A database of life-history traits of European amphibians

Audrey Trochet†‡, Sylvain Moulherat§, Olivier Calvez‡, Virginie M Stevens‡, Jean Clobert‡, Dirk S Schmeller†§

† Université Toulouse 3 Paul Sabatier, CNRS, UMR5174 EDB (Laboratoire Évolution & Diversité Biologique), Toulouse, France
‡ Station d’Ecologie Expérimentale du CNRS at Moulis, Moulis, France
§ TerrOïko, Revel, France
¶ Helmholtz-Centre for Environmental Research - UFZ, Department of Conservation Biology, Leipzig, Germany

Corresponding author: Audrey Trochet (audrey.trochet@univ-tlse3.fr)

Academic editor: Diogo Provete

Received: 30 Sep 2014 | Accepted: 24 Oct 2014 | Published: 30 Oct 2014

Citation: Trochet A, Moulherat S, Calvez O, Stevens V, Clobert J, Schmeller D (2014) A database of life-history traits of European amphibians. Biodiversity Data Journal 2: e4123. doi: 10.3897/BDJ.2.e4123

Abstract

In the current context of climate change and landscape fragmentation, efficient conservation strategies require the explicit consideration of life history traits. This is particularly true for amphibians, which are highly threatened worldwide, composed by more than 7400 species, which is constitute one of the most species-rich vertebrate groups. The collection of information on life history traits is difficult due to the ecology of species and remoteness of their habitats. It is therefore not surprising that our knowledge is limited, and missing information on certain life history traits are common for in this species group. We compiled data on amphibian life history traits from literature in an extensive database with morphological and behavioral traits, habitat preferences and movement abilities for 86 European amphibian species (50 Anuran and 36 Urodela species). When it were available, we reported data for males, females, juveniles and tadpoles. Our database may serve as an important starting point for further analyses regarding amphibian conservation.
Keywords

Amphibians, life history traits, Europe

Introduction

Amphibians are ectotherms, and all aspects of their life history are strongly influenced by the external environment, including weather and climate. Amphibians are currently the most threatened taxonomic group worldwide (Temple and Cox 2009, IUCN 2011). The major threats acting on amphibian populations are habitat loss and habitat fragmentation, pollution, global change or disease exposure (Beebee and Griffith 2005, Blaustein and Kiesecker 2002, Houllahan et al. 2000, Stuart et al. 2004). Habitat fragmentation is actually recognized as the major treat of amphibian decline (Chanson et al. 2008, Marsh and Trenham 2001) by its strong impact on population functioning, in particular in amphibians. Indeed, habitat fragmentation can decrease the size of habitat patches, and also the distances between habitat patches (Fahrig 2003, Chanson et al. 2008, Reh and Seitz 1990). Consequently, this loss of connectivity should negatively affect population functioning, by limiting dispersal events between patches and by increasing inbreeding risk (Sjögren-Gulve 1994).

The impact of global warming on amphibian populations has been reported several times (Beebee 2002, Blaustein et al. 2001, Blaustein and Kiesecker 2002, Corn 2003, Houllahan et al. 2000, Araujo et al. 2006, Alford et al. 2006). For example, the breeding phenology of anurans adapted to breeding in early spring might be shifted to even earlier breeding in recent years in response to warmer spring temperatures (Beebee 1995, Parmesan 2006, Klaus and Lougheed 2013). These responses may not be universal among amphibians and remain a matter of debate (Beebee 2002, Corn 2003, Reading 1998). It is undoubted that rising temperatures, changes in precipitation and UV-radiation are considered stressful and might be associated with disease outbreaks in amphibian populations (Blaustein and Kiesecker 2002, Kiesecker and Blaustein 1995, Walker et al. 2010). UV-B may, however, also enhance tadpole growth in some species (Pahkala et al. 2003), but with not yet anticipated effects on survival of metamorphs and population dynamics.

Our database on life history traits of 86 European Amphibian species is an important prerequisite for understanding change in amphibian life history, community composition and migration behavior. Such data is important to inform the Essential Biodiversity Variables (Pereira et al. 2013), develop new indicators and ultimately inform the decision-making process to improve amphibian conservation.
General description

Purpose: Our database summarizes life history traits, including morphology, reproductive strategies, movement abilities, habitat preferences, distribution and IUCN status for all European amphibian species (N=86), all in all 44 traits subdivided into 253 modalities. Our database comprises information from 304 scientific publications assembled by searching Web of Science®, Amphibiaweb (AmphibiaWeb 2012) and herpetological books. The IUCN status, from 1 (least concern) to 6 (extinct in the wild), and their population trends (-1: decreasing, 0: stable or +1: increasing) were extracted from the IUCN red list website (IUCN 2011). In total, we were able to compile data for 50 Anurans and 36 Urodela (Fig. 1). When several values were available for a continuous trait, we averaged them across studies (i.e. between populations). When they are available, data for males, females, juveniles (larvae) and tadpoles were reported. Summary of mean data, range and missing values are given in Table 2.

Figure 1.
Proportion of (a) Anura (N=50) and (b) Urodela species (N=36) within IUCN categories used in our database. Data were extracted in 2013 from information found on the IUCN website (IUCN 2011). IUCN categories: LC = least concern, NT = near threatened, VU = vulnerable, EN = endangered, CR = critically endangered.

Because habitat fragmentation is currently the most threat affecting amphibian populations, movement specific data could help for conservation plans. By this way, we first selected traits related to movement abilities. Then, the costs associated with movements, and particularly with dispersal, might constrain the allocation of resources among all components of an individual’s life, and could lead to relationships between movement abilities and several other traits. Indeed, and compared to relationships found between movement and life history traits in other groups (in mammals and birds: Bowman 2003, Bowman et al. 2002, Sutherland et al. 2000), we then reported traits that could be related to movement abilities, always in order to help for amphibian management.
Geographic coverage

Description: Our database included all amphibian species present in Europe (Frost et al. 2006, IUCN 2011). Four invasive species were included in the database (*Anaxyrus americanus*, *Lithobates catesbeianus*, *Lithobates sylvaticus* and *Xenopus laevis*). A particularity is that *Bufotes viridis* has been recently split in several species. To avoid biased data, we considered all populations to represent identical entities and therefore argued that they shared identical traits. By this way, we reported only traits referring to *Bufotes viridis* (formerly *Bufo viridis*) and we did not take into account traits related to new splited species.

Taxonomic coverage

Description: We based our taxonomic coverage on European species described on the IUCN website (IUCN 2011) and from the Amphibian Tree of Life (Frost et al. 2006). More details on species are given in Table 1.

| Anurans/ Urodela | Species                  | Synonyms                      | Family            | Invasive Species (Yes/ No) | Species living out of Europe | References | Number of publications used | % of missing values |
|------------------|--------------------------|-------------------------------|-------------------|----------------------------|------------------------------|------------|----------------------------|---------------------|
| A                | *Alytes cisternasii*     | -                             | Discoglossidae    | No                         | No                           | 1, 2, 3, 4, 5, 6, 7          | 7           | 11.46                      |
| A                | *Alytes dickhilleni*     | -                             | Discoglossidae    | No                         | No                           | 4, 8       | 2                          | 26.09               |
| A                | *Alytes muletensis*      | -                             | Discoglossidae    | No                         | No                           | 4, 7, 9    | 3                          | 21.34               |
| A                | *Alytes obstetricans*    | -                             | Discoglossidae    | No                         | No                           | 2, 3, 5, 6, 10, 11, 12, 13, 14, 15, 16, 17 | 12          | 5.14                       |
| A                | *Anaxyrus americanus*    | *Bufo americanus*             | Bufonidae         | Yes                        | Yes                          | 7, 137, 228, 229            | 4           | 13.83                      |
| U                | *Atylodes genei*         | -                             | Plethodontidae    | No                         | No                           | 4, 138, 139, 140, 141, 142 | 6           | 22.53                      |
| A                | *Bombina bombina*        | -                             | Bombinatoridae    | No                         | Yes                          | 4, 6, 18, 19, 20, 21        | 6           | 3.56                       |

