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Literature Review on Life History Traits of European Amphibian and Reptile Species

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Introduction

According to the IUCN, amphibians and reptiles are the most endangered vertebrate groups, with habitat loss and pollution commonly listed as the main reasons. In agricultural landscapes, amphibians and reptiles might be exposed to pesticides, which have been suggested as possible cause for population declines in these areas. The Regulation 1107/2009 requires the risk of pesticides to be addressed for all terrestrial vertebrates. However, no standard risk assessment is conducted for amphibians and reptiles, and concern was raised on the coverage provided by other vertebrate groups. A Scientific Opinion is being developed by EFSA´s PPR panel providing the scientific basis for pesticide risk assessment for amphibian and reptiles. Because a better understanding of life history traits of European amphibian and reptiles is crucial to identify exposure risks and potential susceptibility to pesticides, an extensive literature review was conducted to extract data on the preferred size of breeding waters and migratory behaviour of amphibians in correlation with environmental factors, as well as on in-field movement patterns of amphibians and reptiles.

Methods

The literature review aimed at answering three different research questions on life history traits of amphibians and reptiles:

1. What type and size of water body do different amphibian species prefer for breeding?
2. When do amphibians migrate? Does migration time correlate with humidity, temperature or moon phase?
3. How much time do amphibian and reptile species spend in treated fields (arable land, vineyards and orchards) or areas adjacent to fields (field margins and immediate surroundings of the field)?

To answer these questions, peer-reviewed literature was gathered from the cross-disciplinary literature database Web of Science (Thomson Reuter). Search strings included names of 48 European amphibian and 59 reptile species (for coverage of species families included to the search strings, see fig. 1). Species lists were compiled based on expert judgements on the presence of species in agricultural landscapes within the different zones of the EU according to Annex I, EC 1107/2009 [23]. Species strings were combined with keywords to refine the search output. In two consecutive steps (2&3 in fig. 2), the relevance of search results was assessed in order to define those references from which appropriate data was retrieved (fig. 2).

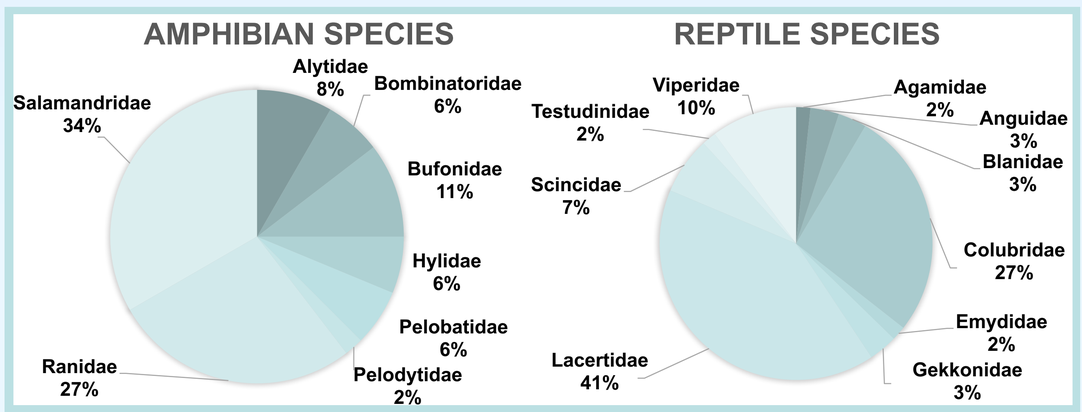

Fig. 1. Proportion of families of amphibian and reptile species included to search strings to answer the research questions. 97% of reptile species were squamates, 3% testudines. For amphibian species, 67% belonged to the order of anurans, and 33% to the order of caudates.

