Monitoring of the initial succession of zooplankton communities in newly created ponds within the Territorial System of Ecological Stability

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Abstract: The ponds represent the interesting environment suitable for studying ecological relationships among particular compounds of freshwater habitats thanks to their easily defined borders and relatively simple food-webs structure. Zooplankton communities as representatives of freshwater organisms can provide an excellent model for assessing the success of restoration or colonization of newly created ponds in cultural environment. Within one year, initial colonization by zooplankton of two newly built ponds in TSES was monitored. Sampling was realized monthly from September 2013 to September 2014. Zooplankton identification and enumeration was carried out. Very first colonists of ponds were rotifers which occurred immediately after flooding in relatively high abundances, followed by cladocerans. During the first growing season rotifers were most abundant group of zooplankton at all. Copepods came as the last ones. In many samples predominated big species of cladocerans in both ponds. 11 taxa of rotifers, 6 taxa of cladocerans and 9 taxa of copepods were identified. The biggest impact on zooplankton communities in the first year of succession had the size of the pond, the presence of predators and the weather conditions.

Key Words: cladocerans, colonization, copepods, restoration, rotifers

Introduction

Freshwater biodiversity has declined in recent decades faster than the terrestrial or marine biodiversity. Increasing demands on freshwater resources, climate change and the impact of alien species will probably lead to continuing loss of biodiversity in the future [1]. Creation of new freshwater ecosystems or restoration of damaged ones are now common measures for conservation of aquatic biodiversity [2]. Ecological survey of ponds and of other small lentic ecosystems came in awareness in last 20 years and the attention is still rising. In spite the present trend of creating new ponds in cultural landscape, their ecological role, importance for evolutionary biology and biodiversity protection come rarely fully to realize [3]. In the past times these habitats became relatively rare due the human intervention into water regime of landscape [4]. In spite their small size and irregular water regime, ponds substantially increase biodiversity in the area and can provide suitable habitat even for very uncommon species [5]. Not only for that The Ramsar Convention on Wetlands was found to set the rules for preservation and wise using of all of the wetlands types all over the world (The Convention on Wetlands, Ramsar, Iran, 1971).

The colonization of newly created ponds is realized very quickly [2] and the structure of population is changing due the water regime and the level of succession [6]. Usually, zooplankton belongs to the first colonists of new niche [7]. Its role is mainly in supporting the self-cleaning ability of water and as one of the first levels in food webs they serve also as the food for predators [8]. The abundance and species composition of zooplankton depend on many factors of the environment which are the subjects of the studies and complex monitoring of stated biotope. Even more, based on the zooplankton species composition the whole condition of ecosystem and its potential development can be evaluated [9]. In this project, the initial colonization and subsequent succession of cladocerans, copepods and rotifers, as main representatives of freshwater zooplankton in newly built ponds was monitored.

Material and Methods

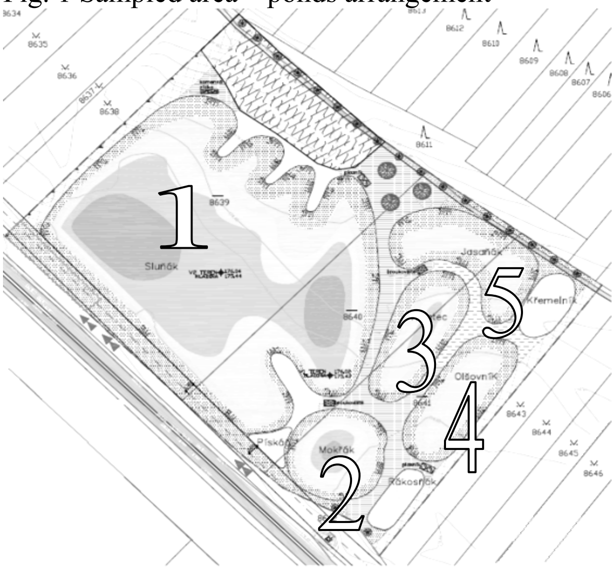
Characterization of studied site

In 2013 building plans of creating new ponds with tree planting were realized in the area near Šardice village. These lands were registered as meadows and pastures and also as the Territorial System of Ecological Stability (TSES), recently used as agriculturally used land.

The building of ponds extended the regional biocentre 12 "Díly za rybníkem" for non-forest parts in intervale of Šardický brook and connected a local and regional TSES localities bounded to local biocorridor "Šardický potok". The purpose of the construction was to increase the ecological stability of the land area and to create suitable conditions for array of species which vanished due the intensification of land use in this area.

