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Conservation Action
Plan for the
Amphibians of
Argentina



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Una publicación semestral de la Asociación Herpetológica Argentina (Facultad de Ciencias Agrarias, Universidad Nacional de Jujuy, Alberdi 47 - CP 4600, S. S. de Jujuy, Argentina). Incluye trabajos científicos relacionados con todos los aspectos de la investigación en Anfibios y Reptiles, abarcando tópicos como: sistemática, taxonomía, anatomía, fisiología, embriología, ecología, comportamiento, zoogeografía, etc. Comprende las siguientes secciones: Trabajos, Puntos de Vista, Notas, Novedades Zoogeográficas y Novedades Bibliográficas. Publica en formato digital online y en formato impreso artículos científicos originales asegurando a los autores un proceso de revisión por evaluadores externos sólido y transparente más una alta visibilidad internacional de sus trabajos. Para los lectores, se garantiza el acceso libre a los artículos. Los idiomas aceptados son castellano, portugués e inglés.

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Ilustración de tapa:

Argenteohyla siemersi; *Boana riojana*; *Melanophryniscus rubriventris*; *Ceratophrys ornata* **Fotos:** Eduardo Schaefer - Mauricio S. Akmentins - Martín Boullhessen - Gabriela Agostini.

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Conservation Action Plan for the Amphibians of Argentina

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In September 2005, the IUCN Species Survival Commission (SSC) held a summit for the conservation of amphibians where specialists from around the world agreed that, in addition to the need to document the declines and extinctions, we need to promote action strategies designed to respond to the global biodiversity crisis. The outcome of this summit was expressed in the Amphibian Conservation Action Plan (Gascon *et al.*, 2007) with the recommendation that governments, civil society and the academic community adopt it and implement the suggested measures.

Since 2007, almost 60 Action Plans have been developed at the national or regional level throughout the world, including six in South American countries (source: <http://www.amphibians.org/publications/national-action-plans/>).

In Argentina, there is a growing number of research groups that develop projects related to the conservation of amphibians with different approaches and objectives. However, a unified national strategy providing an overview of amphibian conservation actions in the country including a declaration of principles, clearly defined priorities, and short, medium and long-term goals for the implementation of conservation actions does not yet exist.

It is certainly of great value to have a comprehensive strategy that provides both the national and provincial governments with a framework to promote and support conservation programs and a tool that guides research activities, promotes the creation of information networks, training programs, environmental education, and outreach and community participation, thereby strengthening efforts to protect the biodiversity of our country. The Asociación Herpetológica Argentina (AHA) has long led national actions related to the conservation of amphibians by compiling and publishing the first Categorization of the State of Conservation of the Herpetofauna of Argentina (Lavilla *et al.*, 2000) And the subsequent update (Vaira *et al.*, 2012). In a similar vein, the AHA was actively involved in the first Global Amphibian Assessment (GAA) led by IUCN. Specialists convened during the Argentine Herpetology Congress of Puerto Madryn in 2003 to contribute their knowledge and validate the data compiled by the IUCN regional coordinator (<http://oldredlist.iucnredlist.org/initiatives/amphibians/process/methods>).

As of a result of these activities, the need to design a national strategy for the conservation of amphibians became evident, not only to evaluate the conservation status of amphibians of Argentina, but also to outline and address the problems negatively affecting the species and the courses of action that should be taken.

Based on the input from a local network of specialists on various topics, the development of a base document recommending priority actions was proposed, which could serve as a guideline for the design of conservation initiatives and a national strategy for the conservation of amphibians in our country. The process included the creation of a framework to organize the activities to be developed, the implementation of a standard procedure and the formation of thematic groups of specialists. This initiative was launched in september 2015 during the XVI Argentine Congress of Herpetology held in the city of San Miguel de Tucumán. There, the general objectives of the strategy were outlined, and a tentative work schedule was developed, convening the local specialists who wanted to join this proposal.

This was the starting point for the design and consolidation of specific programs and projects whose goals and actions could be measured and evaluated periodically. It was then proposed to generate a list of concrete and realistic goals, with respective actions and performance indicators that would allow their evaluation and monitoring in the short, medium and long term.

As a result of the process, we finalized this **Action Plan for the Conservation of Amphibians of Argentina,**

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which outlines a set of 47 actions that respond to 18 identified problems grouped into 6 components that can be undertaken in predefined terms. The Plan proposes to execute these actions that experts have considered as priorities or necessary, however this does not imply that it constitutes a plan that has exhaustively evaluated all of the problems and possible actions for the conservation of the amphibians of Argentina.

The Plan propose goals and actions that are considered priority to cover the existing information gaps and face the current and future threats to the conservation of amphibians in our country. It aims to provide clear guidance on issues that are considered relevant to conservation by identifying and ordering a set of measurable goals and the respective actions that respond to specific recommendations grouped in the thematic lines proposed and that can be implemented in the short, medium and long term (1, 3 and 5 years).

Since the fulfillment of the actions is expected to generate changes in the conservation status of the amphibian species, the Plan includes monitoring of its development, evaluating the progress made in achieving the objectives according to the established deadlines. This will allow for the incorporation of changes and addition of new goals during the periodic reviews.

We hope that this Plan will become a starting point for the design and consolidation of inter-institutional and interdisciplinary programs to guarantee the long-term persistence of the amphibian diversity of Argentina. We also hope that this document will be relevant for all actors of civil society and that it will increase awareness of the biodiversity crisis, encouraging them to participate in the proposed action plans.

Finally, we acknowledge the revision of the english translation of the Plan by Kelsey Neam.