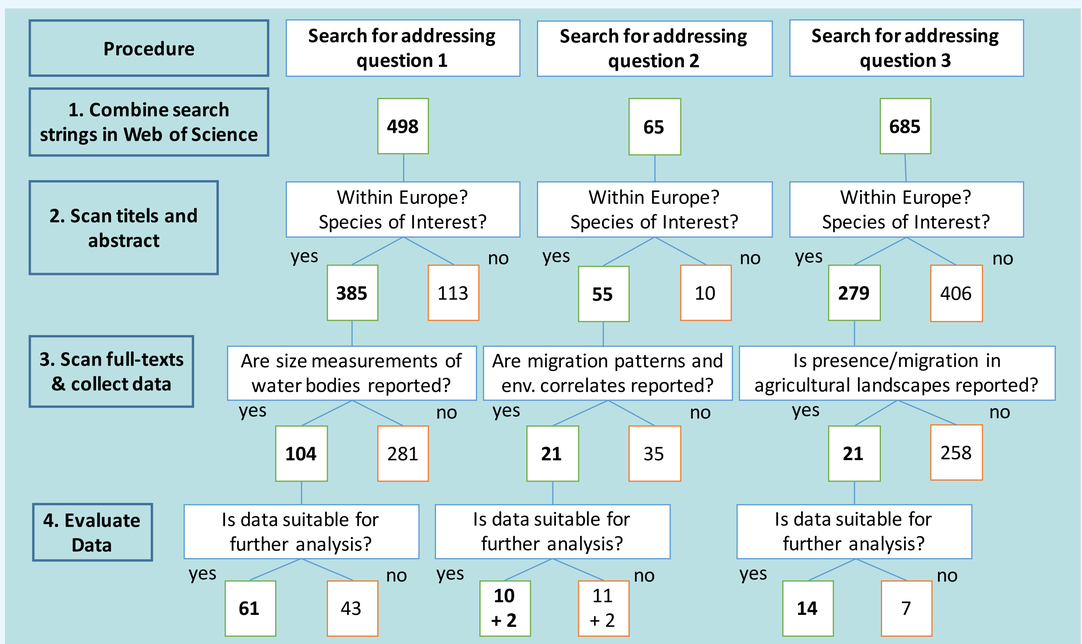

Fig. 2. Schematic flowchart of conducted literature searches. For each step, the number of hits is reported as well as the eligibility criteria. The numbers of (ir)relevant publications after application of exclusion criteria are given below each criteria. If questions to assess relevance were answered with "no", publications were excluded. The remaining publications were used for the next steps of relevance assessment and in the end for evaluation of appropriate data. (If additional publications were included, this was displayed with a +)

Results & Discussion

The results from the first literature search on size measurements of aquatic amphibian breeding habitats are displayed in figure 3. Surface area and depth data could be evaluated for 17 and 14 species, respectively. Median surface areas ranged from 4.5 m^2 to 3500 m^2 for *Discoglossus galganoi* (n=3) and *Hyla meridionalis* (n=2), respectively [10,24]. The smallest median depth was reported for *Discoglossus pictus* (n=10) with 0.18 m [24,26]. Maximum median depth values were reported for *Bufo bufo* (n=6) and *Pelobates fuscus* (n=23) with 1.20 m, respectively [8,22,24,25, 28]. The compiled data can aid to add certainty to the characterization of breeding habitats. The data gives a rough estimate of the ranges of breeding pond sizes within which species occurred, but does not rule out that habitats of different sizes might also be suitable for the respective species.

