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Editorial

The Ecological Role of Salamanders as Prey and Predators

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Salamanders comprise more than 700 living species, mainly found in the Northern hemisphere (i.e., North and Central America and the northern part of Eurasia), and the Amazon region of South America. Salamanders constitute a diverse clade of amphibians with different reproduction modes that range from completely aquatic to fully terrestrial [1]. Salamanders are key components of many temperate forest ecosystems, in particular in North America [2] and in high altitude lakes, where fish are naturally absent [3]. In these temperate ecosystems, salamanders and newts are top predators that regulate top down the invertebrate prey community [4], while at the same time being high-energetic prey items for birds, mammals and reptiles [5].

In any case, despite their ecological importance, the role of salamanders in resource–consumer networks remains remarkably understudied. Therefore, this Special Issue aims to better understand the different ecological roles of these small vertebrates, both in aquatic and terrestrial ecosystems. Indeed, the eight papers published addressed many of the issues related to the trophic strategies and the trophic position of salamanders in the ecological food web. In particular, one review paper [6] makes a significant contribution to our understanding of salamander and newt populations functioning as predators, competitors and prey in freshwater ecosystems. Furthermore, it appears relevant that four papers were all conducted in underground habitats, both of natural or artificial origin [7–10]. This relatively high number of papers dedicated to the ecological structure and functioning of underground ecosystems clearly indicates a recent growing interest of ecologists and conservation biologists over this highly understudied environment [11,12]. Indeed, in underground habitats, salamanders are, together with cave fish, the only vertebrates that were able to permanently establish reproductive populations. This fact highlights the adaptability of salamanders to extreme subterranean habitats, that were probably colonized to reduce the environmental stress and the predation level experienced in adjacent epigean habitats [13]. Two other papers of this Special Issue analyze the diet of terrestrial salamanders, the first in Spain [14] and the second in Italy [15]. In the former paper, a novel COI metabarcoding approach was used to analyze the dietary habits of the fire salamander *Salamandra salamandra* [14], while in the latter, the authors applied for the first time in salamanders the technique of network analysis to study the trophic strategy of the Alpine salamander *Salamandra atra* [15]. Finally, one paper tested the niche variation hypothesis [16] in a newt community sampled in a complex system of artificial aquatic sites [17]. These authors found that individual specialization was widespread in all populations and also provided novel insights on the level of dissimilarity of individual trophic variation in closely related and ecologically similar newt species [17].

Despite the diverse topics that were discussed by all these papers, other interesting issues involving the role of salamanders in the trophic web and their complex behaviors remain to be elucidated and deserve further attention. For example, aposematic displays and deimatic behaviors of salamanders (i.e., startling visual or auditive signals that distract a predator, giving the attacked prey an opportunity to escape) have received little attention by behavioral ecologists [18]. However, separating aposematism from deimatism in brightly colored salamanders or newts may be challenging [19]. This because the same visual signal

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may be perceived in a completely different way by animals possessing different visual systems, and indeed, salamanders may be attacked by many different predators that will perceive differently the colors displayed by their potential prey [5].

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