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Reproductive parameters of topmouth gudgeon (*Pseudorasbora parva*) from a heated Lake Licheńskie (Poland)

Research Article

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Abstract: Temperature regime is known to have considerable influence on the life-histories of fish. Topmouth gudgeon is a very successful invader with high biological flexibility and phenotypic plasticity. The flexibility of topmouth gudgeon in a normal thermal regime has been well described, however there has been no information published about how it would cope with extreme conditions, *e.g.* permanently heated water. Several studies have demonstrated that phenotypic plasticity provides an important advantage to invasive species. To explain their invasion success, the theory of alternative ontogenies and invasive potential has been proposed. The aim of the present study was to examine if the reproductive parameters of a population living in permanently heated water differ from those living in habitats with a normal temperature regime, as well as to test a hypothesis derived from the theory of alternative ontogenies and invasive potential. Over a period of 8 years (2004-2011), a high variation in the reproductive parameters of topmouth gudgeon from Lake Licheńskie was found. With a small exception, all the observed results met the expectations predicted by the hypothesis tested. This indicates that topmouth gudgeon retains high phenotypic plasticity in life-history traits even in a habitat with extreme conditions, which is important for the species' invasion success.

Keywords: *Invasive population • Temperature regime • Life-history traits • Biological flexibility • Phenotypic plasticity*

1. Introduction

One of typical attributes of fishes is a high degree of variability in their life-histories, expressed among populations of the same species. Much of this variability reflects both abiotic and biotic factors, for example thermal regime, fluctuation in environmental variables, productivity and food availability [1]. Several studies have demonstrated that life-history traits, especially reproductive parameters, are highly plastic in many fish species, and that these traits respond to a variety of environmental parameters, including changes in water temperature [2].

According to the theory of alternative ontogenies and invasive potential [3], the changes in life-history traits are supposed to be associated with the species' capability to alternate their ontogenetic trajectories, in subsequent generations, within a continuum from generalized to specialized, responding thus to actual environmental conditions. The wider is this continuum, the higher is the invasive potential of the species [3]. Generalized phenotypes result from unpredictable or unfavourable conditions (*e.g.* an environment that is unknown for an invader during the early stages of its invasion), whereas specialized phenotypes start to emerge once the conditions appear stable and/or favourable for the species. Generalized phenotypes reflect a population strategy aimed at survival rather than individual fitness, and thus individuals tend to mature at earlier age and smaller size, as well as to produce a higher number of oocytes. Given that resources are limited, the higher number of oocytes results in their smaller size. In contrast, specialized phenotypes reflect a population strategy aimed at individual fitness, because the

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