscope LEO 1430 VP):

Taxa <i>Erigeron</i> sect. <i>Conyza</i> diagnostic characteristics	<i>E. ca- na- densis</i>	<i>E. su- mat- rensis</i>	<i>E. bo- na- rien- sis</i>	<i>C. × ro- uya- na</i>
Single- double row involucre of inflorescence (0), multi-row (1)	0	1	1	1
Leaflets of involucre almost glabrous, (0) intensive pubescent (1)	0	1	1	1
Numerous inflorescences (heads) (0), a few inflorescences (1)	0	0	1	0
Inflorescences have small size 5x2 mm (0), middle size 6x3 mm (1), big size 6x5 mm(2)	0	1	2	0
Oval heads (0), round heads (1)	0	0	1	0
Heads aren't swollen at the base (0), swollen at the base (1)	0	1	0	0
Stem with edges (0), without evident edges (1)	0	1	0	0
Stem with single long (1 mm) trichomes (0), stem with very long (up to 2 mm) dense trichomes (1), stem with dense short trichomes (2)	0	1	2	2
Linear-lanceolate leaves (0), lanceolate-oval leaves (1), almost linear leaves (2)	0	1	2	0
The length of trichomes along the middle vein of the leaves and outside the veins does not differ (0); Trichomes on middle vein twice as long as outside of veins (1)	0	1	1	1
The leaf outside the middle vein rare pubescent (only 4–10 trichomes per 1mm ²) (0), medium pubescent (11–20 trichomes) (1), intensive pubescent (more than 20 trichomes) with long soft trichomes (2)	0	1	2	2
The basal cell of the trichome has the shape of a “flower” (0), the basal cell is spherical (1), basal cell does not differ from other cells (2)	0	1	2	2
Shoots are green or gray-green (0), dark green-gray (1), silvery-gray (2)	0	1	2	0
Mesophytes and xerophytes (0), only xerophytes (1)	0	1	1	1

However, preliminary molecular genetic studies (using PCR-ISSR method) didn't confirm their hybridogenic origin, and we plan to continue our research, since according to all micro and macro morphological features, these plants are uniquely hybrids.

VAUCHERIA COMPACTA (XANTHOPHYCEAE), AN ATLANTIC COASTAL MACROALGA NEWLY FOUND IN THE VOLGA RIVER

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Vaucheria presents a relatively large genus of yellow-green algae, xanthophytes, common in different aquatic, semi aquatic and moist terrestrial habitats worldwide. In Russia, ca. 26 *Vaucheria* species have been reported, including eight species discovered recently from Siberia and the Upper Volga Region (Sviridenko et al., 2013; Vishnyakov, 2015, 2016). There is nothing unusual to discover new to Russia species among such poorly studied group of algae as *Vaucheria*s, but this was completely surprised to occur the dioic species section *Piloboloides*, *Vaucheria compacta* (Collins) Collins ex Taylor 1937, in the Upper Volga Region for the first time. This species was previously known as restricted mainly to Atlantic coasts of North America and the Central and Western Europe (Rieth, 1956; Knutzen, 1973; Simons, 1974, 1975; Christensen, 1987; Krieg et al., 1988; Schneider et al., 1996, 1999; Johnson, 2002), where it inhabits a diverse range of biotopes with different salinities (up to 50‰), as well as freshwater, especially in the intertidal zone of estuaries. The alga was collected accidentally from the right bank of the Volga river in Rybinsk at the late June 2017. This formed tufted mats on the silty sand among the stones together with *Eleocharis*. At the date of collection, the alga has no sexual organs. The part of siphons was cleaned and cultured in a tap water, while the other material was left in a perforated plastic bag and preserved on the windowsill. A lots of sexual organs were detected in both conditions three weeks later. As from other freshwater habitats, the newly discovered population of *Vaucheria compacta* shows morphological features fit the variety originally described from the Netherlands as *Vaucheria compacta* var. *dulcis* Simons 1974 (Simons, 1974). Some isolated populations of the species from freshwater riverine non-coastal conditions in Europe and North America also belong this variety (Dangeard, 1939; Behre, 1961; Simons, 1974; Szymanska, Zakrys, 1990; Schneider et al., 1996).

An occurrence of the typical estuarine *Vaucheria* species in the Volga river indicates its high migration potential from the coastal oceanic areas in freshwater. Thus, the Rybinsk location appears to be the most farthest from the ocean. With a view to current knowledge of the species distribution, a migration from the Baltic Sea via the Volga-Baltic Waterway seems to be the most plausible. However, it remains unclear whether *Vaucheria compacta* invaded the Volga recently, or has long been inhabited it being just unidentified or omitted during previous observations. An additional issue requiring exploration concerns the invasive potential of this species: It cannot be excluded that the alga is entered the Volga river only occasionally without any negative impact on its benthic communities. Anyway, an occurrence this non-native species updates the problem of marine algae invasions in the Volga river (e.g., Korneva, 2014, 2015).

Financial support for this work was provided by Russian Found of Fundamental Research (no. 16-34-01139).

