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Colour polymorphism in common wall lizards, *Podarcis muralis*: causes and consequences

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Riassunto. *Colour polymorphism in common wall lizards,* Podarcis muralis*: causes and consequences.* Il polimorfismo cromatico è definito come la coesistenza all'interno della stessa popolazione di due o più morfi di colore distinti e geneticamente determinati. La lucertola muraiola (*Podarcis muralis*) presenta un complesso polimorfismo nella colorazione ventrale, con tre morfi monocromatici (bianco, rosso, giallo) e tre morfi con colorazione intermedia (bianco-rosso, giallo-rosso, bianco-giallo). Dal 2004 è in corso uno studio a lungo termine sui meccanismi ecologici, fisiologici, genetici e comportamentali che mantengono il polimorfismo in questa specie. I risultati finora raggiunti permettono di ipotizzare che i morfi di colore della lucertola muraiola siano associati a differenti strategie comportamentali che coesistono all'interno della stessa specie.

Keywords. colour polymorphism; alternative strategies; *Podarcis muralis*.

Colour polymorphism has been defined as the presence of two or more distinct, genetically determined colour morphs within a single interbreeding population, the rarest of which is too frequent to be solely the result of recurrent mutation (Ford, 1945; Huxley, 1955). These morphs are often associated with alternative behavioural strategies (reproductive, territorial, habitat's use strategies) maintained by different evolutionary mechanisms (Gray & McKinnon, 2007; McKinnon & Pierotti, 2010). The Common wall lizard (*Podarcis muralis*) is a widespread European lacertid lizard that exhibits a marked colour polymorphism throughout its range, adults of both sexes showing six morphs that

differ in throat and belly colourations: three monochrome phenotypes (i.e., white, yellow and red) and three intermediate phenotypes (white-red, yellow-red and white-yellow).

Since 2004 we have been studying the ecological, morpho-physiological, behavioural and genetic causes controlling the evolution and maintenance of colour polymorphism in this species. Our researches highlighted the existence of particular patterns of variability in colour morph frequencies at micro-geographic and temporal scale (Sacchi et al., 2007a; Pellitteri-Rosa et al., 2010), showing that environment and sexual dimorphism represent a relevant component in colour expression by morphs. Observed variation among sites represents the phenotypic variation due to resource availability, and different colour expression between sexes represents the phenotypic response due to hormones and genes. Noteworthy, genetic analyses supported the existence of genetic divergence among colour morphs (Bellati, 2011). Further results have been obtained from immuno-physiological experiments (Sacchi et al., 2007b; Galeotti et al., 2010; Sacchi et al., 2011), which clearly support the hypothesis that Common wall lizard morphs differ in their physiological responses to infections and a long-term stress by leukocyte profiles. Behavioural experiments have shown that aggression is not apparently morph-specific and all males defend their territory using the same patterns of response (Sacchi et al., 2009). Despite the aggression pattern does not differ between male morphs, the space resource use probably does, as evidenced by territory settlement and, particularly, by homing response (Scali et al., 2011). Using ultrasonographic scan of gravid females (Sacchi et al., 2012), we showed that female morphs adopt different reproductive strategies, yellow ones being r-strategists, laying large clutches of small eggs, while white-ones being K-strategists, laying fewer large eggs. All above results suggests that morphs in this species may represent alternative, locally adapted, optima within a single species (Sinervo & Svensson, 2002), which may be at the root of sympatric speciation processes through morph loss and phenotype fixation of a single allele or set of alleles in a newly colonized environment ("morphic speciation", see West-Eberhard, 1986, 1989; Corl et al., 2010).

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