

Consequences of fish introduction and extirpation on populations of metamorphic and paedomorphic newts

MATHIEU DENOËL^{1,2,4}, LAURANE WINANDY^{1,3}

¹ *Behavioural Biology Unit, University of Liège, 22 Quai van Beneden, 4020 Liège, Belgium*

² *F.R.S.-FNRS Senior Research Associate*

³ *F.R.S.-FNRS Research Fellow*

⁴ corresponding author: Mathieu.Denoel@ulg.ac.be

Facultative paedomorphosis in newts and salamanders is a polyphenism that results in the coexistence of two morphs: the paedomorphs that retain gills at the adult stage and the metamorphs that undergo metamorphosis. Paedomorphs are more endangered than metamorphs because they are present in much less populations. As fish introduction is one of the main causes of amphibian decline worldwide, we aimed at determining its consequences on both phenotypes. To this end, we determined occurrence and abundance patterns across aquatic habitats that differ by their current or past presence of introduced fish. The study took place between 2002 and 2015 in Larzac, in southern France, a hotspot for these developmental processes in the palmate newt *Lissotriton helveticus*. Long-term comparisons were done with historical data collected in the seventies. The results show a low resistance of both phenotypes to fish introductions. Although newts can persist in the presence of fish, they do not reach high population sizes such as in fishless ponds. Moreover, the occurrence of paedomorphs in fish ponds was also much rare. Because of conservation management or natural factors, fish disappeared in many ponds and allowed a high resilience of newts. Their abundance was high and close to control ponds in which fish were never introduced. Paedomorphosis was highly expressed as paedomorphs were found in most of the ponds in which fish were extirpated. From one hand, these results show the detrimental effect of fish introductions on both the common metamorphic phenotype and the endangered paedomorphic phenotype. On another hand, they show that there is hope for their conservation as alternative developmental pathways can reappear even when only the common phenotype persisted in the wild.

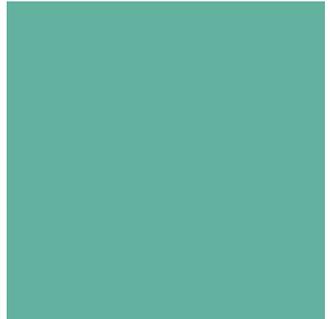
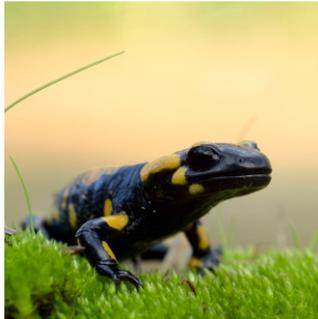
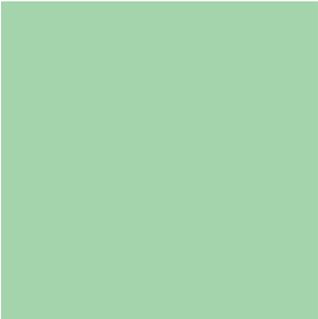
Key words: amphibian decline, conservation, fish introduction, invasive species, paedomorphosis, resilience



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