PECULARITIES OF SPREAD OF *ECHINOCYSTIS LOBATA* IN THE KALININGRAD REGION

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There is no published information about the first registrations of *Echinocystis lobata* (Michx.) Torr. Et Gray (*Cucurbitaceae*), peculiarities of invasion and distribution for the territory of the Kaliningrad region. In the pre-war [Abromeit, 1889–1940] and post-war [Pobedimova, 1956; Saakov, 1956] lists of the flora of the region this species was not mentioned. By personal observations already in the late 1970s the species began to be wild and was met in anthropogenically disturbed habitats. The first herbarium specimens from natural habitats were collected in 1988 (Gvardeysky district, Ozerki village, ameliorative ditch bank, wet meadow, Gubareva I.Y., herbarium of the I. Kant BFU (KLGU). In the summary of the flora of the Kaliningrad region [Gubareva et al., 1999] it is stated, that the species is common in the region, but has a local distribution.

The study summarizes information on findings of *E. lobata* in the coastal water communities of the watercourses and lagoons of the Kaliningrad region in 2006–2007; 2011; 2013–2016.

Since 2011 it is found in natural communities along the banks of the Vistula Lagoon in the vicinity of Pribrezhny settlement in the reed-lythrum tangle, overgrowing reed sprouts. In 2006–2007 the species was reported on the Pregel River which flows into the Vistula Lagoon. In habitats *E. lobata* grows in overgrowths of willows with a projective covering from 1% to 20%.

E. lobata is actively spreading and introducing into natural phytocenoses. In 2014–2015 *E. lobata* is reported on the banks of the Pregel River and on the small rivers of the Pregel River system (the rivers: Instruch, Pissa, Angrapa, Putilovka, Perelesnaya, Golubaya, Lava), where it settles on the stems of reed and bushes, which, according to Y.K. Vinogradova [2010] is the final phase of naturalization of the species.

In all habitats the species grows on sandy soils in communities with reeds or coastal willow thickets together with *Humulus lupulus*. As a rule, the species is scanty, occurs in an amount from one to several to 10 specimens (May), a projective coverage of 0.5–20% (July) and only on the Lava River *E. lobata* forms a thicket with a projective covering of 80–90%.

In 2008 *E. lobata* seeds germinated on the western shore of the Curonian Lagoon as a result of storage of soil and plants after weeding beds in Lesnoy settlement on the Curonian Spit, in 2013 the situation was repeated in Morskoy settlement [Gubareva, 2013]. We also found the *E. lobata* it on the shore in the Lesnoye village (coverage 5%) and in 2015 in the Rybachy village (single).

In connection with the active spread of fruits and seeds by water, the introduction of this species into the coastal biocenoses of the Curonian Lagoon may have negative consequences due to the possible replacement of indigenous species by *E. lobata*, which is observed in many regions.

In 2013–2015 *E. lobata* was also found in the rivers flowing into the Curonian Lagoon – in the Deyma River, Sheshupe River (the tributary of the Neman River).

Since the species is found mainly along the banks of watercourses and rivers, being introduced into natural communities, it can be argued that *E. lobata* is a naturalized species in the region – agriophyte.

GENETIC DIVERSITY OF THE FIRST BALTIC INVASIVE POPULATION OF THE WEDGE CLAM *RANGIA CUNEATA* (BIVALVIA: MACTRIDAE)

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The first individuals of *Rangia cuneata* (G. B. Sowerby I, 1831) has been found in the harbor of Antwerp in 2005 (Verween et al., 2006). Possible sources of the first European population of wedge clam could be only North-American origin: from *rangia* native range, the Gulf of Mexico, or from the Chesapeake Bay, where the species is regarded as introduced. Five years later, in 2010, the species was recorded in the Vistula Lagoon, Baltic Sea (Ezhova, 2012; Rudinskaya, Gusev, 2012). Currently, *R. cuneata* is known in the coastal waters of Germany, Poland, Russia, Lithuania, Estonia, Sweden (<http://www.corpi.ku.lt/databases/index.php>), but only in Vistula Lagoon (Russian-Polish waterbody) the population could be defined as established.

The analysis of *R. cuneata* populations genetic diversity in Europe (non-native) and North America (both native and non-native) for the understanding of most probable introduction rout, was the aim of study.

It was shown, Baltic population is characterized by a high diversity of the mitochondrial cytochrome oxidase I (COI) gene fragment. Based on the similarity of the haplotypes frequencies, we suggested the main source of the Baltic settlements was non-native populations of *R. cuneata* in the North Sea. Contrary to expectations, genetic diversity of the populations from Antwerp and Amsterdam was not higher in comparison to the Baltic one. Moreover, in the Vistula Lagoon population H6 haplotype was found, which present in the Chesapeake Bay material and absent in samples from other locations. Individuals, carried this haplotype could be entered both from the USA Atlantic coast directly and through the donor population from the North Sea. However, this haplotype was absent in the sample from Amsterdam and Antwerp, therefore we assumed that in addition to resettlement from the North Sea it is possible intercontinental transport of larvae by ballast water to the Baltic Sea.

The present study was supported by RFBR, grant 17-05-00782 A and general budget of the Shirshov Institute of Oceanology RAS, Atlantic Branch (scientific theme № 0149-2016-0005).