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The Conservation Status of Amphibians in the World



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The decline in amphibian populations worldwide is a phenomenon that has been reported, and gained momentum, since the 1980s. Currently 7888 species of amphibians are known: 6958 anurans, 722 caudates, and 208 gymnophions (Frost, 2018). The latest figures from the International Union for Conservation of Nature (IUCN) Red List of Threatened Species show that, of the more than 6000 species of amphibians evaluated so far, 2100 species are considered threatened (e.g., Vulnerable, Endangered or Critically Endangered), representing approximately one-third of all known amphibians and nearly equivalent to the proportion of threatened species of birds and mammals combined (<http://www.amphibians.org/whyamphibians/>). This situation is all the more concerning when considering that we lack adequate information for a significant proportion of amphibian species.

Among the main activities that have been identified as factors leading to declines in global amphibian populations are: habitat loss or modification resulting from anthropogenic activities, pollution, fire, diseases and pathogens, introduced species, over-exploitation (particularly for human consumption and the pet trade), disturbance and natural disasters. Of all of these, the habitat loss and destruction due to the advancement of the agricultural frontier, deforestation, and urbanization have been identified as the main causes of amphibian declines (Stuart *et al.*, 2008).

In mid-2013, the Amphibian Specialist Group (ASG) of IUCN Species Survival Commission and the Amphibian Survival Alliance (ASA), formed various thematic working groups comprised of ASG members with expertise on relevant topics. The main objective was to develop short- and medium-term priority targets to address amphibian conservation challenges in each field and worldwide.

The first revision of the global Amphibian Conservation Action Plan (ACAP) was recently completed, which promotes the identification of short and medium-term targets based on the major constraints to the effective implementation of conservation actions (Wren *et al.*, 2015).

The main challenge will be to find solutions to counteract declines and extinctions, guaranteeing the long-term persistence of amphibian populations and ensuring the proper functioning of the world's ecosystems.

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The Conservation Status of the Amphibians of Argentina



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Argentina harbors the tenth largest amphibian fauna among the 40 countries included in the Neotropical realm and is among the fifteen countries that exceed 100 species in this region. In addition, it is among the twenty countries in the world with 30% of its amphibian species considered endemic (Bolaños *et al.*, 2008, Lavilla and Heatwole 2010). While there is still a significant lack of information for many of the amphibian species of Argentina, including aspects of systematics, genetics, distribution, natural history, ecology and behavior, the documented or inferred population declines and threats identified for many species require rapid decisions.

In Argentina, there is currently no mutually agreed action plan amongst the different agencies involved in the research and conservation of amphibians, nor between the central government and the provincial states. However, the scientific community, mainly, and certain government agencies, carry out concrete actions to describe and inventory the diversity of amphibian species in Argentina and establish their conservation status. The lack of a consensual national plan may cause some entities involved in conservation actions to adopt individual strategies that may not be the most appropriate or priority for the current conservation situation of the amphibians of Argentina.

The scientific community of Argentina dedicated to amphibian research has undeniably made the greatest contributions to the knowledge of the diversity and state of conservation of the amphibians in the country. The expertise developed over several decades of studies has permitted the completion of the most recent national assessment of the conservation status of the amphibian species of Argentina (Vaira *et al.*, 2012) and made numerous contributions regarding the biology of species and the threats they face in their natural habitats.

This latest national assessment revealed that the conservation status of Argentina's species is relatively promising given that there is no concrete evidence that any species should be considered definitively extinct, and that many of the habitats occupied by the species are at least represented by small fragments which could allow management actions for their preservation or restoration. The result of the evaluation allows us to see that we are still in time to take concrete actions to guarantee the long-term persistence of the amphibian species of Argentina.

A brief update of the results of the 2012 assessment indicates that of the 18 families with representatives in Argentina, five (Batrachylidae, Craugastoridae, Hemiphractidae, Rhinodermatidae and Telmatobiiidae) have between 60% and 100% of their species in some category of threat. The remaining thirteen families present a less urgent situation, including those without threatened species: Brachycephalidae, Centrolenidae, Hylodidae, Microhylidae, Siphonopidae and Typhlonectidae, or those with lower proportions of threatened species: Alsodidae (28%), Phyllomedusidae (25%); Bufonidae (18%); Ceratophryidae (17%), Leptodactylidae (15%), Odontophrynidae (12%) and Hylidae (3%). However, in the case of families represented by no more than two genera or species, such as Brachycephalidae, Centrolenidae, Siphonopidae and Typhlonectidae, all of their members are considered to be Data Deficient, which places them in a situation that demands special attention.

A similar situation occurs at the generic level. Of the 44 genera represented, 17 have at least 50% of

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their species in a threatened or data deficient category. Among these are genera represented by a single species such as *Chthonerpeton*, *Chaltenobatrachus*, *Hylorina*, *Ischnocnema*, *Luetkenotyphlus*, *Rhinoderma* and *Vitreorana*. The most extreme case is the genus *Telmatobius*, with all 15 species included in some category of threat. Other genera with noteworthy conservation challenges are *Alsodes*, *Atelognathus*, *Eupsophus*, *Gastrotheca* and *Siphonops* with 100% of their species threatened or data deficient.

It is usually very difficult to establish conservation priorities at the local or regional level without detailed knowledge of the diversity and distribution patterns of the species. Therefore, the description of the diversity of amphibians and basic studies on the biology of most species continue to be essential actions in our country. Although the description rate of amphibian species continues to grow steadily throughout much of the world and in Argentina, the detailed knowledge of their distributions and their basic requirements for survival is still too uncertain to allow for the establishment of reliable conservation priorities. However, by exclusively focusing our efforts on obtaining essential information for each threatened species, we may be too late in identifying conservation actions for certain species with very imminent threats.