Table 1. Details on species used in our database. For each species, synonyms and family were given. Information about spatial distribution (if the species is an invasive species or not, and if it lives out of Europe) was reported. List of references associated (Suppl. material 2), number of publications used and the percent of missing values for each species were also given.
| A | Bombina pachypus | - | Bombinatoridae | No | No | 6, 19 | 2 | 50.59 |
|---|------------------|---|----------------|----|----|-------|---|------|
| A | Bombina variegata | - | Bombinatoridae | No | No | 4, 11, 13, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33 | 16 | 7.11 |
| A | Bufo bufo | - | Bufonidae | No | Yes | 4, 5, 6, 11, 13, 14, 15, 19, 26, 30, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 48, 49, 50 | 24 | 1.98 |
| A | Bufo mauritanicus | - | Bufonidae | No | Yes | 12, 48 | 2 | 30.83 |
| U | Calotriton arnoldi | - | Salamandridae | No | No | 139, 142, 143 | 3 | 54.15 |
| U | Calotriton asper | Euproctus asper | Salamandridae | No | No | 4, 11, 13, 139, 140, 144, 145, 146, 147, 148, 149, 150, 151 | 14 | 7.91 |
| U | Chioglossa lusitanica | - | Salamandridae | No | No | 4, 139, 140, 141, 152, 156, 157, 158 | 8 | 10.28 |
| A | Discoglossus galganoi | Discoglossus hispanicus | Discoglossidae | No | No | 4, 7, 49 | 3 | 15.81 |
| A | Discoglossus jeanneae | - | Discoglossidae | No | No | 4, 50, 51 | 3 | 24.11 |
| A | Discoglossus montalentii | - | Discoglossidae | No | No | 11, 52 | 2 | 22.92 |
| A | Discoglossus pictus | - | Discoglossidae | No | Yes | 4, 6, 11, 53, 54, 55 | 6 | 13.44 |
| A | Discoglossus sardus | - | Discoglossidae | No | No | 4, 11, 52, 56, 57 | 5 | 18.97 |
| A | Epidalea calamita | Bufo calamita | Bufonidae | No | Yes | 4, 11, 13, 15, 25, 26, 56, 58, 59, 60, 61, 62, 63, 66 | 14 | 1.19 |
|---|------------------|--------------|-----------|----|-----|----------------------------------|-----|-----|
| U | Euproctus montanus | - | Salamandridae | No | No | 4, 7, 139, 141, 157 | 5 | 17.79 |
| U | Euproctus platycephalus | - | Salamandridae | No | No | 4, 139, 141, 157, 158 | 5 | 13.44 |
| A | Hyla arborea | - | Hylidae | No | Yes | 4, 5, 11, 13, 15, 58, 66, 67, 68, 69, 70, 71, 72, 73 | 14 | 2.37 |
| A | Hyla intermedia | Hyla italica | Hylidae | No | No | 4, 57, 58, 67, 74 | 5 | 39.13 |
| A | Hyla meridionalis | - | Hylidae | No | Yes | 7, 11, 12, 13, 58, 75 | 6 | 9.88 |
| A | Hyla sarda | - | Hylidae | No | No | 11, 26, 57, 67 | 4 | 13.04 |
| U | Lissotriton boscai | Triturus boscai | Salamandridae | No | No | 4, 139, 140, 141, 159, 161, 162, 163, 164 | 9 | 15.02 |
| U | Lissotriton helveticus | Triturus helveticus | Salamandridae | No | No | 4, 11, 13, 15, 26, 59, 139, 140, 141, 150, 163, 164, 165, 166 | 14 | 7.91 |
| U | Lissotriton italicus | Triturus italicus | Salamandridae | No | No | 4, 139, 159, 167 | 4 | 18.18 |
| U | Lissotriton montandoni | Triturus montandoni | Salamandridae | No | No | 4, 139, 140, 141, 159, 168, 169 | 7 | 18.18 |
|    | Taxon                           | Scientific Name                  | Family         | Life History Traits | Literature References | Trait Value |
|----|--------------------------------|---------------------------------|----------------|---------------------|------------------------|-------------|
| U  | Lissotriton vulgaris           | Triturus vulgaris               | Salamandridae  | No                  | 4, 11, 14, 15, 18, 19, 26, 44, 59, 64, 169, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184 | 28          | 5.53        |
| A  | Lithobates catesbeianus        | Rana catesbeiana                | Ranidae        | Yes                 | 4, 5, 11, 13, 15, 26, 76, 77, 78, 79, 80, 81 | 12          | 4.35        |
| A  | Lithobates sylvaticus          | Rana sylvatica                  | Ranidae        | Yes                 | 5, 7, 13, 230, 231, 232 | 5           | 13.44       |
| U  | Lyciasalamandra helverseni     | Mertensiella luschani helverseni| Salamandridae  | No                  | 139, 182               | 2           | 49.80       |
| U  | Lyciasalamandra luschani       | Mertensiella luschani           | Salamandridae  | Yes                 | 4, 140, 184, 185, 186, 187 | 6           | 14.62       |
| U  | Mesotriton alpestris           | Triturus alpestris, Ichthyosaura alpestris | Salamandridae  | No                  | 4, 11, 14, 15, 19, 26, 59, 140, 141, 142, 151, 164, 165, 176, 188, 189, 190, 191, 192 | 19          | 6.72        |
| A  | Pelobates cultripes            | -                               | Pelobatidae    | No                  | 4, 6, 11, 13, 56, 82, 83 | 7           | 11.46       |
| A  | Pelobates fuscus               | -                               | Pelobatidae    | Yes                 | 4, 5, 6, 11, 19, 26, 84, 85, 86, 87 | 10          | 5.14        |
| Name | Species | Family | Order | Genus | Yes/No | Code | Length |
|------|---------|--------|-------|-------|--------|------|--------|
| Pelobates syriacus | Pelobates transcaucasicus | Pelobatidae | No | Yes | 4 | 1 | 17.00 |
| Pelodytes ibericus | - | Pelodytidae | No | No | 4, 88, 89 | 3 | 17.79 |
| Pelodytes punctatus | - | Pelodytidae | No | No | 4, 11, 13, 15, 58, 89 | 6 | 13.04 |
| Pelophylax bedriagae | Rana bedriagae | Ranidae | No | Yes | 4, 90 | 2 | 23.32 |
| Pelophylax bergeri | Rana bergeri | Ranidae | No | No | 4 | 1 | 22.13 |
| Pelophylax cerigensis | Rana cerigensis | Ranidae | No | No | 4, 91 | 2 | 31.23 |
| Pelophylax cretensis | Rana cretensis | Ranidae | No | No | 4, 92 | 2 | 31.23 |
| Pelophylax epeiroticus | Rana epeirotica | Ranidae | No | No | 4, 93, 94, 95, 96 | 5 | 24.51 |
| Pelophylax esculentus | Rana esculenta | Ranidae | No | Yes | 4, 6, 14, 15, 18, 97, 98, 99, 100, 101, 102 | 11 | 5.14 |
| Pelophylax grafi | Rana grafi | Ranidae | No | No | 4, 26, 97 | 3 | 23.72 |
| Pelophylax hispanicus | Rana hispanica | Ranidae | No | No | 4, 51 | 2 | 51.78 |
| Pelophylax kurtmuelleri | Rana kurtmuelleri | Ranidae | No | No | 4, 51 | 2 | 28.85 |
| Pelophylax lessonae | Rana lessonae | Ranidae | No | Yes | 4, 6, 14, 15, 26, 97, 98, 99, 100, 101, 103, 104, 105 | 13 | 4.35 |
| Pelophylax perezi | Rana perezi | Ranidae | No | No | 4, 5, 26, 97, 106 | 5 | 15.81 |
| Pelophylax ridibundus | Rana ridibunda | Ranidae | No | Yes | 4, 14, 15, 58, 97, 99, 100, 102, 107, 108, 109, 110, 111, 112 | 14 | 3.95 |
| Pelophylax shqipericus | Rana shqiperica | Ranidae | No | No | 4, 113 | 2 | 34.78 |
| Species                      | Family       | Order       | Defense | Breeding | References | Body Length |
|------------------------------|--------------|-------------|---------|----------|------------|-------------|
| *Pleurodeles waltl*          | Salamandridae| No          | Yes     |          | 4, 7, 12, 140, 141, 142, 177, 193 | 8 | 13.83 |
| *Proteus anguinus*           | Siren anguina| No          | No      |          | 4, 140, 141, 142, 148, 149, 194 | 7 | 14.23 |
| *Pseudopidalea viridis*      | *Bufo viridis*, *Bufo sp.* | Bufonidae   | No      | Yes      | 4, 11, 12, 26, 30, 51, 58, 90, 115, 116, 117, 118, 119 | 13 | 5.93 |
| *Rana arvalis*               | Ranidae      | No          | Yes     |          | 4, 11, 15, 19, 58, 120 | 6 | 6.72 |
| *Rana dalmatina*             | *Rana sp.*   | Ranidae     | No      | Yes      | 4, 11, 13, 15, 30, 46, 58, 121, 122, 123 | 10 | 3.56 |
| *Rana graeca*                | Ranidae      | No          | No      |          | 4, 5, 58, 123 | 4 | 12.25 |
| *Rana iberica*               | Ranidae      | No          | No      |          | 4, 11, 51, 124, 125 | 2 | 23.72 |
| *Rana italica*               | Ranidae      | No          | No      |          | 4, 5, 58, 124, 125 | 4 | 15.02 |
| *Rana latastei*              | Ranidae      | No          | No      |          | 4, 11, 13, 16, 126, 127 | 6 | 17.39 |
| *Rana pyrenaica*             | Ranidae      | No          | No      |          | 4, 11, 13, 16, 126, 127 | 19 | 2.37 |
| *Rana temporaria*            | Ranidae      | No          | Yes     |          | 4, 5, 11, 13, 14, 15, 19, 26, 44, 58, 120, 121, 126, 128, 129, 130, 131, 132, 133 | 2 | 32.02 |
| *Salamandra algira*          | Salamandridae| No          | Yes     |          | 12, 140 | 2 | 13.83 |
| U | Species                        | Family     | Category | Pages | Length |
|---|--------------------------------|------------|----------|-------|--------|
| 1 | *Salamandra atra*              | Salamandridae | No No 4, 11, 13, 14, 140, 141, 142, 151, 195, 196 | 8 | 18.58 |
| 2 | *Salamandra corsica*           | Salamandridae | No No 26, 140, 197 | 3 | 22.92 |
| 3 | *Salamandra lanzai*            | Salamandridae | No No 11, 11, 26, 140, 198, 199, 200 | 6 | 17.79 |
| 4 | *Salamandra salamandra*        | Salamandridae | No No 11, 11, 13, 14, 19, 140, 141, 142, 151, 200, 201, 202, 203, 204, 205 | 15 | 9.88 |
| 5 | *Salamandrina perspicillata*   | Salamandridae | No No 40, 140, 142, 206, 207, 208, 209 | 6 | 58.89 |
| 6 | *Salamandrina terdigitata*     | Molge tridactyla | Salamandridae | No No 4, 140, 141, 208 | 4 | 24.51 |
| 7 | *Speleomantes ambrosii*        | Plethodontidae | No No 4, 139, 140 | 3 | 14.62 |
| 8 | *Speleomantes flavus*          | Plethodontidae | No No 4, 139, 140 | 3 | 39.13 |
| 9 | *Speleomantes imperialis*      | Plethodontidae | No No 4, 139, 140 | 3 | 17.00 |
| 10| *Speleomantes italicus*        | Plethodontidae | No No 4, 139, 140, 141 | 4 | 16.21 |
| 11| *Speleomantes sarrabusensis*   | Plethodontidae | No No 4 | 1 | 44.27 |
| 12| *Speleomantes strinatii*       | Plethodontidae | No No 4, 11, 26, 140, 211 | 5 | 15.02 |
| 13| *Speleomantes supramontis*     | Plethodontidae | No No 4, 139, 140 | 3 | 39.13 |
| 14| *Triturus carnifex*            | Salamandridae | No No 4, 18, 36, 140, 160, 176, 197, 212, 213, 214 | 10 | 8.70 |
| U                  | Triturus cristatus                  | Salamandridae | No Yes | 4, 11, 15, 18, 19, 26, 44, 56, 59, 140, 141, 142, 151, 160, 165, 173, 174, 175, 176, 177, 181, 215, 216, 217, 218, 219 | 26 | 4.35 |
|-------------------|---------------------------------------|---------------|-------|-------------------------------------------------|----|-----|
| U                  | Triturus dobrogicus                   | Salamandridae | No No | 4, 18, 85, 140, 160, 176, 177, 220              | 8  | 26.09 |
| U                  | Triturus karelinii                    | Salamandridae | No Yes | 4, 140, 142, 160, 176, 177, 221, 222, 223       | 9  | 40.71 |
| U                  | Triturus marmoratus                   | Salamandridae | No No | 4, 11, 13, 18, 26, 56, 140, 142, 160, 164, 215, 216, 217, 224, 225 | 15 | 10.67 |
| U                  | Triturus pygmaeus                     | Salamandridae | No No | 4, 140, 141, 160, 224, 226, 227                | 7  | 18.18 |
| A                  | Xenopus laevis                        | Bufo laevis   | Pipidae | Yes Yes | 5, 11, 26, 134, 135, 136 | 6  | 11.86 |
Table 2.
Mean and range (min-max) of several traits recorded in Anura and Urodela species from our database. Number of missing values is also reported.