U.S. FISH & WILDLIFE SERVICE ASIAN CARP CONTROL EFFORTS: A PARTNER DRIVEN PROCESS

A. Woldt

United States Fish and Wildlife Service

The mission of the U.S. Fish and Wildlife Service is working with others to conserve, protect, and enhance fish, wildlife, plants, and their habitats for the continuing benefit of the American people. Invasive species, like Asian carps, negatively impact fish and wildlife resources by altering native habitats and by competing with native fishes. The Service, in cooperation with its partners, currently implements two different strategies to address the threat of Asian carps: the Management and Control Plan for Bighead, Black, Grass, and Silver Carps in the United States (Plan), which is national in scope, and the Asian Carp Regional Coordinating Committee's (ACRCC) Asian Carp Action Plan, which focuses on the Great Lakes region. In addition, the Water Resources Reform & Development Act of 2014 (WRRDA) was signed into law on June 10, 2014. As directed, the Service assumed a lead role in coordinating federal interagency efforts to address the threat of Asian carps in the Ohio River and Upper Mississippi River basins and their tributaries, including the CAWS. The Service works with its state, federal, provincial, and tribal partners to monitor the spread of Asian carps, conduct risk assessments, control existing Asian carp populations and minimize impacts of those populations, contain the expansion of such populations, prevent future introductions, educate the public, and conduct necessary research.

ECOLOGICAL MECHANISMS FOR THE REALIZATION OF THE LIFE CYCLE OF ALIEN FISH SPECIES IN RESERVOIRS OF THE FOREST-STEPPE AND STEPPE ZONES OF WESTERN SIBERIA

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Since the second half of the 20th century the alien species are important component of fish community prevailing in commercial catches in West Siberian waters. Under impact of the warmed-up and polluted waters flowing from objects of agricultural and industrial complex there change hydrochemical, gas and thermal regimes of the rivers and lakes and therefore species richness and structure of hydrobionts communities changes too. However, experts often overlook important questions in the context of developing measures to conserve of biological diversity of fish. For example: 1. is it necessary to protect invasive species as objects of aquaculture in natural reservoirs? 2. How dangerous is distribution of alien species in environment to conserve the species richness of fish in the region? A study was carry out of the biology of populations of silver crucian *Carassius auratus*, sunbleak *Leucaspis delineatus* and Chinese sleeper *Perccottus glenii* in different water bodies of Western Siberia. The main tasks of the study were oriented to assessing of the stability of aquatic biological systems under invaders effect, on the one hand, and to identify the strategies for alien species adapting to atypical environmental conditions, on the other. Data on the biological characteristics of alien species populations and their structural and functional role in fish communities on the example different types of rivers and lakes on the territory between the Ob and the Irtysh River were analyzed.

The distribution of alien species in Western Siberia. Currently, *C. auratus* introduced from the Far East (Amur River basin) prevails in most isolated lakes, both in quantity and in biomass. *L. delineatus* (introduced from Europe territory) is typical inhabitant of the small rives with slow flow and flowing shallow lakes. *P. glenii* (the natural areal covers the Amur River basin) prefer the conditions of water stagnation in small lakes and ponds. The results of the study showed that these non-native species are adapted to a low level of water exchange and hypoxia conditions specific to lakes systems of South of Western Siberia.

Competitive relationship. *C. auratus* and *P. glenii* do not compete with the native species in open water area due to their localization in macrophytes along coastline. During coexistence in same biotopes there are not competition between native and alien species in relation to feed resources. Siberian species feed by zooplankton and zoobenthos mainly. The food spectrum of *C. auratus* is based on detritus and periphyton, *L. delineatus* feeds by insects falling on the water surface, and *P. glenii* is characterized by wide diapozon of food objects. Herewith they can be prey of native predators as perch *Perca fluviatilis* and pike *Esox lucius*. The parasitic fauna of introduced fish is not dangerous to native species. The above information could form an opinion that the ecological risks in local fauna changes under the influence of alien species are not high, as species of the aboriginal complex are characterized by early maturation and high fertility. In addition, compared to relatively inactive strangers fish they can move on the long distances during breeding and feeding periods. However, it is proved that diploid form of crucian from Amur basin successfully interbred with native triploid form. In results of introgressive hybridization process the gene pool of *C. gibelio* dissolves in the genetic complex of *C. auratus*.

The strategy of adaptation. Important adaptation to environment of crucian is generation of the dwarf forms in harsh condition of arid climate under decreasing of water volume. Chinese sleeper particularly successful realize the life cycle in temporary (periodically drying up) reservoirs like roadside canals and shallow lakes where other species of fish do not survive. Unlike native fish sunbleak mainly move near surface layers of water and thus they are hiding from the predators.

Conclusion. An analysis of the obtained data about spatial distribution, behavior and food webs reflects the dissimilarity of the ecological niches of alien and native species in the Western Siberia, including the low competition to food resources and differences in biotope distribution.

THE ROLE OF FISH FARMING IN ALIEN SPECIES SPREAD IN THE OB-IRTYSH BASIN

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The Ob is one of the greatest rivers of Asia. Location of Ob basin territory within the West Siberia and the absence of inter-basin canals makes the alien species transfer by water transport hardly possible. The relative isolation of the basin predetermined the major role of industrial fisheries and aquarium fisheries in alien invertebrate transfer.