Habitat loss has been considered the most important threat to the survival of species in Argentina (Vaira *et al.*, 2012). The effects of natural habitat modifications by anthropogenic activities on the diversity and population status of amphibian species has already been well documented in our country (e.g. Peltzer *et al.*, 2003; 2006; 2008; Duré *et al.*, 2008, Lescano, 2018). Specific examples include a species of *Gastrotheca* (*G. christiani*), along with representatives of *Atelognathus* (*A. patagonicus*) and *Alsodes* (*A. pehuenche*), which provide the first cases with concrete data where their survival is threatened due to the extirpation and decline of populations as direct consequences of the alteration of the environments in which they live (Vaira, 2003; Cuello & Perotti, 2005; Cuello *et al.*, 2009; Corbalán *et al.*, 2010; Vaira *et al.*, 2011). In many cases, processes of habitat degradation or destruction have occurred very recently, so we do not yet have an accurate idea of their effects on the long-term persistence of the species.

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COMPONENT 1. SYSTEMATICS and DIVERSITY



Systematics and Diversity

1

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1. 1 Identified problem. Presence of specific taxonomic problems regarding the amphibian fauna of Argentina.

Although at the national level, contributions to the taxonomic knowledge of the Argentine fauna of amphibians has shown exponential growth since the beginning of the 1980s, and at the global level there has been a particular interest since the mid-2000s, several taxa of amphibians registered in the country (either endemic or not) require revision. Among the problems detected, and discussed below, include: (1) persistence of names associated with old morphological / typological descriptions, which do not account for variation and whose limits can be unclear; (2) others names are associated with one or a limited number of specimens collected 50 years ago or more, and never registered again in the country; (3) others names have to do with species with very large geographic distributions, in which the set of populations must be re-analyzed in collaborative international actions. This trio of problems is not an exhaustive list of the difficulties we face (which are explained in more detail later), but provide an overview of the current status of many taxa.

At a time when taxonomic and nomenclatural studies seem outmoded, it is imperative to remember that each properly defined taxon expresses a unique and unrepeatable genome, whose conservation status must be known in a reliable manner. This knowledge goes beyond the description of a relatively long series of character states, molecular sequences, or call frequencies, to become the essential material for carrying out more complex studies that lead to the elucidation of lineages, one of the new categories to consider in conservation biology.

1. 1. 1 Goal. Resolve the taxonomic problems of the amphibian species of Argentina with uncertain taxonomic status.

1. 1. 2 Proposed action. Define annually the priority groups for the development of studies, promoting the search for human resources and funds to advance in its realization.

1. 1. 3 Indicators and terms. At the beginning of each year between 2019 and 2022, specialists will validate the priority group (s) that require the development of studies and propose both human and financial resources necessary for its development and fulfillment. For this stage of the Action Plan (2018-2022), the development of studies are tentatively proposed for the following amphibians of Argentina with uncertain taxonomic status:

1. Batrachylidae

To determine the taxonomic status of various species and subspecies of the genus *Atelognathus*.

2. Bufonidae

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To determine the taxonomic status of various populations of the genus *Melanophryniscus*.

To determine the taxonomic status of *Rhinella gnustae*.

To determine the taxonomic status of the Argentine populations of *Rhinella* cf. *cerradensis*.

To determine the taxonomic status of the subspecies of *Rhinella spinulosa*.

3. Craugastoridae

To determine the taxonomic status of populations of the genus *Oreobates*.

4. Hylidae

To determine the taxonomic status of *Boana varelae*.

To determine the taxonomic status of *Scinax castroviejoi*.

To determine the status of the subspecies of *Argenteohyla siemersi*.

To determine the status of the Argentine populations of *Trachycephalus typhonius*.

5. Hylodidae

To determine the taxonomic status of *Crossodactylus dispar* in Misiones.

6. Leptodactylidae

To determine the taxonomic status of the populations of *Leptodactylus latrans*.

To determine the taxonomic status of the populations of *Pleurodema borellii* and *Pleurodema cinereum*.

To determine the taxonomic status of *Pleurodema somuncurense*.

To determine the taxonomic status of populations of the genus *Adenomera*.

7. Odontophrynidae

To determine the taxonomic status of various populations of the genus *Odontophrynus*.

8. Telmatobiidae

To determine the taxonomic status of the multiple populations associated with *Telmatobius marmoratus* and other not nominated populations.

9. Microhylidae

To determine the taxonomic status of several populations of the genus *Elachistocleis*.

To determine the taxonomic status and distribution in Argentina of *Chiasmocleis albopunctata*.

1. 2 Identified problem. Lack of knowledge about the phylogenetic and phylogeographic relationships of many amphibian species of Argentina.

Phylogenetic and phylogeographic information is fundamental to addressing conservation actions. This involves defining and knowing lineages on the one hand and, on the other hand, understanding the variations that occur between populations of different taxa, especially those widely distributed. Faced with a map in which the distribution of a species appears as an extensive patch, we often do not see the disjunctions, the local threats of specific populations, or the genetic variation they may harbor. Thus, confronted with a global conservation crisis, it is essential to have adequate knowledge of the intra and interspecific relationships to decide, on a reliable basis, the actions, baselines and goals required to ensure the long-term conservation of the species.

1. 2. 1 **Goal.** To promote phylogenetic and phylogeographic studies in priority groups.

1. 2. 2 **Proposed action.** Define annually the priority groups for the development of studies, promoting the search for human resources and funds to advance in its accomplishment.