Two newly built ponds are compared within this project. Pond no. 1 (P1) with the area of 4796 m^2 and maximum depth 2m, with indented shores and both slow and steep slopping. One side was planted by reed. Pond no. 4 (P4) with the area of 421 m^2 and maximum depth 1m, with regular shape and slow slopping of all shores. Both ponds were partially overgrown by submerse vegetation in growing season 2014. Both are flooded by groundwater and precipitations only.

Fig. 1 Sampled area – ponds arrangement



Sampling

Sampling was carried out monthly from September 2013 to September 2014, starting immediately after flooding. Always at the same time at 8 AM. Together with zooplankton samples also phytoplankton, zoobenthos and samples for water analysis were taken. Basic physicochemical parameters (temperature, dissolved oxygen, pH, conductivity, transparency) of water were measured on site. Also the actual weather conditions were noted.

Zooplankton samples for identification were taken by throwing planktonic net with mesh size 40 µm. All of the habitat types of pond were sampled to cover full spectrum of present species. Samples for enumeration were taken by planktonic tube and filtered through the 40 µm mesh. In total 15 L of water was filtered, taken from various parts of pond to get homogenous sample from the whole pond. All samples were fixed by 4% formaldehyde solution on site and transported into the hydrobiological laboratory of the department of zoology, fisheries, hydrobiology and apiculture where were subsequently processed

Results

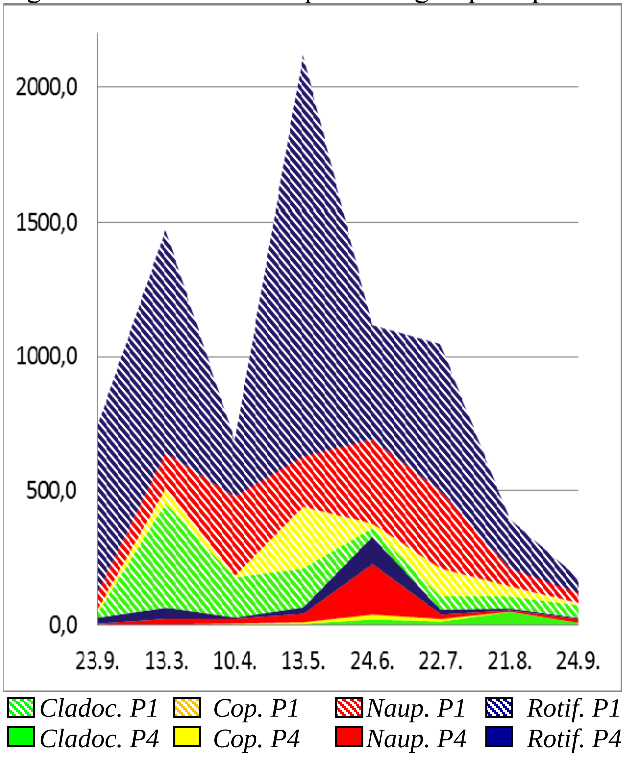
Zooplankton colonization

In September 2013, the pond P1 was immediately colonized after flooding, mainly by rotifers and a few cladocerans and copepods. Also some nauplium stages of copepods were present. In the first spring sample rotifers predominated again, but cladocerans showed considerable growth. From the very beginning, big individuals were present. Most of the copepods were in the nauplium stage. In April, rapid decrease of abundances of all three groups occurred. Big individuals of cladocerans were predominant anyway, most of the copepods were still in the naplium stage. In May, maximum increase of all three groups occurred. Big cladocerans and copepods species were present. Permanent eggs (ephipia) of Daphnia species started to occur and were present till the end of the monitoring. In June and July, rotifers were predominant, copepods were present in all stages (nauplium, copepodit, adult) but mostly as nauplii. Bigger species had higher abundances than smaller. Cladocerans were present in various sizes (0.5 – 4 mm) equally. At the end of the monitoring, number of rotifers and nauplii decreased, big individuals of cladocerans became predominant.

Pond P4 was in the September 2013 immediately colonized by rotifers. Cladocerans and copepods were present as well, but most of the copepods were in the nauplium stage. In March 2014, rotifers were significantly predominated again, but cladocerans showed considerable growth as well. From the very beginning, big individuals were present. Most of the copepods were in the nauplium stage again. From April to May, continual growth of all three groups was noted. Most of the copepods were in nauplium stage. Big cladocerans became predominant. In June, rapid increase of all groups occurred. Big individuals of cladocerans and copepods were predominant, but most of the copepods were in nauplium stage. Cladocerans were present in various sizes (0.5 – 4 mm) In July, the abundances of rotifers and nauplium stages of copepods rapidly decreased, big cladocerans were predominant. In September, abundances of all groups decreased, big cladocerans were predominant.