A total of 22 alien naturalized species have been discovered, that regularly occur in some water bodies of the Ob basin. The richness of alien species in the studied water bodies of the Ob River basin comprises 2–5% of the total species list of macroinvertebrates, and this value approaches that of the acknowledged “center of xenodiversity,” such as the Gulf of Finland in the Baltic Sea (Orlova et al., 2006). It should be noted that 7 species were deliberately introduced to enhance food reserves for fish, 8 – released by aquarists, 6 – inadvertently released during fish and forage organisms introduction and 1 (crayfish) was imported for human consumption. About 65% of the alien species were introduced into water bodies of West Siberia through the industrial fishery and about 35% through the aquarium fishery. Despite different invasive ways, crustaceans and mollusks dominate among alien invertebrates as in Europe as in the Ob basin.

The main gateways for the dispersal of alien macroinvertebrate species in the Ob River basin are reservoirs, where about 90% of initial introductions have been recorded. Temporal trend of initial introduction was assessed for the Novosibirsk (the Ob River) and Bukhtarma (the Irtysh River) reservoirs distinguished by the most intensive fisheries. Despite considerable remoteness of the reservoirs from each other and the absence of hydrologically connected waters, they had similar trends in invasion rate change. The maximum invasion rate was marked in 1960s and was associated with amphipods and mysids intentional introduction for stock enhancement. The alien macroinvertebrates found for the last three decades entered the water bodies as contaminants of fish stocks or stock of forage organisms.

For species with a known naturalization period, a prolonged lag time was marked both in case of intentional and inadvertent introduction. Probably, the prolonged lag times are related to invasion occurred at the initial stage of the reservoir creation. During this period, flooded soils turned to bottom sediments of the reservoir that was accompanied by the temporary decreased oxygen concentration and the increased content of organic substances in the water caused by flooded vegetation decomposition. The new species-invaders experience stress associated with adaptation to the changing environmental conditions. Long lasting establishment of some alien species in the recipient reservoirs requires the long-term management of biological invasions in the reservoirs meant for fishery purposes.

Unlike invasions occurred 150 years ago in European waterways (Jackson and Grey 2013; Ricciardi, 2015), the introduction of the non-indigenous fauna into the Ob River basin started just 50 years ago due to the intensive development of Siberian water resources for energy and fishery purposes. A longer period of invasions in European water bodies as well as a greater diversity of pathways of alien species has led to a larger number of alien species in large river systems as compared to Ob River. Nevertheless, the Ob basin and the most highly invaded European freshwater systems demonstrate similarity in average invasion rate of macroinvertebrates for the period of the highest rate of invasion (1960–2000). The rate of invasion was 0.42 alien species per year in the Ob River, 0.46 in the Ebro River, 0.52 in the Rhine River and 0.6 in the Thames River. High invasion rate in the relatively isolated water bodies of the Ob river basin is comparable to that in Europe; hence, the establishment of the control over fishery-induced movement of alien invertebrates is required.

**A COMPARATIVE MORPHOLOGICAL STUDY
OF THE INVASIVE ROUND GOBY (*NEOGOBIOUS MELANOSTOMUS*) FROM
DIFFERENT PARTS OF THE BALTIC SEA (THE GULFS OF FINLAND AND RIGA)**

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The first finding of the invasive round goby in the Baltic Sea relates to the 1990s. Since that time its extensive expansion throughout the sea has been observed (Kornis et al., 2012; Kotta et al., 2016). Currently the species is quite abundant and commercial in some parts of the Baltic Sea, though remains to be mostly unstudied there, particularly in relation to external morphology. Morphological characters reflect adaptations of the alien species to the new environment and morphological differences between populations can be informative for the knowledge about the species differentiation and to clarify directions of its distribution. The aim of the current study was to estimate morphological differences between the introduced round goby from several sites of the Baltic Sea.

Materials were collected in the five sites located in the Gulf of Finland (NW, Emäsalonselkä, Porvoo, January 2015, ♀, KK 3011 MZH; NE, Sestroretsk, spring 2016, ♂, ZISP 55879 and SE, Sosnoviy Bor, September 2016, 12♀ & 3♂, ZISP 55880), and near Latvia's coast (the Gulf of Riga, Mangaļsalas mols, August 2016, 4♀ & 4♂, ZISP 55877, and Liepāja, 10♂, ZISP 55878). 6 meristic (number of fin rays and scales in the lateral surface of the body) and 35 morphometric characters were estimated according to Zabroda, Deripasko (2009).

Total length of the round gobies was 69 mm in Porvoo, 80±11 mm in Sosnoviy Bor, 166 mm in Sestroretsk, 122±13 mm in Mangaļsalas mols and 204±6 in Liepāja and mass was 4, 7±3 and 70, 29±8 and 165±24 g respectively. Gobies caught in the Gulf of Finland were significantly smaller (SL=72±22 mm, $n=17$) than caught near Latvia's coast (SL=145±39 mm, $n=18$). It was supposed to be due to use of different fishing gear and depths for their capture. Round gobies from the Gulf of Finland were caught by fishing rod in the inshore zones (excluding a fish from Sestroretsk captured by a fish trap), while the most of gobies caught near Latvia's coast (in Liepāja) were captured with use of commercial trawls further from the shore.