1. 2. 3 **Indicators and terms.** At the beginning of each year between 2019 and 2022, specialists will validate the priority group (s) that require the development of phylogenetic studies and propose both human and financial resources necessary for its development and fulfillment. For this stage of the Action Plan (2018-2022), the development of heavily sampled phylogenetic studies are tentatively proposed for the

following species:

- *Batrachylidae*
- *Odontophrynus*
- *Proceratophrys*
- *Melanophryniscus*
- *Rhinella*
- *Scinax*
- *Telmatobius*

COMPONENT 2. RESEARCH IN CONSERVATION and MONITORING



Research in Conservation and Monitoring

2

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2. 1 Identified problem. A lack of systematized data obtained from biodiversity inventories or surveys of specific areas or regions.

Population decline is a comparative concept that requires knowing the state of the species in the past in order to compare it with the present, and can be presented as a reduction in the abundance of individuals or a reduction of the areas that the species occupies. Presently, the latter is the only aspect that we could determine with the vast majority of the data we have for many amphibians in Argentina. Although Argentina has an information system that includes all past and current records of amphibian species in National Parks (Sistema de Información de Biodiversidad, SIB: <https://sib.gob.ar/>), there are few other examples of databases or long-term updatable systems for determining the status of different populations for most amphibian species and / or regions of Argentina.

The method of documenting declines by re-surveying historically known sites involves serious difficulties. For many cases where historical distribution records have been reconfirmed, reports do not usually indicate density or abundance data of the surveyed populations, therefore we cannot assess how indicative those data are. This makes it difficult to determine the possible existence of declines, which may result in the shrinking of populations and, consequently, the disappearance of the historic site where the species is still registered.

Changes in methods and sampling efforts can influence quantitative estimates of population sizes making difficult to compare studies over time. For this reason, it is essential to consider the sampling effort carried out in order to better interpret the data. In any case, even when rigorous criteria for recording new data are established, these can only be compared with future data obtained in the same systematized way, therefore we must begin collecting this type of data as soon as possible.

The limited consistency in sampling effort for the majority of data involves the limitations of the initial database to make spatial or temporal comparisons. In most cases, data collection in different study sites has not been systematized in terms of stratification or sampling effort. The precision of many analyses is therefore very restricted by the condition of the database. The availability of data has been and probably will continue to be limited in the future. Even with adding new working groups, the investment required by large-scale inventories is sometimes difficult to achieve. It is imperative to develop efficient and standardized inventory methods and techniques that allow for obtaining accurate and comparable data.

2. 1. 1 Goal. To develop a manual of standard techniques and protocols for the inventory and monitoring of amphibian populations, updated with the more recent procedures, tools and techniques of analysis, and adapted to national conditions and realities.

2. 1. 2 Proposed actions.

- 1) Create a group of specialists who, through workshops and collaborative work, will generate a base document for the writing of the manual.
- 2) Create a web portal that includes a systematized protocol for inventories and surveys of amphibian

biodiversity that includes a detailed description of methods, tools and suggested processes designed to systematize procedures and the analysis of results.

2. 1. 3 Indicators and terms. Action 1) By the end of 2019, the base document will be generated and made available for consultation to all researchers interested in reviewing and proposing adjustments. By 2020, the manual will be published electronically with open access and will be free to download. Simultaneously, the search for government or NGO sponsors interested in publishing the document in the form of a printed book will be encouraged.

Action 2) By mid-2020, the open access web portal will be generated, including the processes and tools agreed by specialists.

2. 2 Identified problemo. Systematized surveys of amphibian fauna are lacking in much of the country which would allow for the solid understanding of the composition of the respective amphibian assemblages.

Despite the existence of amphibian lists for certain political units (provinces) or certain ecoregions of Argentina, many are the result of observations and / or collections that were not systematized and/or not supported by reference specimens deposited in recognized herpetological collections or in public museums. This problem becomes confounded when considering that most amphibian distributions in Argentina have been mapped based on expert-opinion (e.g. <http://www.iucnredlist.org/initiatives/amphibians>) where wide margins of error have been tolerated. The general lack of knowledge is due to a variety of factors, such as the aggregated distribution of the specialists or the difficulties in carrying out continuous faunal surveys. This apparent deficit is the result of the inverse relationship between time and resources and the assessment of results in high-impact publications. However, understanding the true geographical distribution of the amphibians of Argentina is essential to achieving successful conservation actions.

2. 2. 1. Goals.

- 1) Identify priority areas in terms of information gaps regarding the distribution of amphibians in Argentina.
- 2) Identify research centers of natural sciences or related sciences (faculties, teaching institutes) in the regions of the identified priority areas.
- 3) Develop a training program for volunteer biologists and / or parabiologists on topics related to the identification of amphibians and on survey and monitoring techniques.
- 4) After completion of the training programs and surveys, conduct workshops for the compilation and analysis of results.

2. 2. 2 Proposed actions.

- 1) Form a group of specialists to identify vacant areas and educational centers in the areas of influence.
- 2) Form a group of specialists and educators who will be responsible for the development of the programs.
- 3) Formulate proposals for courses / workshops for the training of volunteer biologists / parabiologists.
- 4) Organize teams trained in surveying and monitoring.

2. 2. 3 Indicators and terms. By the beginning of 2019, Actions 1 to 3 will be completed. By July and August 2019, volunteer training courses will be running.

Action 4) In the spring-summer of 2019-20, the first surveys and monitoring will take place. In May 2020, the first workshop will be held, which will be presented in a national plenary session coinciding with the National Congress of Herpetology.

2. 3 Identified problem. Databases of scientific collections, researchers, or institutions associated with the study and preservation of the biodiversity of Argentina are imprecise and outdated.