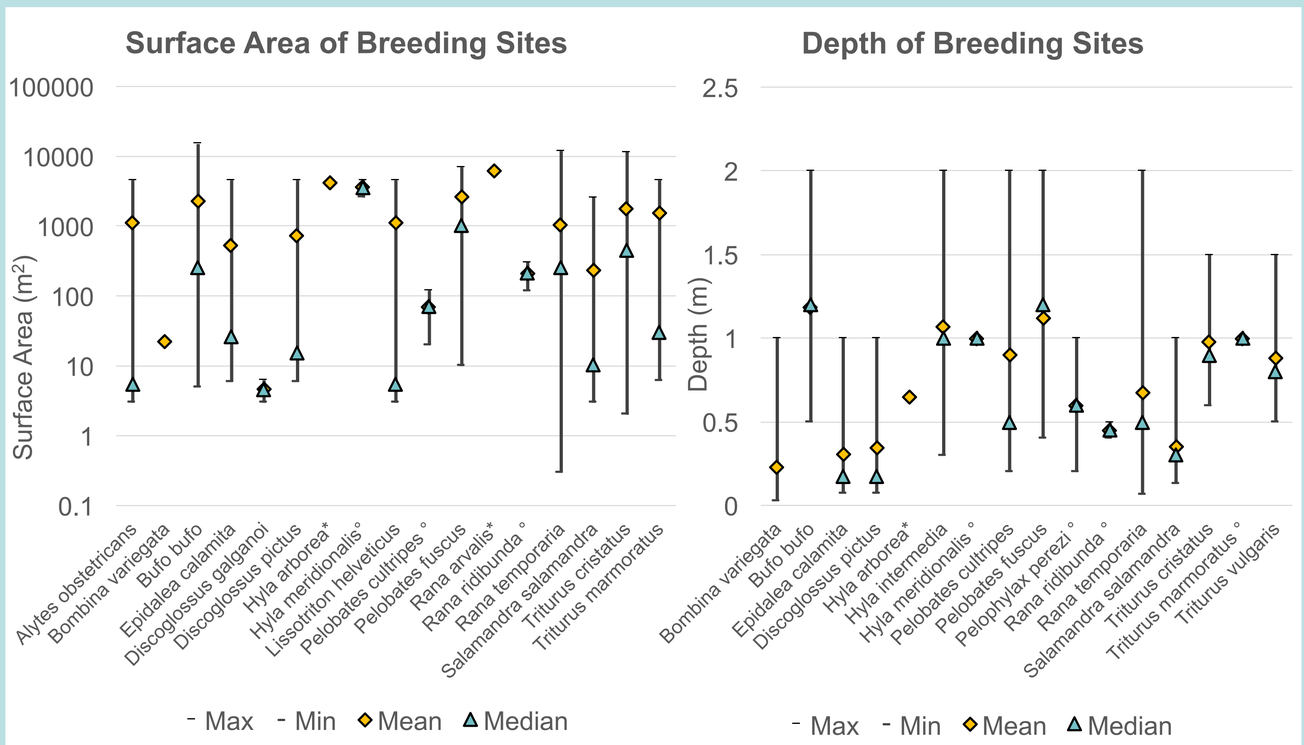

Fig. 3. Ranges of surface area and depth measurements of breeding sites reported in literature for different amphibian species. Medians (yellow diamond) and means (blue triangle) were calculated from literature values for n ≧2. Species for which only 2 data points were available are marked with a ° ; species for which only a single mean value was reported are marked with a *.

The second search resulted in a list of environmental factors which correlate with migration patterns of 13 amphibian species. Migration was shown to depend on weather and light conditions: temperatures about 5° C, nocturnal conditions, as well as increased precipitation generally favoured migration (e.g., of *Bufo bufo, Epidalea calamita, Hyla arborea, Lissotriton vulgaris, Triturus sp.*) [4,6,7,9,11,12,18,19,21,27]. During non-favourable periods, animals would bury in soil or hide in pre-existing mammal burrows, as observed for instance in *Epidalea calamita* and *Bufotes viridis* [27].

From the third literature review, data on the presence and migration of 17 amphibian and reptile species in and around agricultural areas was gathered. Some amphibian species were shown to move across fields during pre- and post-breeding migrations *(e.g., Bufo bufo, Epidalea calamita, Lissotriton helveticus, Lissotriton vulgaris)* [14,16,20,21]. Further, the habitat of some species was located in agricultural areas: *Natrix natrix* was monitored on arable land in Sweden [17], *Epidalea calamita* post-breeding in barely fields in Spain [20,21], *Coronella austriaca* and *Lacerta agilis* in managed pine plantations in the UK [13], and *Pelophylax perezi* in rice fields in Spain [3]. Finally, time of migration through fields was shown in some cases to coincide with applications of fertilizers and pesticides [1,2,15].

The review confirms the presence of today's most threatened vertebrate species groups in agricultural areas [5,29]. The outcome of this review elucidates occurrence patterns of amphibians. Knowledge on the characterization of suitable breeding habitats and on environmental correlates that increase activity patterns of the poikilothermic organisms is crucial to address central questions such as exposure estimates for the development of the Scientific Opinion on the EU risk assessment for amphibians and reptiles.

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