Paired comparisons of the round gobies caught in the Gulf of Finland ($n=17$) and near Latvia's coast ($n=18$) revealed differences between them in 22 morphometric characters (ANOVA, $p < 0.01$). Indices of body and fins (ratio to SL) were mostly lower in gobies from the Gulf of Finland (maximal height and width of body and caudal peduncle, preanal distance, ventral fin-anal fin distance, length of D1 fin base, width of bases of P and V fins, but the opposite for length of P and C fins and height of D2 fin). Similarly, all indices of the head (ratio to head length) were lower in gobies from the Gulf of Finland, except the eye diameter. Found differences can be caused by different factors, among them environmental conditions in sampling sites, as well as differences in fish length between samples. Besides, the most of gobies caught in the Gulf of Finland were females (4♂:13♀), while males dominated in the samples caught near Latvia's coast (14♂:4♀). This phenomenon was probably a result of quite limited sample size. Due to noticed above, effects of geographic morphological variability can be hardly differentiated out of effects of fish sex and size on the studied morphological characters with use of the analysed materials.

In meristic characters a correlation was found between the number of fin rays in D2 and A for the pool of all analysed fishes ($r=0.82$, $p < 0.05$). On average, gobies caught in the Gulf of Finland had lower number of fin rays (15.3±0.6 in D2 and 12.6±0.5 in A) than gobies caught near Latvia's coast (16.4±0.7 in D2 and 13.7±1.0 in A) ($p < 0.01$ in both cases).

These preliminary results provide new data about the morphological characters and their differences between the invasive round goby from different locations of the Baltic Sea. However, further studies are needed for getting deeper knowledge on morphological differentiation of the round goby in the new for the species localities of the Baltic Sea basin.

The study was supported by the Russian Foundation for Basic Research (grant number 17-05-00782A).

MORPHOLOGICAL CHARACTERISTICS AND GENETIC POLYMORPHISM OF INVASIVE ROUND GOBY (*NEOGOBIOUS MELANOSTOMUS*) IN THE GULF OF FINLAND (BALTIC SEA)

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Native range of the round goby (*Neogobius melanostomus*) covers the basins of the Black, Azov and Caspian seas where it is among of the most abundant commercial fish. However, since 1990s an extensive north-west expansion of the species has been observed (Kornis et al., 2012; Kotta et al., 2016). Currently the species is quite common in some localities of the Baltic Sea, however remains to be not well studied. The aim of the study was to obtain data about morphological and genetic peculiarities of the non-indigenous round goby in the Gulf of Finland of the Baltic Sea.

Materials were collected in Emäsalonselkä, Porvoo (January 2015, ♀, KK 3011 MZH), Sestroretsk (spring 2016, ♂, ZISP 55879) and Sosnoviy Bor (September 2016, 12 ♀ & 3 ♂, ZISP 55880). 6 meristic (number of rays in dorsal, anal, pectoral and ventral fins, and number of scales in the lateral surface of the body) and 35 morphometric characters were estimated according to Zabroda, Deripasko (2009). An analysis of sequence polymorphism of the part of the mitochondrial gene encoding cytochrome *c* oxidase subunit 1 (*coI*) was also performed for six individuals from Sosnoviy Bor and Sestroretsk. Approximately 655 bp fragment of the *coI* gene (COI) was amplified using primers FishF1 and FishR1 according to Ward et al., 2005. Sequencing was done on the ABI PRISM 3500 analyser at the IBIW RAS following the manufacturer instructions.

Total length of fishes was 69 mm in Porvoo ($n=1$), 52–103 mm in Sosnoviy Bor (80 ± 11 mm, $n=15$) and 166 mm in Sestroretsk ($n=1$), and mass 4, 7 ± 3 and 70 g respectively. Meristic characters (D1 VI-VII, D2 I 13-15, A I 11-12, P 17-19, V 10-12, Squ 56-63) were in the same range as in native and other introduced populations (Yurtseva, 2016). The fish from Sestroretsk was essentially bigger, and was excluded from statistical comparisons of the morphometric characters. Males were bigger (SL = 76.2 mm vs. 64.6 mm in females) and had higher ($p < 0.05$) indices (in % SL) of head width (ic) and height (hco) and height of the basement of pectoral fin (iP). Gobies in Sosnoviy Bor had higher ($p < 0.05$) than in Porvoo indices of characters V-A, ID1, hD2, hA, hcz, ao, and lower indices of ID2 and IA. Thus, round goby from Sosnoviy Bor possess higher height of the second dorsal and anal fins than goby in Porvoo, but shorter length of these fins.

Specimens from the Gulf of Finland were similar in the COI sequences. Comparison of COI polymorphism in these specimens with our unpublished data and GenBank information revealed that sequences of the specimens from the Gulf of Finland belonged to the wide spread COI haplotype. This haplotype was also found in other invasive round goby populations of the Baltic and North seas and their basins, as well as in North America. The obtained data can be considered as an argument of the spread of these introduced populations from the same donor region, namely north- and/or south-western parts of the Black Sea basin.