Despite the large number of records that can be obtained from databases, there are often a series of drawbacks relating to studies on species' diversity and distribution that are difficult to solve. However, recognizing these shortcomings, it is still possible to obtain invaluable information. Integrating historical data with current records can provide evidence for any anticipated population changes and threats for the species of a region.

Biodiversity databases need standards that ensure interoperability and exchange of information data among specialists. Argentina already has a set of instruments with rules and principles that provide a firm foundation, but it is likely that they need increased precision and development to meet the emerging needs. Diversity data records will only reach their full potential if the databases are constantly updated, they can interoperate, and are based on a shared set of rules.

2. 3. 1 Goal. To generate common mechanisms and protocols to standardize the information in the databases and ensure periodic updates of the records.

2. 3. 2 Proposed action. Create a group of specialists that generate information protocols, encourage training, and assist in the permanent updating of the records.

2. 3. 3 Indicators and terms. By the beginning of 2019, the base document with protocols for the handling of information associated with databases will be generated. By the middle of 2019, the training and assistance program in updating records will be designed. During 2020, trainings will be developed within the annual AHA Congress or in specific workshops.

2. 4 Identified problem. Insufficient coverage in diversity data and lack of associated information.

Given the low number of researchers and the high overlap in terms of their geographical focus, there is often a significant limitation related to the data that is available for many species of amphibians, and even more for their different populations, both in aspects of their basic biology (phenology, population densities, life history characteristics, habitat requirements, etc.), as well as, aspects of their geographic distribution (historic locations, extensions or retractions of geographic ranges).

Since the objective of collecting and / or recording specimens is often not related to studies of local diversity and distribution, areas where it is presumed that species will not be found, including highly modified areas, are not surveyed. Records tend to be concentrated in easily accessible sites, there is usually a greater representation of conspicuous species, and there may be some temporary bias in the data.

Many historical distribution data are not usually reconfirmed. On the other hand, the data of a "true" absence of the species in a site are sometimes unreliable because it is unknown whether all sites visited have been surveyed with the same intensity or if the focal species has been included in the surveys of that site.

Online databases that report occurrence records and allow specific users to use these metadata are becoming increasingly common. The benefits of these online databases are already widely recognized and several of these systems have been developed by recognized international organizations.

They have significant potential to improve the efficiency of the data flow. They can also help to facilitate interaction and collaboration, increasing the spread of data among the academic sector and the public, encouraging the support of networks of specialists who usually provide verification services, often on a voluntary basis.

There is storage capacity and the necessary infrastructure for the management of biodiversity data and there are

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continuous improvements in the management tools of this type of data. In this respect, it would be beneficial to coordinate actions by generating the inputs for the development of a system for recording data on the amphibians of Argentina in order to foster collaboration networks and integration of these data and to promote collaborative publication at a national level.

2. 4. 1 Goal. To create an information portal of species records that can be sustained by a network of amphibian observers and specialists.

2. 4. 2 Proposed actions.

1) Build a data portal that allows the notification of records, data entry and consultation, and mapped distributions. The database can be reviewed by experts for the identification of species and will offer online tools for the identification of species using photographs, audios and videos. The web site may include descriptions, identification guides and data on amphibian species from Argentina.

2) Generate standards that provide a safe and equitable basis for the dissemination and use of data supporting interoperability and data exchange between specialists, academic sectors and public control agencies.

2. 4. 3 Indicators and terms. Action 1) By the beginning of 2019, the first beta version of the portal will be generated and available for consultation to all researchers interested in reviewing it and proposing modifications. By the end of 2019 a first version of the open access web portal will be created, including all of the agreed tools.

Action 2) By mid-2019, a set of terms and conditions that guarantee the dissemination and safe and equitable use of the information that will host the web portal will have been generated.

2. 5 Identified problem. A lack of channels for the publication of systematized surveys of amphibian diversity from different areas or regions of Argentina.

Many diversity surveys or faunal lists that include amphibians in their lists are usually scarcely disseminated through classical mechanisms of scientific communication (in the form of books, chapters or publications in referred periodical journals). The most frequently cited cause is the reluctance of many specialized journals to publish extensive articles with collection information and / or because they are local or regional journals, lacking the global significance that most international scientific journals intend to offer. In the same way, the publication of these results is often inaccessible in the form of books or chapters because of the high printing costs. This problem often prevents access to information that would be invaluable in establishing the state of conservation for a large portion of amphibian species in Argentina.

The publication of books or journals in digital format is becoming an increasingly popular mechanism for scientific communication. This alternative opens up a concrete possibility to promote the publication and dissemination of valuable information that is otherwise usually archived in the form of reports or unpublished data. If this form of dissemination is integrated into scientific journals with recognized national and regional prestige, authors of these data may be encouraged by an accessible and controlled way to publish the results of their work.

2. 5. 1 Goal. To promote the creation of an alternative for the publication of survey data and species lists with standards and review procedures that guarantee their dissemination in recognized scientific journals.

2. 5. 2 Proposed actions.

- 1) Propose the creation of an electronic section in the journal Cuadernos de Herpetología that allows the publication of surveys and species lists under author norms and corresponding review processes.
- 2) Propose a group of specific associate editors to establish the standards of the type of studies for publication in the journal.

2. 5. 3 Indicators and terms. Action 1) By the beginning of 2019, the creation of the new electronic section in the journal will be proposed to the editors of Cuadernos de Herpetología and the instructions to authors will be defined.

Action 2) By mid-2019, the group of specialists will develop the author instructions and propose them to the editors of the journal. By the beginning of 2020, the author instructions will be proposed to the journal and a team of Associate Editors for the new electronic section will be established. By the end of 2020, at least one publication will have been published in the new electronic section.

