

# INTER-SPECIFIC AND INTER-POPULATION VARIATION IN INDIVIDUAL DIET SPECIALIZATION: DO ENVIRONMENTAL FACTORS HAVE A ROLE?

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## Study Description

Individual diet specialization occurs when individuals consume only a subset of prey composing the whole population trophic niche. In our study, we assessed trophic specialization in five species of European cave salamanders (genus *Hydromantes*) from Sardinia (Italy), hypothesizing two potential (but not exclusive) causes. Our results showed that all the *Hydromantes* populations analyzed included “true specialists,” and the scenario in which the availability and diversity of prey, rather than negative biological interactions, is more likely represents the major cause of individual specialization. We then successfully used environmental features (both climatic and vegetation) to predict the specialization in these salamanders.



Photo 1. Two adult *Hydromantes* from Sardinia. (A) The Monte Albo cave salamander, *H. flavus*, is endemic to the namesake mountain in the northeast of Sardinia. (B) The Sette fratelli cave salamander, *H. sarrabusensis*, is one of the European amphibian species with the smallest distribution: It is found only in a small area in the southeast of Sardinia. The high intraspecific variability in the proportion of specialized individuals observed among Sardinian *Hydromantes* is likely promoted by the characteristics of the cave surroundings, their main foraging area. Specifically, we observed that the local vegetation cover and habitat heterogeneity successfully predicted the degree of individual specialization within the populations. These environmental features likely represent a proxy for the availability and diversity of prey. In our study, one population of *H. flavus* showed the lowest proportion of specialized individuals, while the highest level of specialization was observed in *H. genei*. Photo credits: A) E. Lunghi; B) G. F. Ficetola.



Photo 2. E. Lunghi performing stomach flushing. This is a non-invasive method allowing to study the trophic niche of amphibians. The small plastic pipe was inserted in the salamander mouth to flush in water; the funnel below was directing the reflux into a tube. Stomach contents were preserved in 75% ethanol. The equipment was constantly disinfected (especially after sampling a population) to avoid the spread of potential pathogens. Photo credit: B. Barzaghi.





Photo 3. A student (L. Cornago) during the recognition of stomach contents. A digital microscope connected to a laptop was used for a first screening of samples; an optic microscope was then used to recognize prey items at least to the order level and, in some cases, between different life stages. The achievement of a lower taxonomic order with high confidence was not always possible; we chose to stop at the order level. We based our analyses on stomach contents only, as all *Hydromantes* species are strictly protected by both National and International laws, and thus, more invasive methods (e.g., the removal of tissue) are not allowed. Photo credit: E. Lunghi.



Photo 4. A few examples of the recognized prey items: (A) Pseudoscorpiones; (B) Araneae; (C) Julida; (D) Hymenoptera–Formicidae. Within *Hydromantes* stomach contents, we recognized 35 different orders of invertebrates and, in a few cases, we found that these salamanders ate their own eggs (likely those unfertilized) and even small juveniles (likely a dead salamander). However, the variability of prey consumed by these salamanders is likely higher. Although the trophic niche of *Hydromantes* is wider in autumn compared to spring, no seasonal effect on individual diet specialization was observed here. Furthermore, salamanders specialization was not affected by any of the other considered life traits (e.g., sex or ontogenetic stage). Populations showing a wider trophic niche were also characterized by a higher proportion of specialized individuals, meaning that the niche breadth of these populations was more likely due to an inter-individual variability of the consumed prey. Photo credits: E. Lunghi.

These photographs illustrate the article “Inter-specific and inter-population variation in individual diet specialization: do environmental factors have a role?” by Enrico Lunghi, Raoul Manenti, Fabio Cianferoni, Filippo Ceccolini, Michael Veith, Claudia Corti, Gentile Francesco Ficetola, Giorgio Mancinelli published in *Ecology*. <https://doi.org/10.1002/ecy.3088>