The study provides new data about the morphological and genetic traits of the non-indigenous round goby in the Gulf of Finland. However, further studies are needed for the better characteristics of the invasive round goby in the Baltic Sea and ways of its range expansion.

This study was supported by the Russian Foundation for Basic Research (grant number 17-05-00782A).

HEMATOLOGICAL CHARACTERISTICS OF THE BLACK SEA - CASPIAN TYULKA *CLUPEONELLA CULTRIVENTRIS* NORDMANN, 1840

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The settlement of the tulka in the Volga reservoirs takes place during the last 60 years. There are a few of data on the tulka physiology or biochemistry, the fragmentary information on the effect of pesticides on the activity of glycosidases (Aminov et al., 2013), morphological adaptations in expanding the habitat (Slynko et al., 2015), water-salt metabolism (Martemyanov, Borisovskaya, 2010), pathological changes in the organs of the tulka, inhabiting the Caspian Sea (Fedorova et al., 2010, 2014). The dates on hematological parameters of the tulka were not found.

The fish was carried out in June–July 2015–2016 by the trawl method in reservoirs of Volga-Ksama basin. The 65 fish with a length of 54–85 mm and a mass of 3–9 g were examined. Peripheral blood smears were prepared after a caudectomy. The smears were fixed with ethyl alcohol and stained with azur-eosin by Romanovsky-Gimza.

At least 500 red blood cells were counted on each smear. The erythroblasts, immature and mature erythrocytes (%), amitoses (%), microcytic (%) and micronuclea (‰) were determined. On each smear, large and small diameters were measured in 100 mature erythrocytes. The area of the cell and nucleus, the shape of the cell, the nuclear-cytoplasmic ratio were calculated.

For the first time, the morphometric characteristics and stages of the erythrocyte maturity of the peripheral blood of the Black Sea-Caspian tulka are studied, which is the invader in the reservoirs of the Volga cascade.

The results of the study showed that the blood of the tulka contains mainly mature red blood cells. The share of erythroblasts and immature erythrocytes was minimal in fish from the Rybinsk Reservoir (no more than 10% and 20–50%, respectively). In the reservoirs of the Middle Volga their shares were higher than in the reservoirs of the Upper Volga. The proportion of erythroblasts and immature red blood cells was high in fish from Lyubets station of the Rybinsk reservoir, and in fish from the reservoirs of the Middle Volga. Differences in the erythroblasts, immature and mature erythrocytes can be associated with increased cell death in fish living in dirty water, and the intensification of erythropoiesis in these fish and the release of immature cells into the bloodstream.

The pathological forms of erythrocytes (amitoses and micronuclei) were observed in all fish. Their highest proportion was noted in fish with st. Lyubets (Rybinsk Reservoir (60 and 30%, respectively)). The share of these cells in the Upper Volga reservoirs was slightly higher than in the Middle Volga reservoirs, and their share was the lowest in the Kama Reservoir.

The presence of amitoses indicates a compensatory response from red blood cells, most often to tissue hypoxia. The proportion of these cells was also the highest in fish with Lyubets (Rybinsk Reservoir). The share of pathological forms of cells was also higher in fish from the reservoirs of the Upper Volga. The proportion of erythrocytes with micronuclei in the blood of the tulka is very low and does not go beyond the level of spontaneous mutagenesis.

The minimum values for the size of the cell and the area of the cell and nucleus were noted in fish from the Ivankovsky reservoir, the maximum was recorded in the Rybinsk reservoir's tulka, and the nuclear-cytoplasmic ratio and the cell-form index were higher in the Gorky reservoir fish erythrocytes. The correlations of medium tightness are found between the studied indices and the water temperature. A higher correlation was noted for the small diameter, area and index of the cell-form.

Thus, studies of hematological parameters of the tulka from the reservoirs of the Volga-Kama basin showed that differences in the ratio of red blood cells of different degrees of maturity, amitoses can be on the one hand due to the quality of the habitat, on the other - a low level of micronuclei indicates that the water were non genotoxic. The morphometric analysis of erythrocytes showed a correlation dependence on water temperature.

CONDUCT ROLE INVALIEN SPECIES IN THE ZOOPLANKTON COMMUNITY OF THE MIDDLE AND SOUTHERN CASPIAN

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Zooplankton of the Caspian Sea, being one of the links in the tropic food chain of the sea, is involved in the formation of commercial stocks of kilka, herring and other pelagic fish. Regular observations on summer zooplankton in the standart section of the Middle: Devechi-Gulf Kenderli and South: the Kura stone island-Island Ogurchinsky of Caspian Sea.

Along with this long-term observations made it possible. To track chances in the invertebrate fauna of the Caspian Sea.

Quantitate indicators of zooplankton are characterized with sharp seasonal and annual changes under the influence of environmental factors and antropogen impacts: from the fall of sea level, regulation of runoff of River Volga, pollution, invasion of new species, etc.

Since 1978, a period of rising sea levels, and it coincided with the invasion of new species of copepods in the Caspian Sea – *Acartia clausi*.

