

Variability and plasticity of growth rate of the invasive Zebra mussel in anthropogenic water-bodies

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Introduction

The uncontrolled spread of the plant and animal invasive species is one of the major environmental problem in the present days. Zebra mussel (*Dreissena polymorpha*) is important invasive clam. It is very effective ecosystem engineer, which has an impact on all parts of the water ecosystem. In the Czech Republic, typically new invaded localities are flooded sand-gravel pits and quarries. These anthropogenic habitats offer a wide range of environmental conditions, which reflect a large plasticity of Zebra mussel life strategy.

Methods

Six different water-bodies (three sand-gravel pits and three quarries) in the Czech Republic were selected for the study. Observed sand-gravel pits were Poděbrady (sand-gravel mining finished before 50 years, use for recreation; Fig. 1), Troubky (current sand gravel mining, a source of drinking water; Fig. 2) and Kvasice (sand-gravel mining finished before 25 years, a source of drinking water; Fig 3). Observed quarries were Nová Ves, Leštinka and Výkleky (all sites are used for recreation; Fig 4, 5 and 6).

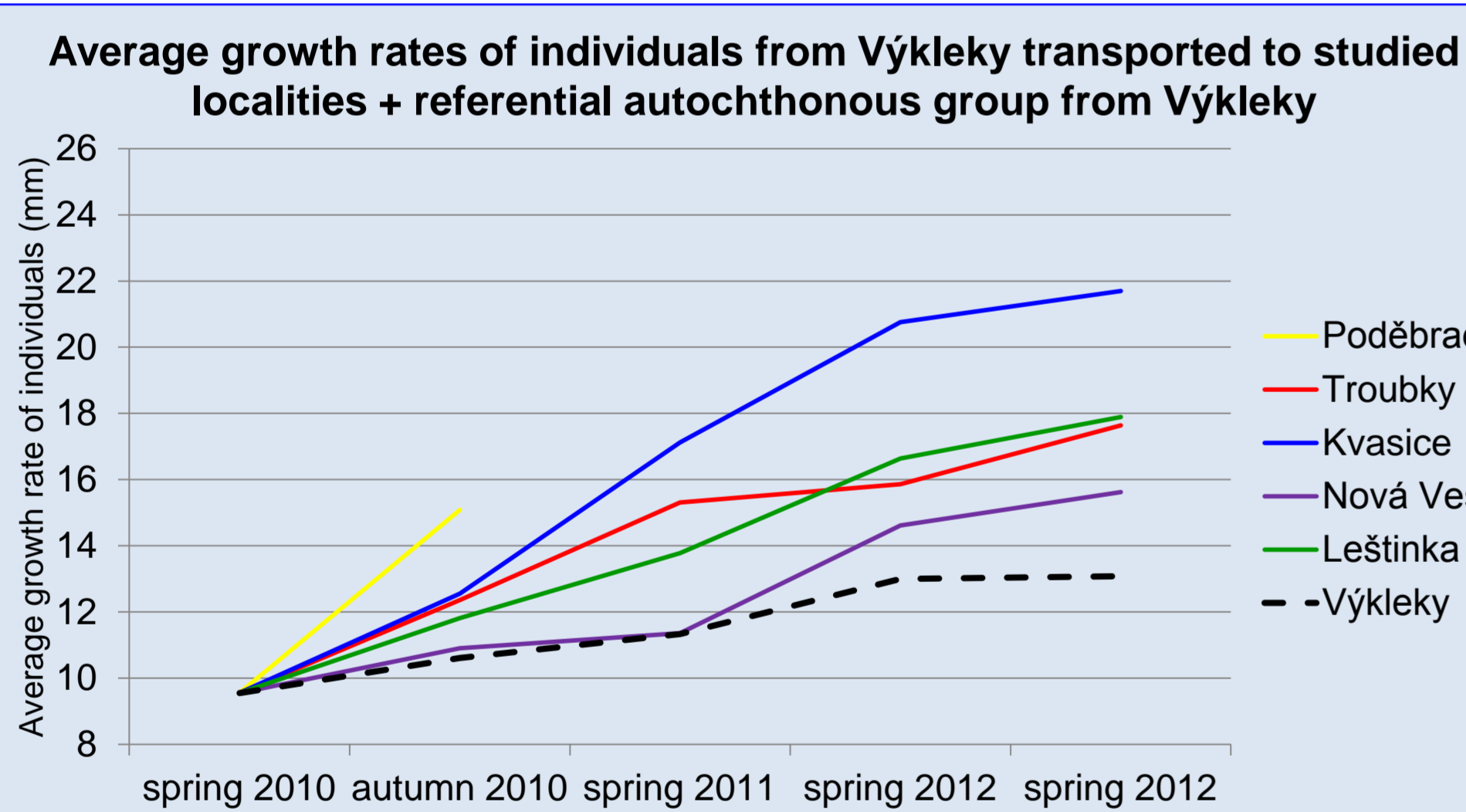
Our experiment was based on exchange of individuals between the chosen localities. The individuals from the quarry Výkleky were transported to other five sites. Simultaneously, the individuals from these five sites were transported to quarry Výkleky (experimental cages). We also measured the growth rate of individuals autochthonous for each locality (control cages). The average initial shell length were 9,55 – 9,75 mm in each cage (with exception of Nová Ves - 13,5 mm). The growth of shells was monitored by digital calipers several time per year within three years study.