|                               | Anura (N=50)          | Urodela (N=36)         |
|--------------------------------|-----------------------|------------------------|
| Mean                           | Range (min–max)       | Number of missing values | Mean        | Range (min–max)       | Number of missing values |
| Body mass (in g)               | 32.34                 | 2.31–307.23            | 19          | 6.68                  | 0.98–35.23              | 10                      |
| Snout-to-vent length in adults (in mm) | 61.89                | 35.18–141.00           | 0           | 63.64                 | 33.31–169.90           | 4                       |
| Snout-to-vent length in males (in mm) | 56.01                | 34.70–134.74           | 9           | 59.19                 | 31–129.75              | 7                       |
| Snout-to-vent length in females (in mm) | 62.14                | 35.65–150.00           | 10          | 61.72                 | 38.12–155.25           | 7                       |
| Total length in adults (in mm)  | 61.89                 | 35.18–141.00           | 0           | 126.15                | 67.28–257.00           | 1                       |
| Foot length (in mm)            | 27.73                 | 5.37–65.95             | 25          | 7.56                  | 6.50–9.09              | 31                      |
| Tibia length (in mm)           | 26.89                 | 13.15–56.81            | 19          | 18.88                 | 4.81–32.94             | 34                      |
| Hind limb length (in mm)       | 90.40                 | 45.28–188.98           | 25          | 19.71                 | 10.68–41.00            | 8                       |
| Metamorphosis size (in mm)     | 20.83                 | 9.50–95.00             | 14          | 38.76                 | 20.00–70.00            | 5                       |
| Number of eggs                 | 4875.70               | 20–25000               | 0           | 164.06                | 2–1400                 | 0                       |
| Survival rates in adults       | 0.64                  | 0.34–0.80              | 44          | 0.63                  | 0.42–0.79              | 27                      |
| Sexual maturity (in years)     | 2.18                  | 1–4                    | 12          | 3.35                  | 1.5–7                  | 8                       |
| Movement ability (in m)        | 5422.73               | 150–15000              | 26          | 481.08                | 21–1500                | 23                      |

Taxa included:

| Rank | Scientific Name     | Common Name              |
|------|---------------------|--------------------------|
| species | Alytes cisternasii | Iberian Midwife Toad    |
| species | Alytes dickhilleni  | Betic Midwife Toad      |
| species | Alytes muletensis   | Mallorcan Midwife Toad  |
| species | Alytes obstetricans | Common Midwife Toad     |
| species | Anaxyrus americanus | American Toad           |
| species                        | Common Name                                      |
|-------------------------------|-------------------------------------------------|
| Atylodes genei                | Sardinian Cave Salamander                       |
| Bombina bombina               | Fire-bellied Toad                               |
| Bombina pachypus              | Appenine Yellow-bellied Toad                    |
| Bombina variegata             | Yellow–bellied Toad                             |
| Bufo bufo                     | Common Toad                                     |
| Bufo mauritanicus             | Mauritanian Toad                                 |
| Calotriton arnoldi            | -                                               |
| Calotriton asper              | Pyrenean Brook Salamander                       |
| Chioglossa lusitanica         | Golden-striped Salamander                       |
| Discoglossus galganoi        | Iberian Painted Frog                            |
| Discoglossus jeanneae         | Spanish Painted Frog                            |
| Discoglossus montalentii      | Corsican Painted Frog                           |
| Discoglossus pictus          | Painted Frog                                     |
| Discoglossus sardus           | Tyrrhenian Painted Frog                         |
| Epidalea calamita             | Natterjack Toad                                  |
| Euproctus montanus            | Corsican Brook Salamander                       |
| Euproctus platycephalus       | Sardinian Brook Salamander                      |
| Hyla arborea                  | European Tree Frog                              |
| Hyla intermedia               | Italian Tree Frog                               |
| Hyla meridionalis             | Mediterranean Tree Frog                         |
| Hyla sarda                    | Tyrrhenian Tree Frog                            |
| Lissotriton boscai            | Iberian Newt                                    |
| Lissotriton helveticus        | Palmate Newt                                     |
| Lissotriton italicus          | Italian Newt                                     |
| Lissotriton montandoni        | Carpathian Newt                                 |
| Lissotriton vulgaris          | Smooth Newt                                     |
| Lithobates catesbeianus       | American Bullfrog                               |
| Lithobates sylvaticus         | Wood Frog                                        |
| Lyciasalamandra helverseni    | -                                               |
| Lyciasalamandra luschani      | -                                               |
| Mesotriton alpestris          | Alpine Newt                                      |
| Pelobates cultripes           | Western Spadefoot                               |
| Pelobates fuscus              | Common Spadefoot                                |
| Pelobates syriacus            | Eastern Spadefoot                               |
| Pelodytes ibericus            | Sapillo Moteado Ibérico                         |
| Pelodytes punctatus           | Parsley Frog                                     |
| Pelophylax bedriagae          | Levant Water Frog                                |
| Pelophylax bergeri            | Italian Pool Frog                                |
| Pelophylax cerigensis         | Karpathos Frog                                   |
| Pelophylax cretensis          | Cretan Frog                                      |
| Pelophylax epeiroticus        | Epirus Water Frog                                |
| Pelophylax esculentus         | Edible Frog                                      |
| Pelophylax grafi              | Rana De Graf                                     |
| species                  | Common Name                        |
|--------------------------|-----------------------------------|
| Pelophylax hispanicus    | Italian Edible Frog               |
| Pelophylax kurtmuelleri  | Balkan Water Frog                 |
| Pelophylax lessonae      | Pool Frog                         |
| Pelophylax perezi        | Perez’s Frog                      |
| Pelophylax ridibundus    | Eurasian Marsh Frog               |
| Pelophylax shqipericus   | Albanian Water Frog               |
| Pleurodeles waltl        | Sharp-ribbed Salamander           |
| Proteus anginus          | Proteus                           |
| Pseudepidalea viridis    | Green Toad                        |
| Rana arvalis             | Altai Brown Frog                  |
| Rana dalmatina           | Agile Frog                        |
| Rana graeca              | Greek Stream Frog                 |
| Rana iberica             | Iberian Frog                      |
| Rana italic              | Italian Stream Frog               |
| Rana lastatei            | Italian Agile Frog                |
| Rana pyrenaica           | Pyrenean Frog                     |
| Rana temporaria          | European Common Frog              |
| Salamandra algira        | North African Fire Salamander     |
| Salamandra atra          | Golden Salamander                 |
| Salamandra corsica       | Corsican Fire Salamander          |
| Salamandra lanzai        | Lanza’s Alpine Salamander         |
| Salamandra salamandra    | Common Fire Salamander            |
| Salamandrina perspicillata | -                               |
| Salamandrina terdigitata | Spectacled Salamander             |
| Speleomantes ambrosii    | Ambrosi’s Cave Salamander         |
| Speleomantes flavus      | Monte Albo Cave Salamander        |
| Speleomantes Imperialis  | Imperial Cave Salamander          |
| Speleomantes italicicus  | Italian Cave Salamander           |
| Speleomantes sarrabusensis | -                             |
| Speleomantes strinatii   | North-west Italian Cave Salamander|
| Speleomantes supramontis | Supramonte Cave Salamander        |
| Triturus carnifex        | Italian Crested New               |
| Triturus cristatus      | Northern Crested Newt             |
| Triturus dobrogicus      | Danube Crested Newt               |
| Triturus karelinii       | Southern Crested Newt             |
| Triturus marmoratus      | Marbled Newt                      |
| Triturus pygmaeus        | Southern Marbled Newt             |
| Xenopus laevis           | Platanna                          |
Traits coverage

Morphological traits

We reported 14 morphological traits (32 modalities) for each European amphibian species: body lengths, body mass, limb lengths and details about webbing and fingers (Table 3). These traits were supposed to be relevant for amphibian conservation.

| Table 3. |
| Definition of the 14 morphological traits and their modalities in the European amphibian database. For all traits recorded, DD (data deficient) means that no data were reported. When several values were available for a trait, we averaged them across studies (i.e. between populations). |

| Sexual dimorphism | Difference in ornamentation (coloration) or in size (length of tail, size of head or body size) between sexes. In amphibians, females are generally bigger than males. This difference may be caused by natural selection of a large female size due to a fecundity advantage. This phenotypic difference in size is often explained by sexual selection. |
| Modalities: | |
| 0 | Absence of sexual dimorphism. |
| 1 | Presence of sexual dimorphism. |

| Body mass | Body mass in males, females or both when sex specific data were not available. |
| Modalities: | |
| Body mass in males | Body mass in males, in grams. |
| Body mass in females | Body mass in males, in grams. |
| Adult body mass | Body mass in adults, without distinction between males and females, in grams. This data was recorded when no sex specific data on body mass were available in the literature. |
| Body mass in juveniles | Body mass in juveniles, in grams. No distinction between sexes was available. |