It replaced endemic species, widely settled in the waters of the Middle and South Caspian and has taken a leading position in the total biomass of zooplankton.

In the South Caspian, from 1986, *Acartia* was 65.7% among copepods, in the Middle Caspian, from 1989 – 58.5%.

Studies in 1999 were marked by sharp changes in the food supply of kilka, the total biomass of zooplankton in the Middle and South Caspian was decreased by 4.5 times, the reducing affected all groups of organizmes, except *A. clausi*.

In the summer of that year, at the eastern shelf of the South Caspian was discovered a new type of invader-comb jelly *Mnemiopsis leidyi* A. Agassiz. By august 2000 had spread across the Caspian Sea, and the maximum number of ctenophore was noted in the southern part of the sea.

Biostatistical materials pointed to the profound changes that have occurred in the population of anchovy kilka affecting the structure, growth and reproductive ability. Ctenophore development is accompanied often with acts not only on the biota of the sea, but also on abiotic processes. The mass development of *Mnemiopsis* has led to environmental changes in the bottom environment, too.

Recent studies have shown that the development of *Mnemiopsis* at the western coast of the Middle and South Caspian does not coincide with forecast data.

The high survival rate of *acartia* in the presence of predator *mnemiopsis* consuming zooplankton in large volumes, exterminated almost all endemic populations of copepods is associated with the peculiarities of developmental biology and behavior of this species.

THE ROLE OF INVASIVE ROTIFER *KELLICOTTIA BOSTONIENSIS* (ROUSLET, 1908) IN THE SPECIES STRUCTURE OF ZOOPLANKTON COMMUNITIES OF THE PUSTYN LAKE-RIVER SYSTEM (THE NIZHNI NOVGOROD REGION)

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At present, the problem of the introduction and successful adaptation of organisms beyond their historical area is very actual. It is well known, that alien invasions and destruction of natural habitats of species are one of the major threats to biodiversity. The main indicators of the intensity of bioinvasions are the share of the invader in the fauna (relative alien species richness) and its relative abundance in the community (relative abundance of species).

The genus *Kellicottia* Ahlstrom, 1938 (fam. Brachionidae) includes two species: *K. longispina* (Kellicott, 1879) and *K. bostoniensis*. *K. longispina* is a widespread cold stenotherm species. *K. bostoniensis* is a North American species, widely dispersed in diverse water bodies of South America and Europe. In the territory of the Nizhni Novgorod region the species was found in lakes of the south-west of the region, in the middle reaches of the Kerzhenets River, the Chara River and the Charskoe lake, also in water objects of the Nizhni Novgorod city, the Cheboksary reservoir and the mouth of the Oka river.

The aim of the research was to determine the quantitative development of *K. bostoniensis* and to assess the role of this invasive species in the zooplankton communities of the Pustyn lake-river system in 2014.

In July 2014, 120 zooplankton samples were collected in water bodies of the Pustyn lake-river system. Water bodies the Serezha River, lakes Velikoye, Svyato, Glubokoe, Paravoe, Dolgoe, the Protoka (the watercourse connecting lakes Velikoe and Svyato) were investigated. These water objects are located in the territory of the "Pustynsky" reserve of the Nizhni Novgorod region, and are formed as a result of karst processes. The total area of the system is 303.1 hectares. On the water area of the lake – river system 7 discrete areas with different species structure of the zooplankton was identified (the Serezha river, the Serezha – Velikoye transitional community, the Velikoye lake, the Protoka, the transitional community of the Protoka – Svyato, the Svyato lake and a vast community that includes the Serezha riverbeds (Glubokoe, Parovoe, Dolgoe), and the Serezha river at the lake system outlet) with the method of multidimensional vector analysis.

According to the results, the invasive species of *K. bostoniensis* was identified in all communities, with the exception of the transitional community the Serezha – Velikoe. The smallest quantitative development was found in the transitional community of the Protoka – Svyato – 1.4% (10.0 thous. ind./m³) of the total density of zooplankton and 1.8% (8.4 thou. ind./m³) in the Velikoe. The invasive species dominated and had the greatest density in the community the Svyato lake – 36.9% (45.8 thous. ind./m³) of the total density of zooplankton. Also, a high density of *K. bostoniensis* was found in the communities of riverine lakes (Glubokoe, Parovoe, Dolgoe) – 7.7% (51.9 thous. ind./m³) of the total density of zooplankton.

Along with the invasive species, the indigenous species *K. longispina* was identified in the communities. However, the species density was small, the share of the species from the total density of zooplankton did not exceed 0.6% (4.3 thous. ind./m³). The species was not identified in communities the Serezha river and the transitional community the Serezha – Velikoe.

Thus, the invasive species of *K. bostoniensis* was widely spread in all water bodies of the Pustyn lake-river system. It was the dominant in the community of the lake Svyato. Further monitoring studies are needed to control the quantitative development and to study of the ecological preferences of *K. bostoniensis*.

TREMATODES (BRACHYLAEMIDAE) FROM INVASIVE SLUGS *ARION LUSITANICUS* AUCT. NON MABILLE

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Digeneans evolved multiple strategies for each complex life cycle. Their life cycles consist of a few parthenogenetic generations and a hermaphroditic generation. All those generations develop in three environments where their hosts live: a) aquatic, b) semi-aquatic and c) terrestrial. Digenean species from aquatic and semi-aquatic environments and their life cycles are extensively studied in comparison to species whose life cycles are associated with a terrestrial environment.