Results

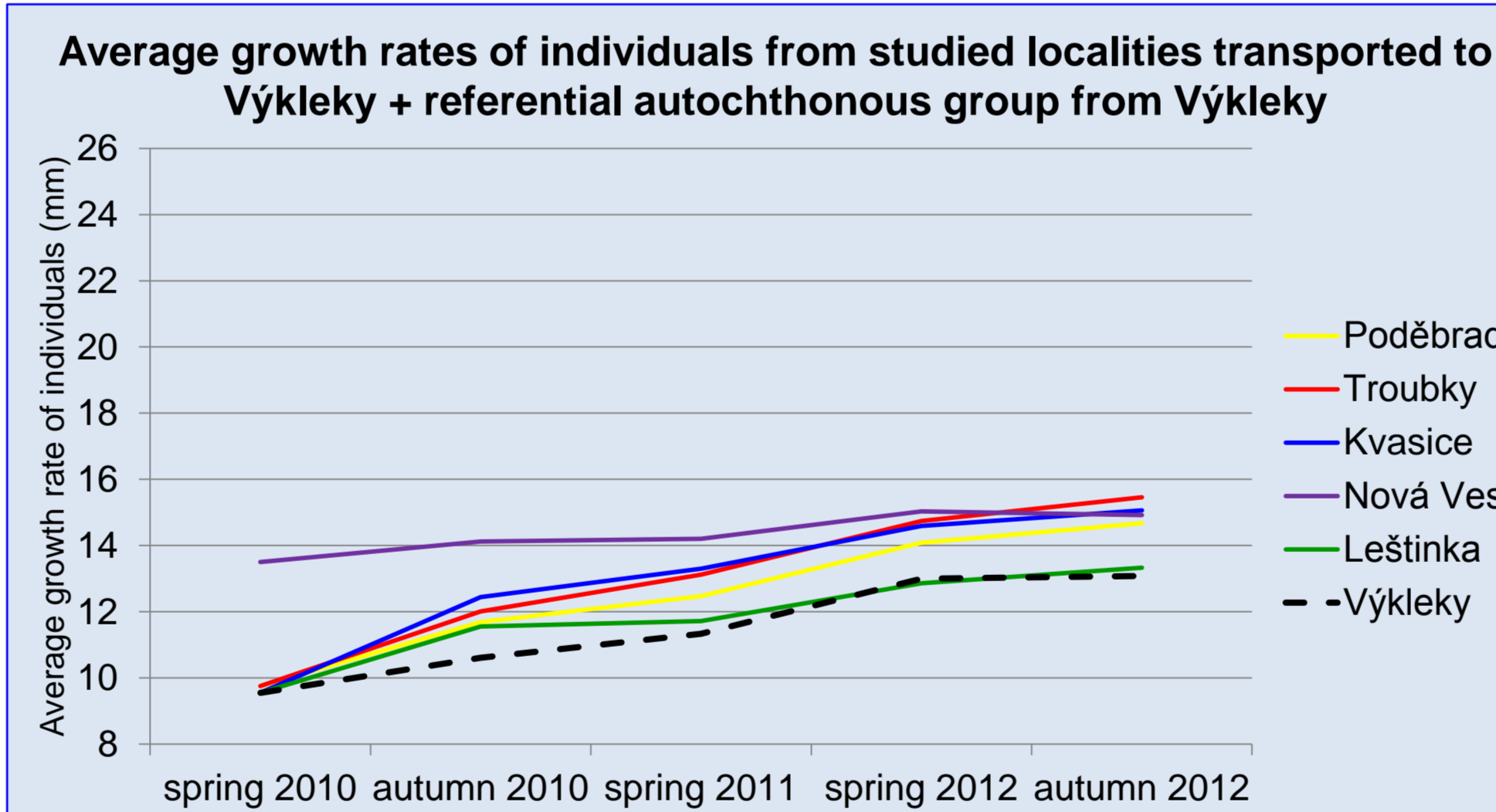
The growth rate and final size of individuals were different in observed water-bodies. Individuals from quarry Výkleky (final shell length of original individuals from Výkleky was 13,08 mm) grew faster at the other localities (Troubky 17,64 mm; Kvasice 21,70 mm; Leštinka 17,89 mm). At the Poděbrady, individuals reached average final size 15,08 mm after first year of experiment (cages were lost at the end of the first season). At the Nová Ves, individuals reached average final size 15,62 mm after three years of experiment (Graph 1).