| Body length | A measurement of the longest dimension of a body, typically between two distinct ends of the body. In amphibians, the distance snout-to-vent length is usually measured. To take into account the tail length in Urodela, we also reported a total length for each species, in males, in females or both when sex-specific data were not available. |
| Modalities: | |
| Snout-to-vent length in males | Measurement between the snout and the vent in males (in millimeters). |
| Snout-to-vent length in females | Measurement between the snout and the vent in females (in millimeters). |
| Adult snout-to-vent length | Measurement between the snout and the vent in adults, when no sex specific data were available (in millimeters). |
| Total length | In Anura, this measure was similar to the snout-to-vent length. In Urodela, this measurement takes into account the tail length. |
| Measure                                      | Description                                                                 |
|----------------------------------------------|-----------------------------------------------------------------------------|
| **Total length in males**                    | Measure of the total body length in males, in millimeters.                  |
| **Total length in females**                  | Measure of the total body length in females, in millimeters.                |
| **Adult total length**                       | Measure of the total body length in adults, when no sex specific data were available, in millimeters. |
| **Head and body length proportion**          | Proportion of the head length compared to the body length.                  |
| **Head length < Body length**                | Modalities: 0: Head length is not lower than body length. 1: Head length is lower than body length. |
| **Head length = Body length**                | Modalities: 0: Head length is not similar to body length. 1: Head length is similar to body length. |
| **Head length > Body length**                | Modalities: 0: Head length is not longer than body length. 1: Head length is longer than body length. |
| **Limb length**                              | Measurements of limb (foot, tibia and hind limb) in males, in females, or both when data were not sex specific available. |
| **Foot length**                              | Measurement of the foot in millimeters.                                    |
| **Foot length in males**                     | Modalities: Measurement of the foot in males, in millimeters.              |
| **Foot length in females**                   | Modalities: Measurement of the foot in females, in millimeters.            |
| **Adult foot length**                        | Modalities: Measurement of the foot in adults, when no sex specific data were available, in millimeters. |
| **Hind limb length**                         | Measurement of the hind limb, in millimeters.                              |
| **Hind limb length in males**                | Modalities: Measurement of the hind limb in males, in millimeters.         |
| **Hind limb length in females**              | Modalities: Measurement of the hind limb in females, in millimeters.       |
| **Adult hind limb length**                   | Modalities: Measurement of the hind limb in adults, when no sex specific data were available, in millimeters. |
| **Tibia length**                             | Measurement of the tibia, in millimeters.                                  |
| **Tibia length in males**                    | Modalities: Measurement of the tibia in males, in millimeters.             |
| **Tibia length in females**                  | Modalities: Measurement of the tibia in females, in millimeters.           |
| **Adult tibia length**                       | Modalities: Measurement of the tibia in adults, when no sex specific data were available, in millimeters. |
| **Fore and hind limb proportion**            | Proportion of the fore limb length compared to the hind limb length.        |
| **Fore limb length < Hind limb length**      | Modalities: 0: Fore limb length is not lower than hind limb length. 1: Fore limb length is lower than hind limb length. |
| **Fore limb length = Hind limb length**      | Modalities: 0: Fore limb length is not similar to hind limb length. 1: Fore limb length is similar to hind limb length. |
Fore limb length > Hind limb length
0: Fore limb length is not longer than hind limb length.
1: Fore limb length is longer than hind limb length.

**Fingers and webbing**

**Presence of discs**
Some amphibians have adhesive discs at the ends of the toes and fingers.

**Modalities:**

|   |   |
|---|---|
| 0 | Absence of adhesive discs |
| 1 | Presence of adhesive discs on fingers and/or on toes |

**Webbing**

**Modalities:**

| Presence of webbing |   |
|---------------------|---|
| 0: Absence of webbing. |
| 1: Presence of webbing on toes and/or fingers |

| Presence of webbing on toes only |   |
|---------------------------------|---|
| 0: Absence of webbing on toes only. |
| 1: Presence of webbing on toes only. |

| Presence of webbing on toes and fingers |   |
|----------------------------------------|---|
| 0: Absence of webbing on toes and fingers. |
| 1: Presence of webbing on toes and fingers. |

**Number of toes/fingers**
Most of amphibians have 5 toes on their feet and 4 fingers on their hands. But some of them can have less than 5 toes and/or 4 fingers. We reported if each species have a reduction only on fingers (4), or if the individuals have less than 5 toes and 4 fingers.

**Modalities:**

| Reduction on fingers only |   |
|---------------------------|---|
| 0: Individuals have less than 5 toes and 4 fingers. |
| 1: Individuals have 5 toes and 4 fingers. |

| Reduction on fingers and toes |   |
|------------------------------|---|
| 0: Individuals have 5 toes and 4 fingers. |
| 1: Individuals have less than 5 toes and 4 fingers. |

**Presence of metatarsal tubercle**
Some species have a metatarsal tubercle on hind limb. A prominent inner metatarsal tubercle used for burrowing with the hind limbs. When available, the length of the tubercle is given.

**Modalities:**

|   |   |
|---|---|
| 0 | Absence of metatarsal tubercle. |
| 1 | Presence of metatarsal tubercle. |

**Coloration**

**Modalities:**

| Dorsoseparation |   |
|-----------------|---|
| 0: Dorsoseparation weak |
| 1: Dorsoseparation sharp |

| Webbing colour contrast |   |
|-------------------------|---|
| 0: Absence of webbing colour contrast |
| 1: Presence of webbing colour contrast |
**Life history traits**

We collected 17 life history traits (65 modalities), when available, for European amphibians (Table 4). Life history traits vary considerably between species, and between Anura and Urodela in particular. The database includes data about activity, survival rates, sexual maturity, mating systems, characteristics of eggs and clutch position, parental care, foot diet, defense system, communication and territoriality.

| Table 4. |
|----------------|
| Definition of the 17 life history traits and their modalities in the European amphibian database. For all traits recorded, DD (data deficient) means that none data were reported in the literature. When several values were available for a trait, we averaged them across studies (i.e. between populations). |

| Activity          | Details about the period of activity. |
|-------------------|---------------------------------------|
| **Modalities:**   |                                       |
| Diurnal           | 0: No diurnal species.                 |
|                   | 1: Diurnal species.                    |
| Nocturnal         | 0: No nocturnal species.               |
|                   | 1: Nocturnal species.                  |
| Both              | 0: Species diurnal or nocturnal.       |
|                   | 1: Species diurnal and nocturnal.      |

| Survival rates    | Survival rate indicates the percentage of individuals who are alive for a given period of time. |
|-------------------|------------------------------------------------------------------------------------------------|
| **Modalities:**   |                                                                                               |
| Survival rates in males | Survival rates in males.                                                                     |
| Survival rates in females | Survival rates in females.                                                                   |
| Adult survival rates | Survival rates in adults, when no sex specific data were available.                          |

| Sexual maturity   | Sexual maturity in years.                                                                   |
|-------------------|------------------------------------------------------------------------------------------------|
| **Modalities:**   |                                                                                               |
| Sexual maturity in males | Sexual maturity in males, in years.                                                          |
| Sexual maturity in females | Sexual maturity in females, in years.                                                        |
| Adult sexual maturity | Sexual maturity in adults, when no sex specific data were available, in years.               |

| Mating systems    | Structuration of sexual behaviour relationships during the breeding season. We recorded 2 different types of mating systems through amphibians: polygyny when a male has mating relationships with several females; polyandry when a female has mating relationships with several males. |
|-------------------|------------------------------------------------------------------------------------------------|
| **Modalities:**   |                                                                                               |
| Polyandry         | 0: No polyandry species.                                                                      |
|                   | 1: Polyandry species                                                                         |
| Polygyny          | 0: No polygyny species.                                                                      |
|                   | 1: Polygyny species                                                                          |
### Eggs and young
Details about clutch size, egg laying mode, eggs and young characteristics.

### Number of eggs/offspring

| Modalities                        | Description                                                                 |
|-----------------------------------|-----------------------------------------------------------------------------|
| Viviparous: number of offspring   | When the species is viviparous, number of offspring by female by clutch.    |
| Ovoviviparous: number of eggs     | When the species is ovoviviparous, number of eggs by female by clutch.      |
| Ovoviviparous: number of offspring| When the species is ovoviviparous, number of offspring by female by clutch.|

### Egg laying mode

| Modalities | Description                          |
|------------|--------------------------------------|
| Single     | 0: Eggs are not laid single.          |
|            | 1: Eggs are laid single.              |
| Cluster    | 0: Eggs are not laid by cluster.      |
|            | 1: Eggs are laid by cluster.          |
| Strings    | 0: Eggs are not laid by strings.      |
|            | 1: Eggs are laid by strings.          |

### Eggs and larvae characteristics

| Modalities                        | Description                                                                 |
|-----------------------------------|-----------------------------------------------------------------------------|
| Metamorphosis size                | Measurement of the total body length of juveniles before metamorphosis, in millimeters. |
| Number of eggs                    | When the species is oviparous, number of eggs by female by clutch.           |
| Egg diameter                      | Egg diameter in millimeters.                                                |
| Egg mass                          | Egg mass in grams.                                                          |
| Pole visible on eggs              | 0: Pole not visible on eggs.                                                |
|                                  | 1: Pole visible on eggs.                                                     |