COMPONENT 3. THREATS



Threats

3

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3. 1 Identified problem. The knowledge of direct and indirect threats of natural or anthropogenic origin about the amphibians of the Argentine Republic is incipient and only focuses on some species, type/s of threat/s or region.

The main environmental threats facing amphibians in Argentina have been synthesized and analyzed in a general context by Lavilla (2001) and Lavilla and Heatwole (2010). In this sense, these authors pointed out ten threats for Argentina: habitat loss, conversion of native natural areas into areas of agricultural use, alteration of water bodies, expansion of urbanization, pollution of diverse origins, introduction of exotic species, diseases, increased UV radiation, climate change and commercial exploitation. All these threats are coincident with those mentioned on a global scale (Stuart *et al.*, 2004, 2008), including enigmatic declines (those taking place in pristine or protected natural environments).

These threats have been studied by various authors around the world, both individually and in an additive or synergistic way, leading to controversies in the mechanisms of threats, how they affect the biological parameters, the scales (individual, population, spatial, temporal, etc.) that should be analyzed, as well as, future predictions or projections. In this sense, Blaustein *et al.* (2011) noted that the global decline of amphibians should be studied at the community level for the key role of these vertebrates play within ecosystems and their consideration as bioindicators: (i) Habitat loss includes alteration and destruction of the environments by the conversion of natural areas into agricultural, livestock and industry areas, the drainage of wetlands, and the expansion of urban environments. (ii) Chemical and organic pollution that is manifested by the presence of metals, agrochemicals, emerging pollutants (pharmaceutical products for veterinary and human medicinal use, and personal care products) and biocides for the control of vectors (e.g. *Bacillus turingiensis*), products of different human activities (mining, pastries, agroindustry, prevention of vectors, among others). (iii) The introduction of vertebrate species (including amphibians) from other ecoregions or from other regions of the world directly or indirectly affects the amphibians. Within this threat, commercial exploitation and pets are included. (iv) The presence of emerging diseases refers to reported cases of chytridiomycosis (caused by the fungus *Batrachochytrium dendrobatidis*) and

Ranavirus infections (with erythema, general inflammation and hemorrhages in one or more organs or tissues). (v) The incidence of UV radiation due to the destruction of the ozone layer stratospheric refers to a threat that has been considered at the individual as well as multicausal level (acidification of the water, contamination by chemicals and increase in water temperature). (vi) Climate change is related to increases in global temperature, UV radiation and variations in rainfall regimes. Likewise, this threat has been considered at the single or multicausal level. (vii) Synergy of threats. Although there is evidence of declines in amphibian populations since the 1950s (Conant, 1958), the scientific community began to study and pay attention to the magnitude and global reach of the problem in 1989, during the First World Herpetology Congress held in England (Wake and Morowitz, 1991). Some assessments on the global status of amphibians revealed that the degradation and loss of habitat is the main threat to amphibians (Stuart *et al.*, 2004, IUCN, 2008) and affects at least 4000 species (Stuart *et al.*, 2008). The impact of modifications and alterations caused by human activities as a result of direct (habitat loss) and indirect causes (contamination by chemicals, UV radiation, diseases) on the survival, bioecology, population status, dynamics and diversity of amphibians, began to be referenced in our country with some isolated studies since the mid-70s (Bustoabab *et al.*, 1977; Salibián *et al.*, 1984; Pérez-Coll *et al.*, 1986, among others).

However, since the 1990s, research on specific threats, as well as, the synergy of several threats, became a more notable beginning in 2005 (some examples: Rengel and Pisanó, 1991; Salibián, 1992; Lavilla and Buti, 1999; Lajmanovich *et al.*, 1998, 2002, 2003a,b, 2005, 2010, 2011, 2015, 2017; Úbeda *et al.*, 1999; Natale *et al.*, 2000; Lavilla, 2001; Izaguirre *et al.*, 2000, 2001; Peltzer *et al.*, 2003, 2004, 2006, 2008, 2010, 2013, 2015, 2017; Lajmanovich and Peltzer, 2001; Ponssa *et al.*, 2001; Vaira, 2002; Attademo *et al.*, 2005, 2007, 2011; Perotti and Dieguez, 2006; Natale *et al.*, 2006; Barrionuevo and Ponssa, 2008; Agostini *et al.*, 2009, 2012; Cuello *et al.*, 2006, 2009; Junges *et al.*, 2010; Bionda *et al.*, 2011a,b, 2013; Nori *et al.*, 2013; Sánchez *et al.*, 2014; López *et al.*, 2015; Pollo *et al.*, 2016; Akmentins *et al.*, 2015; Curi *et al.*, 2017; Velasco *et al.*, 2018). The studies are distributed in different localities, provinces or regions of the country, however, most of the research referring to the contamination by different substances was developed under laboratory conditions, being insufficient to those analyzed under real conditions of field or *in situ*. To this point, there is no current data bank or updated system that can serve as a basis for characterization of biological, ecological and ecotoxicological risk nor a geo-location or geo-reference of completed studies in order to make future predictions.

3. 1. 1 Goal. To detect the main causes of decline of amphibian species by ecoregion based on direct and indirect mortality and the alteration of reproductive sites and survival.

3. 1. 2 Proposed actions.