The life cycle of terrestrial digeneans markedly differs from aquatic or semi-aquatic life cycles. The free-living stages of terrestrial life cycles (miracidia and cercariae) infect an intermediate host by trophic transmission because they have not a suitable anatomical adaptation to infect hosts via an active way. Moreover, several parasite species use snails and slugs as first and second intermediate host. For example, many parasite species that use this strategy belong to brachylaimids.

Some of Brachylaimidae family species are poorly described with incomplete life-cycles. For example, the cosmopolitan genus *Brachylaima* has at least 72 species and their metacercariae are unencysted in snails and slugs.

Slugs may easily transmit *Brachylaima* parasites from native distribution to the new territories because they harbor most of the parasites' life stages (from miracidia to metacercariae) and those parasites infect a wide range of birds and mammals species.

We studied the occurrence of digeneans in invasive slugs *Arion lusitanicus* auct. non Mabilie whose native range of distribution is considered southern Europe. In Latvia, it was introduced in 2009. We asked whether *A. lusitanicus* harbor *Brachylaima* species and whether they were introduced with *A. lusitanicus* slugs. To answer this question we examined inner organs of slugs and recorded all detected parasites. The recorded parasites were measured and drawings were prepared. According to morphological characteristics, we identified at least four *Brachylaima* species.

BAIKAL INVASIVE AMPHIPOD *GMELINOIDES FASCIATUS* (STEBBING 1899) ON LITTORAL ZONE OF ONEGO AND LADOGA LAKES

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Since the middle of the XX century the rapid spread of exotic species and their successful penetration in natural and artificial ecosystems has led to significant environmental changes all over the world (Strayer, 2010; Keller et al., 2011). As it was pointed out by many researchers biological invasion by alien species is one of the main threats to biodiversity (McNeely, 2001; Davis, 2003; Charles, Dukes, 2007; Walther et al., 2009; Berezina, Panov, 2003). *Gmelinoides fasciatus* (Stebbing, 1899) attracts special attention due to the fact that it is the most successful alien species among other invaders in aquatic ecosystems in Eurasia. In the 1960–70 it has been intentionally introduced from Siberia into lakes and reservoirs in the former USSR with the purpose of enhancing fish production. During the 1960–2000 this species colonized the coastal zone of some large and small lakes and artificial reservoirs of European Russia (Barkov, Kurashov, 2011; Panov, 1994; Panov et al., 2000; Panov, Berezina, 2002). This invasive amphipod of Baikalian origin was first recorded in Ladoga Lake in 1988 and in Lake Onego in 2001 by Berezina and Panov (2002).

In the Petrozavodsk Bay of Onego Lake the distribution of *G. fasciatus* was investigated on two sections at depths from 0.5 m to 4 m on sandy bottom. The maximum abundance and biomass were fixed at depths of 0.5 m. The average abundance on the sections varied from 250 to 7800 ind./m², the average biomass from 0.7 to 18.0 g/m². The maximum population indices were recorded at stations with depths up to 1 m with the highest temperature of water (18–19° C).

The role of *G. fasciatus* in feeding the younger groups of perch on the littoral of the Povenets Bay of Onega Lake was investigated (Lobanova et al., 2017). Amphipods dominated in the stomachs of fish according to the frequency of occurrence. They were found in all the samples studied. In addition, in 90% of stomachs, the larvae of the orders Ephemeroptera and Trichoptera were found. In one half of all the digestive tracts larvae of Chironomidae, detritus and macrophyte remains were recorded. In the biomass was dominated by larvae of the mayflies (33%), amphipods *G. fasciatus* (28%) and caddisflies (20%).

In Ladoga Lake the distribution of *G. fasciatus* was studied in 7 sections in the northern lake and in the Valaam archipelago at a depth of 0.5 to 25 m. The maximum abundance of the amphipod was observed at depths of up to 0.7 m and amounted to 6500 ind./m² and up to 15.0 g/m². Some aggregations and individuals inhabited of sandy bottom to a depth of 9 m. The multiple dredging samples at depths of 15–25 m did not reveal the presence of a species at these depths (Zuyev et al., 2016).

According to the funds of the FSBSI "GosNIORH" and from the research of other authors it is known that the amphipod is widely abundant in the zone of macrophyte propagation and up to depths of 5–9 m in the Shlisselburg and Volkhov Bay. Here they form an essential part of the perch and roach ration. In the stomachs of the most valuable commercial fish species (whitefish and lake char) of Ladoga Lake, *G. fasciatus* was not detected in any significant quantities.

Thus, at present the Baikalian invader *G. fasciatus* exerts a significant influence on the transport of matter and energy in the narrow coastal strip of Onego and Ladoga lakes. The influence of the amphipods on the formation of the food base of benthophagous fishes is significant only in shallow, well-buried areas where the biomass of the fine-mesh fish is formed. Influences on aboriginal relict species of crustaceans and valuable commercial fish which consume these species were not observed.



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