Comparison of abundances of zooplankton in both monitored ponds is depicted in Fig. 2.
Besides the three main zooplanktonic groups were also present representatives of Ostracods and *Chaoborus sp*. Due they rare occurrence and mainly benthic lifestyle, Ostracods were not included into evaluation. The presence of *Chaoborus* is discussed in chapter Discussion.

Fig. 2 Abundances of zooplankton groups in ponds.



Zooplankton species

Within the one year sampling 11 taxa of rotifers, 6 taxa of cladocerans and 9 taxa of copepods were identified in both ponds (Tab. 1). Due the fixation by formaldehyde, it was not possible to identify Bdelloidea into lower taxon.

Table 1 List of taxa found in new ponds P1 and P4.

Cladocerans	Copepods	Rotifers
Alona sp.	Calanoida copepodids	*Ascomorpha sp.*
Bosmina longirostris	Calanoida nauplii	*Asplanchna priodonta*
Chidorus sphaericus	Cyclopoida copepodids	*Asplanchna sieboldi*
Daphnia galeata x cucullata	Cyclopoida nauplii	Bdelloidea undet.
Daphnia magna	Cyclopoida undet.	*Brachionus caliciflorus*
Scapholeberis sp.	*Eudiaptomus gracilis*	*Brachionus budapestinensis*
	Macrocyclops albidus	*Hexarthra mira*
	Microcyclops bicolor	*Keratella cochlearis*
	Thermocyclops sp.	*Keratella quadrata*
		Lecane luna
		Polyarthra dolichoptera

Discussion

Ponds generaly represent the interesting environment suitable for studying ecological relationships among particular compounds of freshwater habitats thanks to their easily defined borders and relatively simple food-webs structure [10]. Zooplankton communities as representatives of freshwater organisms can provide an excellent model for assessing the success of restoration or colonization of newly created ponds in cultural environment [11]. Such habitats are quickly colonized by organisms with high dispersion ability, as adult individuals or as other resistant stage. Thanks to their adaptation, dormant stages of water invertebrates are very suitable for dispersion [12].
Similar colonization trend of newly built ponds, first fast increase of rotifers immediately after flooding, is presented by a few authors [7, 8]. Similar colonization trend of newly built ponds, first fast increase of rotifers immediately after flooding, is presented by a few authors. On the contrary, initial colonization mainly by cladocerans was presented by Vondrák [13] and Louette and De Meester [14,¨15]. I suspect that in our case were rotifers first because of initial flooding the ponds in very early autumn so the cladocerans community couldn´t

growth enough. Presence of big individauls, namely *Daphnia magna* and *Eudiaptomus gracilis* or *Macrocyclops albidus* during the whole period can be explained by no presence of predators such a fish in the whole pond system [16]. There was the catch by electric aggregate carried out in the locality with no proving of presence of any fish species. The question is how long will last such a condition? On the contrary, the presence of predator glassworm Chaoborus sp. which was present regularly is contradictory. E.g. Mackay et al. [17] describe the strong influence of predatory pressure of glassworm on zooplankton, but it´s abundance in our ponds did not apparently correlate with fluctuation of other groups. Anyway, it would be worthy to test this influence in further studies. Important factor influencing the hierarchy of colonization is, based on our data, the size of the pond. Pond P1 is approximately ten times bigger than pond P4, which provided most likely more space for all of the main zooplankton groups and provided more variable habitats and shelters, so the growth of community was more rapid than in much smaller pond. This finding supports also Frisch et al. [18]. Despite the other factors, the biggest fluctuation in relatively fluent course of colonization is caused by weather conditions. As Jenkins and Underwood [19] present, duet he small body size and relativelly low body density, zooplankton is vulnerable to windy or rainy weather as can be seen in the sample from April. This influence is even stronger if the area of pond is larger.

Conclusion

Within one year, an initial colonization by zooplankton of two newly built ponds in TSES was monitored. Sampling was realized monthly from September 2013 to September 2014. Zooplankton identification and enumeration was carried out. Very first colonists of ponds were rotifers which occurred immediately after flooding in relatively high abundances, followed by cladocerans. During the first growing season rotifers were most abundant group of zooplankton at all. Copepods came as the last ones. In many samples predominated big species of cladocerans in both ponds. 11 taxa of rotifers, 6 taxa of cladocerans and 9 taxa of copepods were identified. The biggest impact on zooplankton communities in the first year of succession had the size of the pond, the presence of predators and the weather conditions.

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