### Clutch position
Eggs can be lay at different places in the breeding environment.

| Modalities                        | Description                                                                 |
|-----------------------------------|-----------------------------------------------------------------------------|
| On ground                         | 0: Eggs are not laid on ground.                                             |
|                                  | 1: Eggs are laid on ground.                                                 |
| On adult                          | 0: Eggs are not laid on adult.                                              |
|                                  | 1: Eggs are laid on adult.                                                  |
| Attach in lotic habitat           | 0: Eggs are not attached in lotic habitat.                                  |
|                                  | 1: Eggs are attached in lotic habitat.                                     |
| Attach in lentic habitat          | 0: Eggs are not attached in lentic habitat.                                 |
|                                  | 1: Eggs are attached in lentic habitat.                                    |
| Free in lentic habitat            | 0: Eggs are not laid free in lentic habitat.                                |
|                                  | 1: Eggs are laid free in lentic habitat.                                   |
| On surface in lentic habitat      | 0: Eggs are not laid on surface in lentic habitat.                          |
|                                  | 1: Eggs are laid on surface in lentic habitat.                             |
| Attach on swamps in lentic habitat| 0: Eggs are not attached on swamps in lentic habitat.                      |
|                                  | 1: Eggs are attached on swamps in lentic habitat.                          |
| Free on swamps in lentic habitat | 0: Eggs are not laid free on swamps in lentic habitat.  
1: Eggs are laid free on swamps in lentic habitat. |
|----------------------------------|------------------------------------------------------------------------------------------------|
| On surface on swamps in lentic habitat | 0: Eggs are not laid on surface on swamps in lentic habitat.  
1: Eggs are laid on surface on swamps in lentic habitat. |
| On surface on non-permanent lentic ponds | 0: Eggs are not laid on surface on non-permanent lentic ponds.  
1: Eggs are laid on surface on non-permanent lentic ponds. |
| Breeding season | Breeding season can be prolonged or explosive (*breeding periods of a few days to a few weeks*). |
| **Modalities:** | |
| Explosive or prolonged | 0: Prolonged breeding season.  
1: Explosive breeding season. |
| Parental care | Parental care is defined as any behaviour of parents for increasing the fitness of their young. Most of amphibians do not perform parental care, but a few transport, guard and defend their eggs. |
| **Modalities:** | |
| Presence of parental care | 0: Absence of parental care.  
1: Presence of parental care. |
| Transport of eggs | 0: Parents do not transport their eggs.  
1: Parents transport their eggs. |
| Transport of tadpoles | 0: Parents do not transport their tadpoles.  
1: Parents transport their tadpoles. |
| Guarding eggs | 0: Parents do not guard their eggs.  
1: Parents guard their eggs. |
| Defend eggs | 0: Parents do not defend their eggs.  
1: Parents defend their eggs. |
| Water eggs | 0: Parents do not humidify their eggs.  
1: Parents humidify their eggs. |
| **Food diet** | |
| **Food active or passive** | |
| **Modalities:** | |
| 0 | Food passive (sit-and-wait) |
| 1 | Food active (active foragers) |
| **Food of juveniles** | |
| **Modalities:** | |
| Carnivorous | 0: Juveniles are not carnivorous.  
1: Juveniles are carnivorous. |
| Insectivorous | 0: Juveniles are not insectivorous.  
1: Juveniles are insectivorous. |
| Moluscivorous | 0: Juveniles are not moluscivorous.  
1: Juveniles are moluscivorous. |
| Cannibalism | 0: Juveniles are not cannibals.  
1: Juveniles are cannibals. |
| Trait                      | Option 0                                                                 | Option 1                                                                 |
|----------------------------|--------------------------------------------------------------------------|--------------------------------------------------------------------------|
| Herbivorous                | Juveniles are not herbivorous.                                           | Juveniles are herbivorous.                                               |
| Detritivorous              | Juveniles are not detritivorous.                                         | Juveniles are detritivorous.                                             |
| **Food of adults**         |                                                                          |                                                                          |
| Modalities:                |                                                                          |                                                                          |
| Carnivorous                | Adults are not carnivorous.                                              | Juveniles are carnivorous.                                               |
| Insectivorous              | Juveniles are not insectivorous.                                         | Juveniles are insectivorous.                                             |
| Moluscivorous              | Juveniles are not moluscivorous.                                         | Juveniles are moluscivorous.                                             |
| Cannibalism                | Juveniles are not cannibals.                                             | Juveniles are cannibals.                                                 |
| Herbivorous                | Juveniles are not herbivorous.                                           | Juveniles are herbivorous.                                               |
| Detritivorous              | Juveniles are not detritivorous.                                         | Juveniles are detritivorous.                                             |
| **Metabolism**             |                                                                          |                                                                          |
| Modalities:                |                                                                          |                                                                          |
| Metabolism rates           | Metabolism rate in adults.                                               |                                                                          |
| **Defense**                | Mode of defense                                                          |                                                                          |
| Modalities:                |                                                                          |                                                                          |
| Secretion                  | Species do not use secretion as mode of defense.                         | Species uses secretion as mode of defense.                               |
| Toxicity                   | Species do not use toxicity as mode of defense.                          | Species uses toxicity as mode of defense.                                |
| Death simulation           | Species do not use death simulation as mode of defense.                  | Species uses death simulation as mode of defense.                         |
| Unken reflex               | Species do not use unken reflex as mode of defense.                      | Species uses unken reflex as mode of defense.                             |
| Other                      | Species do not use other mode of defense.                                | Species uses other mode of defense.                                      |
| **Communication**         | Mode of communication                                                    |                                                                          |
| Modalities:                |                                                                          |                                                                          |
| Visual                     | Species do not use visual communication.                                 | Species uses visual communication.                                       |
| Acoustic                   | Species do not use acoustic communication.                               | Species uses acoustic communication.                                     |
| Chemical                   | Species do not use chemical communication.                               | Species uses chemical communication.                                     |
Seismic
0: Species do not use seismic communication.
1: Species uses seismic communication.

Territoriality
Territoriality can serve individuals to defend their nest, den, sexual partners, mating sites or high quality resources sites needed for themselves or their young. We recorded species for which individuals develop a territorial behaviour (by scent markings or fighting) during the breeding season.

Modalities:
- Male territorial
  0: No.
  1: Yes.
- Female territorial
  0: No.
  1: Yes.
- Both territorial
  0: Both males and females not territorial.
  1: Both males and females territorial.

Movement

We reported 7 traits related to movement, by separating when possible migration (N subcategories) and dispersal events (21 modalities; Table 5). In contrast to migration, dispersal is defined as individual movement that induces gene flow (Ronce 2007). Amphibians regularly migrate between terrestrial and aquatic habitats, and some individuals also engage in dispersal, leaving their population of birth (or previous reproduction) to join another suitable habitat in the landscape. We used the maximum distance (and not the modal distance) recorded by species because long-distance dispersal movements have considerably higher impact on species spread, species persistence, and metapopulation functioning (Trakhtenbrot et al. 2005). All dispersal and migration values were estimated using mark-release-recapture or individual tracking. In general, amphibians are considered as low dispersal species (Boissinot 2009, Smith and Green 2005), but we detected several species for which dispersal and/or migration distances were > 10 km (Fig. 2).

| Table 5. |
| Definition of the 7 traits related to movement in the European amphibian database. For all traits recorded, DD (data deficient) means that no data were reported in the literature. When several values were available for a trait, we averaged them across studies (i.e. between populations). |

| Home range Modalities: |
| Home range Here, we consider home range as the area that an individual needs throughout a year. Home range recorded in the literature, in m². |

| Movement event Modalities: |
| Movement event 0: Movement events performed by one single individual (solitary individual). 1: Movement events performed by several individuals (social individuals). |
### Dispersal active or passive

**Modalities:**

| Dispersal active or passive | 0: Passive dispersal. | 1: Active dispersal. |
|----------------------------|-----------------------|----------------------|

### Sex-biased dispersal

Dispersal abilities can be significantly different between genders. We reported here if sex-biased dispersal was identified in species (if males have faster or longer dispersal abilities than females).

**Modalities:**

| Sex-biased dispersal | 0: No sex-biased dispersal reported in the literature. | 1: Significant sex-biased dispersal reported in the literature. |
|----------------------|-------------------------------------------------------|---------------------------------------------------------------|

### Mode of displacement

**Modalities:**

| Walker 0: Individuals do not walk during displacement event. | 1: Individuals walk during displacement event. |
|----------------------------------------------------------|-----------------------------------------------|
| Jumper 0: Individuals do not jump during displacement event. | 1: Individuals jump during displacement event. |
| Runner 0: Individuals do not run during displacement event. | 1: Individuals run during displacement event. |
| Climber 0: Individuals do not climb during displacement event. | 1: Individuals climb during displacement event. |
| Swimmer 0: Individuals do not swim during displacement event. | 1: Individuals swim during displacement event. |
| Crawler 0: Individuals do not crawl during displacement event. | 1: Individuals crawl during displacement event. |

### Dispersal

Contrary to migration, dispersal is defined as individual movement could induce gene flow. Dispersal distances came from mark-release-recapture and/or radio-tracking studies.

**Modalities:**

| Dispersal stage juvenile 0: Dispersal event not at juvenile stage. | 1: Dispersal event at juvenile stage. |
| Dispersal stage adult 0: Dispersal event not at adult stage. | 1: Dispersal event at adult stage. |
| Dispersal stage during breeding season 0: Dispersal event not during breeding season. | 1: Dispersal event during breeding season. |
| Mean dispersal distance Mean dispersal distance, in meters. |
| Maximum dispersal distance Maximum dispersal distance, in meters. |
| Minimal dispersal distance Minimal dispersal distance, in meters. |

### Migration

Contrary to dispersal, migration is defined as individual movement that not induces gene flow. Migration distances came from mark-release-recapture and/or radio-tracking studies.

**Modalities:**
### Migration stage adult

0: Migration event not at adult stage.

1: Migration event at adult stage.

### Migration stage during breeding season

0: Migration event not during breeding season.

1: Migration event during breeding season.

### Mean migration distance

Mean migration distance, in meters.

### Maximum migration distance

Maximum migration distance, in meters.

### Minimal migration distance

Minimal migration distance, in meters.

---

**Figure 2.**

Frequency histogram of the maximum distance moved by (a) 56 Anura and (b) 30 Urodela species.