- 1) Detect the main threats to amphibians of the different ecoregions of Argentina.
- 2) Determine which species are vulnerable and / or in critical condition according to the threat detected by ecoregion.
- 3) Quantify and qualify threats by ecoregion.
- 4) Make a list of vulnerable, endangered, or critically endangered species facing threats that need be studied or whether there is insufficient information.
- 5) Analyze the threats individually and establish the degree of knowledge / information about them.
- 6) Carry out an ecotoxicological data bank of amphibians from Argentina, considering: type of work (field, laboratory, mixed); species and stage (larva, adult); chemical studied (insecticide, herbicide, heavy metal, other emerging contaminants); dose or concentration (lethal, sub-lethal, of environmental relevance).
- 7) Prepare recommendations for the conservation of threatened species by ecoregion and proposal for risk assessment.

3. 1. 3 Indicators and terms. Action 1 to 3) At the beginning of 2020, a National Workshop will have been

developed to survey threats by ecoregion and by species.

Action 2) By the middle of 2020, the analysis of the national survey by ecoregion and by species will be completed and the result of the survey will be presented in the Argentine Congress of Herpetology.

Action 4 to 6) By the end of 2020, the document that qualifies and quantifies the threats will have been prepared by ecoregions and indicates the degree of existing information. The same will be done for the relationship ecoregion-threat-species.

Action 5 to 7) At the beginning of 2021, the list of vulnerable, endangered, or critically endangered species and species with insufficient information will be published according to the threats identified. Additionally, there will be a risk assessment plan generated for the different threats.

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COMPONENT 4. EVALUATION and CATEGORIZATION of the CONSERVATION STATUS



Evaluation and Categorization of the Conservation Status

4

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4. 1 Identified problem. Outdated categories and data of the amphibian species of Argentina included in the IUCN Red List of Threatened Species.

The inclusion of a species in some category of threat within the IUCN Red List of Threatened Species constitutes, often, the only support and justification for numerous initiatives and global or regional conservation projects. In the same way, the IUCN Red List is used by various international funding agencies to justify and support the decision-making related to the support of research and conservation actions in certain species of amphibians. For these reasons, it would be very valuable if the categorization of the Argentine species indicated in the IUCN Red List (and all its associated data) is kept up-to-date, minimizing the degree of uncertainty or inaccurate information for the greatest number of species.

An example of the risks of not keeping databases updated is the use of distribution maps of amphibian species, originally published by the Global Amphibian Assessment (GAA) in 2004, that were prepared based on the consensus of specialists (e.g., www.iucnredlist.org/initiatives/amphibians), but on many occasions without sufficient documentation and based on large-scale maps, where wide margins of error were tolerated. These same maps were then submitted into the IUCN Red List database with free access and used in an increasing number of studies that associate the distributions of amphibians with various aspects of their biology, ecology and threats. Many distributions (represented as dot clouds or polygons) maintain strong precision errors due to the lack of data updated since the last evaluation in 2004. Although new assessments and updates have already been made for the amphibians of Argentina, a minor part of these updates have been focused on the correction of distribution. A new update will surely eliminate a large amount of inaccurate or insufficient information, reducing the uncertainty and errors in the regional or global analyses that are being performed using these data.

4. 1. 1 Goal. To propose the updating of the information for the amphibian species of Argentina on the IUCN Red List of Threatened Species.

4. 1. 2 Proposed actions.

1) To form a group of specialists who, through workshops or networking, generate the basic information

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for the updating of the information for each species present in Argentina, and included in the IUCN Red List, according to the criteria and procedures established by IUCN (Pre-Assessment Process for the IUCN Red List).

2) Combine the information generated by the specialists with the Species Information System (SIS) of IUCN and then send the results of the update for review and publication.

4. 1. 3 Indicators and terms. Action 1 and 2) By the end of 2019, updated information will have been generated and agreed upon by the specialists, and will have been presented to those responsible for updating the IUCN Red List for each species.

4. 2 Identified problem. Lack of basic information on distribution and basic characteristics of life histories (abundance estimates, natural / seasonal fluctuations, trophic aspects, reproductive characteristics, etc.) of the Data Deficient (DD) or recently described species.

According to the data provided by the latest classification of Amphibians of Argentina (Vaira et al., 2012), our country has 175 species and subspecies of amphibians. Of these, 12% (n = 21) are included in the category of Data Deficient (DD). This situation is particularly delicate both for the order Gymnophiona (four species), as well as, for families of the order Anura: Brachycephalidae and Centrolenidae (with one species each) which have all its members under this category. This implies a large information gap about the state of conservation, not only of particular species but of families and even complete orders for our country.

From a geographical point of view, we can see that the province of Misiones (n = 9) followed by Neuquén (n = 3) and Río Negro (n = 3) are those that present more species categorized as DD.

4. 2. 1 Goal. To work, in a focused manner, on the list of species categorized as Data Deficient, forming interdisciplinary working groups that can contribute their knowledge at the local and regional levels.

4. 2. 2 Proposed actions.

1) Carry out periodic virtual exchanges between researchers to prepare a complete list and updated of the DD and recently described species.

2) Contact researchers who are working in the same distribution area or who have worked on some aspect of their life history to coordinate working groups that aim to expand the information on each species.

3) Promote focused research on little-known species, creating a space for exchange of information regarding their conservation status in scientific congresses and meetings and promoting the exchange of data.

4. 2. 3 Indicators and terms. Actions 1 to 3) Every year (2019-2022), a report on the conservation status of the DD species and recently described species will have been prepared.

4. 3 Identified problem. Validity and / or continuity of the method used in 2012, for future categorizations and / or updates of the state of conservation of the amphibians of Argentina. Lack of compatibility between the previously used method and the IUCN method.