The average final size of individuals from five localities transported to quarry Výkleky was comparable (from Poděbrady 14,67mm; Troubky 15,46 mm; Kvasice 15,06 mm; Nová Ves 14,92 mm; Leštinka 13,33 m) to the average final size of original individuals at the quarry Výkleky (13,08 mm) (Graph 2).

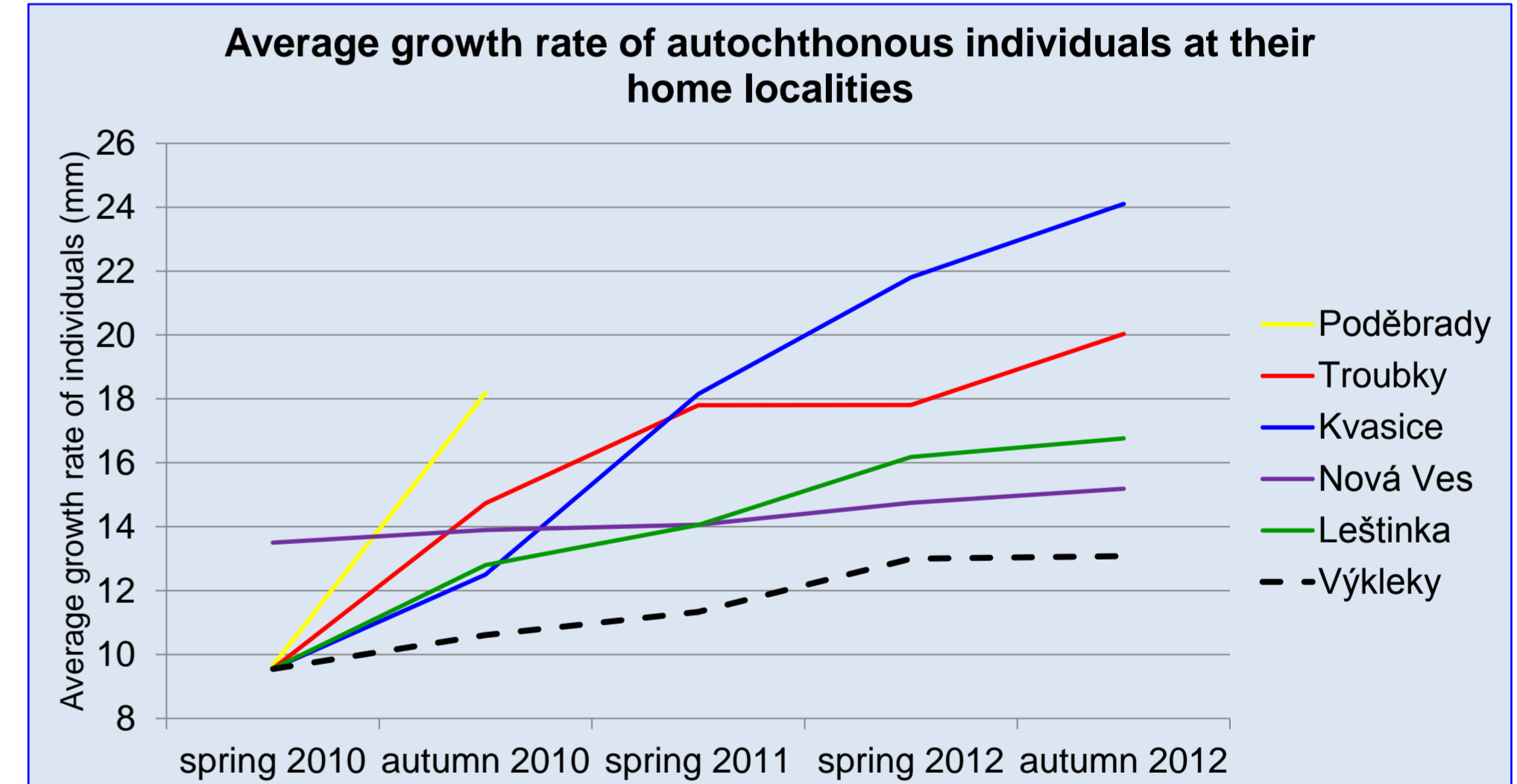
The average final size of autochthonous individuals at the their localities was higher at the flooded sand-gravel pits than flooded quarries (Graph 3).



Graph 1



Graph 2



Graph 3

Discussion

Variability of growth rate, the highest shell length and maximum old age are very important for mussels. These characters depends on the physical-chemical factors and food availability of each locality (Karatayev et al. 2006). We recorded extraordinarily small average increment of individuals at the flooded quarry Výkleky (2,0 – 2,7 mm per three years experiment) (Tošenovský et al. 2008, Uvírová et al. 2007).

The aim of this study was to observe plasticity of growth rate of Zebra mussel individuals in different water bodies. We wonder if slowly growing individuals from quarry Výkleky have ability to adapt to changeable environmental conditions. We recorded substantial increase of growth rate of the individuals from the quarry Výkleky, which were transported to other localities. On the other hand, the individuals from these water-bodies, which were transported to the quarry Výkleky, decreased their growth rate. Studied sand-gravel pits were in all cases more suitable habitats than flooded quarries according to growth rate of mussels.



Conclusion

Zebra mussel individuals have considerable ability to adapt to changeable environmental conditions. This plasticity of life strategies is typical for invasive organisms and it is reason of their success in the process of colonization new habitats. The variability of Zebra mussel growth rate depends on environmental conditions of the water-bodies. Subsequent evaluation of parallel measurements of abiotic parameters (temperature; pH; conductivity; nutrient content – NH_4^+ , NO_3^- , PO_4^{3-} ; food supplies parameters – TOC and Chla; metals content – Na^+ , K^+ , Ca^{2+} , Mg^{2+}) enables to evaluate their influence on the growth rate of the invasive clam Zebra mussel.