---

**Habitat preferences and distribution**

We collected habitat preferences and 2 traits related to spatial distribution (113 modalities; Table 6). Amphibians are often considered as specialized to certain habitat types, which make them particularly sensitive to landscape changes. Nevertheless, habitat preferences, and particularly terrestrial habitats of amphibian species request much clarification, especially given the recent changes induced by habitat fragmentation. We categorized habitats as follows (IUCN 2011): forest, savanna, shrubland, grassland, wetlands, rocky areas, caves and subterranean habitats (non-aquatic), deserts, artificial/terrestrial habitats, and other. We chose to use the following IUCN habitats because in our opinion it is the most conservative assumptions about species delimitations and also because these are the entities currently recognized by international conservation authorities and that is the actual aim of the database. Moreover, for this inter-specific database we avoided selecting too specific habitats, and chose relatively broad habitat categories which included all habitats in which species live. We also noted biogeographical regions (European Environment Agency 2010) where species were present, and the proportion of their distribution map on each continent.
| Habitat | Habitat(s) where the species is frequently found. |
|---------|-----------------------------------------------|
| **Forest** | |
| Boreal | 0: The species does not live in boreal forests. 1: The species lives in boreal forests. |
| Subarctic | 0: The species does not live in subarctic forests. 1: The species lives in subarctic forests. |
| Subantarctic | 0: The species does not live in subantarctic forests. 1: The species lives in subantarctic forests. |
| Subtropical/tropical dry | 0: The species does not live in subtropical/tropical dry forests. 1: The species lives in subtropical/tropical dry forests. |
| Temperate | 0: The species does not live in temperate forests. 1: The species lives in temperate forests. |
| Subtropical/tropical moist lowland | 0: The species does not live in subtropical/tropical moist lowland forests. 1: The species lives in subtropical/tropical moist lowland forests. |
| Subtropical/tropical mangrove vegetation aboral | 0: The species does not live in subtropical/tropical mangrove vegetation aboral forests. 1: The species lives in subtropical/tropical mangrove vegetation aboral forests. |
| Subtropical/tropical swamp | 0: The species does not live in subtropical/tropical swamp forests. 1: The species lives in subtropical/tropical swamp forests. |
| Subtropical/tropical moist montane | 0: The species does not live in subtropical/tropical moist montane forests. 1: The species lives in subtropical/tropical moist montane forests. |
| **Savanna** | |
| Dry | 0: The species does not live in dry savanna. 1: The species lives in dry savanna. |
| Moist | 0: The species does not live in moist savanna. 1: The species lives in moist savanna. |
| **Shrubland** | |
| Subarctic | 0: The species does not live in subarctic shrubland. 1: The species lives in subarctic shrubland. |
| Subantarctic | 0: The species does not live in subantarctic shrubland. 1: The species lives in subantarctic shrubland. |
| Boreal | 0: The species does not live in boreal shrubland. 1: The species lives in boreal shrubland. |
| Temperate | 0: The species does not live in temperate shrubland. 1: The species lives in temperate shrubland. |
| Ecological Type                                                                 | Option 0: Species does not live in... | Option 1: Species lives in... |
|-------------------------------------------------------------------------------|----------------------------------------|-----------------------------|
| Subtropical/tropical dry                                                      | The species does not live in subtropical/tropical dry shrubland. | The species lives in subtropical/tropical dry shrubland. |
| Subtropical/tropical moist                                                    | The species does not live in subtropical/tropical moist shrubland. | The species lives in subtropical/tropical moist shrubland. |
| Tropical high altitude                                                        | The species does not live in tropical high altitude shrubland. | The species lives in tropical high altitude shrubland. |
| Mediterranean-type shrubby vegetation                                         | The species does not live in mediterranean-type shrubby vegetation shrubland. | The species lives in mediterranean-type shrubby vegetation shrubland. |
| Grasland                                                                      |                                         |                             |
| Tundra                                                                        | The species does not live in tundra grassland. | The species lives in tropical tundra grassland. |
| Subarctic                                                                     | The species does not live in subarctic grassland. | The species lives in tropical subarctic grassland. |
| Subantarctic                                                                  | The species does not live in subantarctic grassland. | The species lives in tropical subantarctic grassland. |
| Temperate                                                                     | The species does not live in temperate grassland. | The species lives in tropical temperate grassland. |
| Subtropical/tropical dry                                                      | The species does not live in subtropical/tropical dry grassland. | The species lives in tropical subtropical/tropical dry grassland. |
| Subtropical/tropical seasonally wet/flooded                                   | The species does not live in subtropical/tropical seasonally wet/flooded grassland. | The species lives in tropical subtropical/tropical seasonally wet/flooded grassland. |
| Subtropical/tropical high altitude                                           | The species does not live in subtropical/tropical high altitude grassland. | The species lives in tropical subtropical/tropical high altitude grassland. |
| Wetlands                                                                       |                                         |                             |
| Permanent rivers/streams/creeks (including waterfalls)                        | The species does not live in permanent rivers/streams/creeks (including waterfalls) wetlands. | The species lives in tropical permanent rivers/streams/creeks (including waterfalls) wetlands. |
| Intermittent/irregular rivers/streams/creeks                                  | The species does not live in intermittent/irregular rivers/streams/creeks wetlands. | The species lives in tropical intermittent/irregular rivers/streams/creeks wetlands. |
| Shrub dominated wetlands                                                      | The species does not live in shrub dominated wetlands wetlands. | The species lives in tropical shrub dominated wetlands wetlands. |
| Bogs/marshes/swamps/fens/peatlands                                            | The species does not live in bogs/marshes/swamps/fens/peatlands wetlands. | The species lives in tropical bogs/marshes/swamps/fens/peatlands wetlands. |
| Permanent freshwater lakes (>8ha)                                            | The species does not live in permanent freshwater lakes (>8ha) wetlands. | The species lives in tropical permanent freshwater lakes (>8ha) wetlands. |
| Wetland Type                                      | Status 0                                                                 | Status 1                                                                 |
|--------------------------------------------------|--------------------------------------------------------------------------|--------------------------------------------------------------------------|
| Seasonal/intermittent freshwater lakes (>8ha)    | 0: The species does not live in seasonal/intermittent freshwater lakes (>8ha) wetlands. | 1: The species lives in tropical seasonal/intermittent freshwater lakes (>8ha) wetlands. |
| Permanent freshwater marshes/pools (>8ha)       | 0: The species does not live in permanent freshwater marshes/pools (>8ha) wetlands. | 1: The species lives in tropical permanent freshwater marshes/pools (>8ha) wetlands. |
| Seasonal/intermittent freshwater marshes/pools (<8ha) | 0: The species does not live in seasonal/intermittent freshwater marshes/pools (<8ha) wetlands. | 1: The species lives in tropical seasonal/intermittent freshwater marshes/pools (<8ha) wetlands. |
| Freshwater springs and oases                     | 0: The species does not live in freshwater springs and oases wetlands.    | 1: The species lives in tropical freshwater springs and oases wetlands.    |
| Tundra wetlands                                  | 0: The species does not live in tundra wetlands wetlands.                 | 1: The species lives in tropical tundra wetlands wetlands.                 |
| Geothermal wetlands                              | 0: The species does not live in geothermal wetlands wetlands.             | 1: The species lives in tropical geothermal wetlands wetlands.             |
| Permanent inland deltas                          | 0: The species does not live in permanent inland deltas wetlands.         | 1: The species lives in tropical permanent inland deltas wetlands.         |
| Permanent saline, brackish or alkaline lakes     | 0: The species does not live in permanent saline, brackish or alkaline lakes wetlands. | 1: The species lives in tropical permanent saline, brackish or alkaline lakes wetlands. |
| Seasonal/intermittent saline, brackish or alkaline lakes | 0: The species does not live in seasonal/intermittent saline, brackish or alkaline lakes wetlands. | 1: The species lives in tropical seasonal/intermittent saline, brackish or alkaline lakes wetlands. |
| Permanent saline, brackish or alkaline marshes/pools | 0: The species does not live in permanent saline, brackish or alkaline marshes/pools wetlands. | 1: The species lives in tropical permanent saline, brackish or alkaline marshes/pools wetlands. |
| Karst and other subterranean hydrological systems | 0: The species does not live in karst and other subterranean hydrological systems wetlands. | 1: The species lives in tropical karst and other subterranean hydrological systems wetlands. |

**Rocky areas**

Inland cliffs, mountan peaks | 0: The species does not live in rock areas as inland cliffs, mountain peaks. | 1: The species lives in rock areas as inland cliffs, mountain peaks. |

**Caves and subterranean habitats (non-aquatic)**

caves | 0: The species does not live in caves and subterranean habitats. | 1: The species lives in caves and subterranean habitats. |

other subterranean habitats | 0: The species does not live in other subterranean habitats. | 1: The species lives in other subterranean habitats. |

**Deserts**

A database of life-history traits of European amphibians 27
| Category                                      | 0: Description                                                                 | 1: Description                                                                 |
|----------------------------------------------|--------------------------------------------------------------------------------|--------------------------------------------------------------------------------|
| Hot                                          | The species does not live in hot deserts.                                      | The species lives in other hot deserts.                                         |
| Temperate                                    | The species does not live in temperate deserts.                               | The species lives in other temperate deserts.                                   |
| Cold                                         | The species does not live in cold deserts.                                    | The species lives in other cold deserts.                                         |
| Artificial/terrestrial                       |                                                                                |                                                                                |
| Arable land                                  | The species does not live in arable land.                                     | The species lives in arable land.                                               |
| Pastureland                                  | The species does not live in pastureland.                                     | The species lives in pastureland.                                               |
| Plantations                                  | The species does not live in plantations.                                     | The species lives in plantations.                                               |
| Rural gardens                                | The species does not live in rural gardens.                                   | The species lives in rural gardens.                                              |
| Urban areas                                  | The species does not live in urban areas.                                     | The species lives in urban areas.                                               |
| Subtropical/tropical heavily degraded former forest | The species does not live in subtropical/tropical heavily degraded former forest. | The species lives in subtropical/tropical heavily degraded former forest.        |
| Other                                        |                                                                                |                                                                                |
| Dunes                                        | The species does not live in dunes.                                           | The species lives in dunes.                                                     |
| Topography                                   |                                                                                |                                                                                |
| Modalities:                                  |                                                                                |                                                                                |
| Altitude min                                 | Minimal attitude where the species was observed.                              | Maximal attitude where the species was observed.                                |
| Biogeographical regions                      |                                                                                |                                                                                |
| Modalities:                                  |                                                                                |                                                                                |
| Alpine                                       | The species does not live in the alpine biogeographical region.                | The species lives in the alpine biogeographical region.                          |
| Anatolian                                    | The species does not live in the anatolian biogeographical region.             | The species lives in the anatolian biogeographical region.                       |
| Arctic                                       | The species does not live in the arctic biogeographical region.                | The species lives in the arctic biogeographical region.                          |
| Atlantic                                     | The species does not live in the atlantic biogeographical region.              | The species lives in the atlantic biogeographical region.                        |
| Black Sea                                    | The species does not live in the black sea biogeographical region.             | The species lives in the black sea biogeographical region.                       |
| Boreal                                       | The species does not live in the boreal biogeographical region.                | The species lives in the boreal biogeographical region.                         |
## Distribution

**Modalities:**

*Europe occupied UTM 50×50 km cells*

| Modality  | Description                                                                 |
|-----------|-----------------------------------------------------------------------------|
| Absolute  | Spatial distribution of the species in Europe, calculated with GIS tools, in km². |
| Asia      | Distribution of the species in Asia.                                         |
| Punctual  | 0: The spatial distribution of the species is not rare. 1: The spatial distribution of the species is rare. |
| < 10%     | 0: Less than 10% of the spatial distribution of the species is not in Asia. 1: Less than 10% of the spatial distribution of the species is in Asia. |
| 10–20%    | 0: Between 10 and 20% of the spatial distribution of the species are not in Asia. 1: Between 10 and 20% of the spatial distribution of the species are in Asia. |
| 20–30%    | 0: Between 20 and 30% of the spatial distribution of the species are not in Asia. 1: Between 20 and 30% of the spatial distribution of the species are in Asia. |
| 30–40%    | 0: Between 30 and 40% of the spatial distribution of the species are not in Asia. 1: Between 30 and 40% of the spatial distribution of the species are in Asia. |
| 40–50%    | 0: Between 40 and 50% of the spatial distribution of the species are not in Asia. 1: Between 40 and 50% of the spatial distribution of the species are in Asia. |
| 50–60%    | 0: Between 50 and 60% of the spatial distribution of the species are not in Asia. 1: Between 50 and 60% of the spatial distribution of the species are in Asia. |
| Percentage Range | 0: Description | 1: Description |
|------------------|----------------|----------------|
| 60–70%           | Between 60 and 70% of the spatial distribution of the species are not in Asia. | Between 60 and 70% of the spatial distribution of the species are in Asia. |
| 70–80%           | Between 70 and 80% of the spatial distribution of the species are not in Asia. | Between 70 and 80% of the spatial distribution of the species are in Asia. |
| 80–90%           | Between 80 and 90% of the spatial distribution of the species are not in Asia. | Between 80 and 90% of the spatial distribution of the species are in Asia. |
| > 90%            | Up to 90% of the spatial distribution of the species is not in Asia. | Up to 90% of the spatial distribution of the species is in Asia. |

### Africa

**Absolute**

Spatial distribution of the species in Africa, calculated with GIS tools, in km².

| Percentage Range | 0: Description | 1: Description |
|------------------|----------------|----------------|
| <15%             | Less than 15% of the spatial distribution of the species is not in Africa. | Less than 15% of the spatial distribution of the species is in Africa. |
| 15–30%           | Between 15 and 30% of the spatial distribution of the species are not in Africa. | Between 15 and 30% of the spatial distribution of the species are in Africa. |
| 30–45%           | Between 30 and 45% of the spatial distribution of the species are not in Africa. | Between 30 and 45% of the spatial distribution of the species are in Africa. |
| 45–60%           | Between 45 and 60% of the spatial distribution of the species are not in Africa. | Between 45 and 60% of the spatial distribution of the species are in Africa. |
| 60–75%           | Between 60 and 75% of the spatial distribution of the species are not in Africa. | Between 60 and 75% of the spatial distribution of the species are in Africa. |
| 75–90%           | Between 75 and 90% of the spatial distribution of the species are not in Africa. | Between 75 and 90% of the spatial distribution of the species are in Africa. |
| >90%             | Up to 90% of the spatial distribution of the species is not in Africa. | Up to 90% of the spatial distribution of the species is in Africa. |

### North America

**Absolute**

Spatial distribution of the species in North America, calculated with GIS tools, in km².
| South America | Distribution of the species in South America. |
|--------------|---------------------------------------------|
| Absolute     | Spatial distribution of the species in South America, calculated with GIS tools, in km². |

### Punctual
- **0**: The spatial distribution of the species is not punctual.
- **1**: The spatial distribution of the species is punctual.

#### <20%
- **0**: Less than 20% of the spatial distribution of the species is not in North America.
- **1**: Less than 20% of the spatial distribution of the species is in North America.

#### 20–40%
- **0**: Between 20 and 40% of the spatial distribution of the species are not in North America.
- **1**: Between 20 and 40% of the spatial distribution of the species are in North America.

#### 40–60%
- **0**: Between 40 and 60% of the spatial distribution of the species are not in North America.
- **1**: Between 40 and 60% of the spatial distribution of the species are in North America.

#### 60–80%
- **0**: Between 60 and 80% of the spatial distribution of the species are not in North America.
- **1**: Between 60 and 80% of the spatial distribution of the species are in North America.

#### >80%
- **0**: Up to 80% of the spatial distribution of the species is not in North America.
- **1**: Up to 80% of the spatial distribution of the species is in North America.

### Australia
- **Distribution of the species in Australia.**

### Absolute
- **Spatial distribution of the species in Australia, calculated with GIS tools, in km².**

### Punctual
- **0**: The spatial distribution of the species is not punctual.
- **1**: The spatial distribution of the species is punctual.

#### <25%
- **0**: Less than 25% of the spatial distribution of the species is not in South America.
- **1**: Less than 25% of the spatial distribution of the species is in South America.

#### 25–50%
- **0**: Between 25 and 50% of the spatial distribution of the species are not in South America.
- **1**: Between 25 and 50% of the spatial distribution of the species are in South America.

#### 50–75%
- **0**: Between 50 and 75% of the spatial distribution of the species are not in South America.
- **1**: Between 50 and 75% of the spatial distribution of the species are in South America.

#### >75%
- **0**: Up to 75% of the spatial distribution of the species is not in South America.
- **1**: Up to 75% of the spatial distribution of the species is in South America.
Least Concern 0: IUCN status for the species is not Least Concern. 1: IUCN status for the species is Least Concern.

Near Threatened 0: IUCN status for the species is not Near Threatened. 1: IUCN status for the species is Near Threatened.

Vulnerable 0: IUCN status for the species is not Vulnerable. 1: IUCN status for the species is Vulnerable.

Endangered 0: IUCN status for the species is not Endangered. 1: IUCN status for the species is Endangered.

Critically Endangered 0: IUCN status for the species is not Critically Endangered. 1: IUCN status for the species is Critically Endangered.

Population trend 0: Evolution of the population. Population trends vary between "decrease", "stable" and "increase".

Modalities:

Threats

We collected information on three categories (22 modalities; Table 7) related to threats of amphibian species: The IUCN status (6 subcategories), population trend (4 subcategories), and major threats (12 subcategories).

Table 7.
Definition of the 3 traits related to threats in the European amphibian database. For all traits recorded, DD (data deficient) means that no data were reported in the literature.

IUCN status
IUCN threat status. Threatened species have one of the three following IUCN status: "vulnerable", "endangered", "critically endangered".

Modalities:

Data Deficient 0: Data sufficient for the species. 1: Data deficient for the species.

Least Concern 0: IUCN status for the species is not Least Concern. 1: IUCN status for the species is Least Concern.

Near Threatened 0: IUCN status for the species is not Near Threatened. 1: IUCN status for the species is Near Threatened.

Vulnerable 0: IUCN status for the species is not Vulnerable. 1: IUCN status for the species is Vulnerable.

Endangered 0: IUCN status for the species is not Endangered. 1: IUCN status for the species is Endangered.

Critically Endangered 0: IUCN status for the species is not Critically Endangered. 1: IUCN status for the species is Critically Endangered.

Population trend Evolution of the population. Population trends vary between "decrease", "stable" and "increase".
### Data Deficient
- 0: Data sufficient for the species.
- 1: Data deficient for the species.

### Decrease
- 0: Population trend for the species is not Decrease.
- 1: Population trend for the species is Decrease.

### Stable
- 0: Population trend for the species is not Stable.
- 1: Population trend for the species is Stable.

### Increase
- 0: Population trend for the species is not Increase.
- 1: Population trend for the species is Increase.

### Major Threats
Major threats impacting the species.

#### Modalities:

- **Habitat loss**
  - 0: Habitat loss does not affect the species.
  - 1: Habitat loss affects the species.

- **Invasive alien**
  - 0: Invasive alien does not affect the species.
  - 1: Invasive alien affects the species.

- **Harvesting**
  - 0: Harvesting does not affect the species.
  - 1: Harvesting affects the species.

- **Accidental**
  - 0: Accidental does not affect the species.
  - 1: Accidental affects the species.

- **Persecution**
  - 0: Persecution does not affect the species.
  - 1: Persecution affects the species.

- **Pollution**
  - 0: Pollution does not affect the species.
  - 1: Pollution affects the species.

- **Climate change**
  - 0: Climate change does not affect the species.
  - 1: Climate change affects the species.

- **Natural disasters**
  - 0: Natural disasters do not affect the species.
  - 1: Natural disasters affect the species.

- **Change dynamics**
  - 0: Change dynamics do not affect the species.
  - 1: Change dynamics affect the species.

- **Intrinsic factors**
  - 0: Intrinsic factors do not affect the species.
  - 1: Intrinsic factors affect the species.

- **Human disturbance**
  - 0: Human disturbance does not affect the species.
  - 1: Human disturbance affects the species.

- **Unknown**
  - 0: Factors affecting the species are known.
  - 1: Factors affecting the species are unknown.

---

**Usage rights**

**Use license:** Creative Commons CCZero

**Data resources**

**Data package title:** European amphibians database

**Number of data sets:** 1
**Data set name:** Database for life-history traits for European amphibians

**Data format:** xls

**Description:** Summary of morphometric and life-history traits for 86 European amphibian species (Suppl. material 1). Values expected for the life-histories have been averaged between studies (i.e. between populations). DD (data deficient) means that data were not available in the literature.

| Column label                                      | Column description                                      |
|---------------------------------------------------|----------------------------------------------------------|
| Sexual dimorphism                                 | Sexual dimorphism                                        |
| Body mass (in g)                                  | Body mass (in g)                                         |
| Snout-to-vent length (in mm)                      | Snout-to-vent length (in mm)                            |
| Total length (in mm)                              | Total length (in mm)                                     |
| Proportion head length/body length                | Proportion head length/body length                       |
| Foot length (in mm)                               | Foot length (in mm)                                      |
| Hind limb length (in mm)                          | Hind limb length (in mm)                                |
| Tibia length (in mm)                              | Tibia length (in mm)                                     |
| Proportion forelimb/hindlimb length               | Proportion forelimb/hindlimb length                      |
| Discs                                             | Discs                                                    |
| Webbing                                           | Webbing                                                  |
| Number of toes/fingers                            | Number of toes/fingers                                   |
| Tubercle                                          | Tubercle                                                 |
| Coloration                                        | Coloration                                               |
| Activity                                          | Activity                                                 |
| Survival rates                                    | Survival rates                                           |
| Sexual maturity (in years)                        | Sexual maturity (in years)                               |
| Mating systems                                    | Mating systems                                           |
| Number of eggs/offspring                          | Number of eggs/offspring                                 |
| Egg laying mode                                   | Egg laying mode                                          |
| Eggs and larvae characteristics                   | Eggs and larvae characteristics                          |
| Clutch position                                   | Clutch position                                          |
| Breeding season                                   | Breeding season                                          |
| Parental care                                     | Parental care                                            |
| Active or passive feeding                         | Active or passive feeding                                |
| Food of juveniles                                 | Food of juveniles                                        |
| Food of adults                                    | Food of adults                                           |
| Metabolism                                        | Metabolism                                               |
| Defense                                           | Defense                                                  |
| Communication                                     | Communication                                            |
| Territoriality                                    | Territoriality                                           |
| Home range                                        | Home range                                               |
| Movement event                                    | Movement event                                           |
| Dispersal active or passive                       | Dispersal active or passive                              |
| Sex biased dispersal                              | Sex biased dispersal                                      |
Additional information

Conclusion

Our database is the first comprehensive trait database in European amphibians. After an extensive research effort, our database highlighted the lack of data about amphibian traits and more generally, on amphibian’s biology. Improve our knowledge on amphibians should certainly help for their management, which might strongly enhance their conservation plans. Morphological traits, which are easy to collect, are still unavailable for many species. Data about movement abilities (both dispersal and migration) were the least informed data of all database. In particular, we showed that movement traits, which are difficult to collect, were unknown for a majority of threatened species. This database could be an essential support for management and conservation plans, and should be more efficient when all data will be available.

Acknowledgements

This study was financed by SCALES (“Securing the Conservation of biodiversity across Administrative Levels and spatial, temporal, and Ecological Scales”; Henle et al. 2010), a large-scale collaborative research project funded by the European Commission under the 7th Framework Programme (contract no. 226852 Programme).

Author contributions

AT collected the data. SM, OC, JC, VMS and DSS participated in the data collection.

References

- Alford R, Bradfield K, Richards S (2006) Ecology: Global warming and amphibian losses. Nature 447: E3-E4. DOI: 10.1038/nature05940
• AmphibiaWeb (2012) Information on amphibian biology and conservation. AmphibiaWeb http://amphibiaweb.org/. 2012-12-10. URL: http://amphibiaweb.org/
• Araujo M, Thuiller W, Pearson R (2006) Climate warming and the decline of amphibians and reptiles in Europe. Journal of Biogeography 33 (10): 1712-1728. DOI: 10.1111/j.1365-2699.2006.01482.x
• Beebee T (1995) Amphibian breeding and climate change. Nature 374: 219-220. DOI: 10.1038/374219a0
• Beebee T (2002) Amphibian phenology and climate change. Conservation Biology 16: 1454-1455. DOI: 10.1046/j.1523-1739.2002.02102.x
• Beebee T, Griffith R (2005) The amphibian decline crisis: A watershed for conservation biology? Biological Conservation 125: 271-285. DOI: 10.1016/j.biocon.2005.04.009
• Blaustein A, Kiesecker J (2002) Complexity in conservation: lessons from the global decline of amphibian populations. Ecology Letters 5 (4): 597-608. DOI: 10.1046/j.1461-0248.2002.00352.x
• Blaustein A, Belden L, Olson D, Grenn D, Root T, Kiesecker J (2001) Amphibian breeding and climate change. Conservation Biology 16: 1804-1809. DOI: 10.1046/j.1523-1739.2001.00307.x
• Boissinot A (2009) Influence de la structure du biotope de reproduction et de l’agencement du paysage, sur le peuplement d’amphibiens d’une région bocagère de l’ouest de la France. Diplôme de l’Ecole Pratique des Hautes Etudes, Laboratoire de Biogéographie et d’Ecologie des Vertébrés (EPHE/CEFE) 1: 192.
• Bowman J (2003) Is dispersal distance of birds proportional to territory size? Canadian Journal of Zoology 81 (2): 195-202. DOI: 10.1139/z02-237
• Bowman J, Jaeger J, Fahrig L (2002) Dispersal distance of mammals is proportional to home range size. Ecology 83: 2049-2055. DOI: 10.1890/0012-9658(2002)083[2049:DDOMIP]2.0.CO;2
• Chanson J, Hoffmann M, Cox N, Stuart S (2008) The State of the World’s Amphibians. In: Stuart SN, Hoffman M, Chanson JS, Cox NA, Berridge RJ, Ramani P, Young BE (Eds) Threatened Amphibians of the World. Lynx Edicions. Barcelona, Spain, 33-52 pp.
• Corn P (2003) Amphibian breeding and climate change: Importance of snow in the mountains. Conservation Biology 17: 622-625. DOI: 10.1046/j.1523-1739.2003.02111.x
• Fahrig L (2003) Effects of habitat fragmentation on biodiversity. Annual Review of Ecology, Evolution, and Systematics 34: 487-515. DOI: 10.1146/annurev.ecolsys.34.011802.132419
• Frost D, Grant T, Faivovich J, Bain R, Haas A, Haddad C, De Sa R, Channing A, Wilkinson M, Donnellan S, Raxworthy C, Campbell J, Blotto B, Moler P, Drewes R, Nussbaum R, Lynch J, Green D, Wheeler W (2006) The amphibian tree of life. Bulletin of the American Museum of Natural History 297: 1-370. DOI: 10.1206/0003-0090(2006)297[0001:TATOL]2.0.CO;2
• Houlanah J, Findlay C, Schmidt B, Meyer A, Kuzmin S (2000) Quantitative evidence for global amphibian population declines. Nature 404: 752-755. DOI: 10.1038/35008052
• IUCN (2011) IUCN Red List of Threatened Species Version 2011. IUCN 1: 2011.
• Kiesecker J, Blaustein A (1995) Synergism between UV-B radiation and a pathogen magnifies amphibian embryo mortality in nature. Proceedings of the National Academy of Sciences 92: 11049-11052. DOI: 10.1073/pnas.92.24.11049
• Klaus S, Lougheed S (2013) Changes in breeding phenology of eastern Ontario frogs over four decades. Ecology and Evolution 3 (4): 835-845. DOI: 10.1002/ece3.501
• Marsh D, Trenham P (2001) Metapopulation dynamics and amphibian conservation. Conservation Biology 15: 40-49. DOI: 10.1046/j.1523-1739.2001.00129.x
• Pahkala M, Laurila A, Merilä J (2003) Effects of ultraviolet-B radiation on behaviour and growth of three species of amphibian larvae. Chemosphere 51: 197-204. DOI: 10.1016/S0045-6535(02)00813-5
• Parmesan C (2006) Ecological and Evolutionary Responses to Recent Climate Change. Annual Review of Ecology, Evolution, and Systematics 37: 637-669. DOI: 10.1146/annurev.ecolsys.37.091305.110100
• Pereira HM, Ferrier S, Walters M, Geller GN, Jongman RHG, Scholes RJ, Bruford MW, Brummitt N, Butchart SHM, Cardoso AC, Coops NC, Dulloo E, Faith DP, Freyhof J, Gregory RD, Heip C, Höft R, Hurtt G, Jetz W, Karp DS, McGeoch MA, Obura D, Onoda Y, Petorelli N, Reyes B, Sayre R, Scharlemann JPW, Stuart SN, Turak E, Walpole M, Wegmann M (2013) Essential Biodiversity Variables. Science 339 (6117): 277-278. DOI: 10.1126/science.1229931
• Reading C (1998) Interspecific spawning between Common frogs (Rana temporaria) and Common toads (Bufo bufo). Journal of Zoology 203: 95-101. DOI: 10.1111/j.1469-7998.1984.tb06046.x
• Reh W, Seitz A (1990) The influence of land use on the genetic structure of populations of the common frog Rana temporaria. Biological Conservation 54 (3): 239-249. DOI: 10.1016/0006-3207(90)90054-S
• Ronce O (2007) How Does It Feel to Be like a Rolling Stone? Ten Questions about Dispersal Evolution. Annual Review of Ecology, Evolution and Systematics 38: 231-253. DOI: 10.1146/annurev.ecolsys.38.091206.095611
• Sjögren-Gulve P (1994) Distribution and extinction patterns within a northern metapopulation of the pool frog, Rana lessonae. Ecology 75: 1357-1367. DOI: 10.2307/1937460
• Smith M, Green D (2005) Dispersal and the metapopulation paradigm in amphibian ecology and conservation: Are all amphibian populations metapopulations? Ecography 28 (1): 110-128. DOI: 10.1111/j.0906-7590.2005.04042.x
• Stuart S, Chanson J, Cox N, Young B, Rodrigues A, Fischman D, Waller R (2004) Status and trends of amphibian declines and extinctions worldwide. Science 306: 1783-1786. DOI: 10.1126/science.1103538
• Sutherland G, Harestad A, Price K, Lertzman K (2000) Scaling of natal dispersal distances in terrestrial birds and mammals. Conservation Ecology 4 (1): 1-16.
• Temple H, Cox N (2009) European Red List of Amphibians. Office for Official Publications of the European Communitie, 44 pp.
• Trakhtenbrot A, Nathan R, Perry G, Richardson D (2005) The importance of long-distance dispersal in biodiversity conservation. Diversity and Distributions 11 (2): 173-181. DOI: 10.1111/j.1366-9516.2005.00156.x
• Walker S, Bosch J, Gomez V, Garner T, Cunningham A, Schmeller D, Ninyerola M, Henk D, Ginestet C, Arthur C, Fisher M (2010) Factors driving pathogenicity vs. prevalence of amphibian panzootic chytridiomycosis in Iberia. Ecology Letters 13: 372-382. DOI: 10.1111/j.1461-0248.2009.01434.x
Supplementary materials

Suppl. material 1: Database for life history traits for European amphibians

Authors: Trochet A, Moulherat S, Calvez O, Schmeller DS, Clobert J, Stevens VM
Data type: life history traits
Brief description: Summary of morphometric and life-history traits for 86 European amphibian species. Values expected for the life-histories have been averaged between studies (i.e. between populations). NA means that data were not available in the literature.
Filename: European_Amphibians_Database3.xlsx - Download file (113.67 kb)

Suppl. material 2: References cited in the database of life-history traits of European amphibians

Authors: Trochet A, Moulherat S, Calvez O, Schmeller DS, Clobert J, Stevens VM
Data type: xls
Filename: References.xlsx - Download file (34.82 kb)