In Argentina, the first categorization of species of its fauna dates from 1983. It was made by J. M. Gallardo and was reflected in the Resolution No. 144/83 of the Ministry of Agriculture and Livestock. Later, in 1993, the Sub-secretary of Natural Resources of the Nation decided to update the categorization of the Argentine fauna with the

endorsement of "entities of recognized scientific hierarchy" and entrusted the task to the National Directorate of Wild Fauna and Flora. This directorate decided to carry out the update on an objective basis and with the help of specialists who would be summoned to work in workshops. Since 1998, the Argentine Herpetological Association contributed to the dissemination and organization of two workshops that brought together herpetologists from all over the country and whose results were published in the book "Categorization of Amphibians and Reptiles of the Argentine Republic", edited by Lavilla *et al.* (2000). This categorization had legal value through Resolution No. 1030/04 of the Secretariat of Environment and Sustainable Development (S.A. and D.S.), which replaced the previous resolution. Subsequently, updates to the list of species were made (Lavilla and Cei 2001 and Lavilla and Heatwole, 2010).

In 2010, a new process of recategorization of the herpetofauna of the country was carried out, in which 35 specialists in amphibians from all over Argentina participated, and they were responsible for reevaluating the conservation status of the 175 amphibian taxa cited for the country based on new information on its taxonomic, biogeographical, and bio-ecological aspects, and the inclusion of methodological modifications with respect to the previous categorization. The results on amphibians (Vaira *et al.*, 2012) were published in the book "Categorization of the Conservation Status of the Herpetofauna of the Argentine Republic". From this recent work, it is known that Argentina harbors 175 taxa of amphibians: eight are Endangered, 11 Threatened, 32 Vulnerable, 21 Insufficiently Known and 103 Not Threatened. This latest categorization was legally enforceable through Resolution No. 1055/13 of the S.A. and D.S.

In the recategorization of the conservation status of the herpetofauna made in 2012 (Giraudo *et al.*, 2012), the methodology previously used in Lavilla *et al.* (2000) was discussed and improved, which in turn was based on the work of Reca *et al.* (1994). This methodology was compared with other proposals including the methodology applied by IUCN. There are operational differences between the methods. In summary, the method of Reca *et al.* (1994) and later, are based on a sum of values of determined range, previously assigned to a series of variables of importance for conservation. Based on the final value, conservation categories are assigned to each range of values. In the case of IUCN, they also work with a series of variables, although the resulting conservation category is not necessarily due to the sum of all of them but may result from the combined threshold values in two or more variables (e.g. area of occupancy of 90 km² and existence of threats).

Each methodology has its pros and cons, and these are sensitive to the degree of uncertainty existing for variables directly associated with extinction risk, such as the population viability of target species and / or the "real" threat effect. Unfortunately, this information is unknown for most species of Argentine herpetofauna. In this context it is important to discuss the scope of the methods previously used and evaluate the possibility of improving them, including factors for the management or identification of the degree of uncertainty for each species.

4. 3. 1 Goals.

- 1) To perform a new revision of the methods and its variables in order to determine its future applicability.
- 2) To evaluate the validity of the 2012 categorizations in real terms (category of conservation versus the current situation of the species).

4. 3. 2 Proposed actions.

- 1) Generate a discussion space in order to review in detail the methods applied to define national (2012 assessment) and international (IUCN) categories.
- 2) Evaluate hypothetical and real cases to determine the robustness of each of these methods.
- 3) Based on the results and discussions generated, suggest adjustments for the previously used methodology.

4. 3. 3 Indicators and terms. Action 1 and 2) By the end of 2019, a document will be agreed upon with a discussion and evaluation of previous systems used (national and international).

Action 3) For the first half of 2020, adjustments to the national assessment methodology will have been proposed.

4. 4. Identified problem. Lack of mechanisms to update the conservation status of recently described species or those whose taxonomic status has been modified.

One of the main disadvantages to having a complete and current list of species with their corresponding conservation status is, in many cases, the lack of updated information available both to the evaluators responsible for categorizing them and to the entities in charge of granting legal protection. A valuable antecedent is the decision of the National Directorate of Wildlife that had incorporated in Resolution No. 1030/04 that any nomenclatural change, new registration of species for Argentina, or the description of new species, should cause that taxon to automatically pass to the category of Insufficiently Known.

4. 4. 1 Goal. To streamline the exchange and updating of information between researchers and evaluators, and of these with the entities responsible for providing legal framework for the conservation of amphibians from Argentina.

4. 4. 2 Proposed actions.

- 1) Establish an interactive system that allows the fluid exchange of information among researchers, evaluators and governmental entities responsible for the conservation of biodiversity, in order to modify or determine the conservation status of new species or modify those already listed as new data emerge.
- 2) Implement a mechanism to update the lists in government agencies, so that the modifications or updates of the list of species and their conservation status have legal support and help the effective protection of them.

4. 4. 3 Indicators and terms. Action 1) Every year (2019-2022) integrated virtual workshops will be developed by representatives of different levels in which the lists of species and their corresponding conservation status will be reviewed and updated.

Action 2) By mid-2020, a mechanism will be agreed with the government agencies in charge to update the conservation status of the amphibian species of Argentina, facilitating access to all available information to the organisms that provide a legal framework for the protection of the species.

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COMPONENT 5. LINKAGE



Linkage

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5. 1 Identified problem. Lack of coordination between strategic conservation plans generated by research centers, researchers and / or museums, with key actors involved in the conservation of biodiversity and the management of resources such as: a) National, provincial and municipal governmental entities; b) Local actors (owners of priority areas for conservation of threatened species or of high diversity value; population, etc.); c) National and local NGOs.

The recent crisis of the global decline of amphibians has generated a new area which are conservation projects of financed by NGOs. In general terms, most of these conservation funds are destined for species-based conservation, in other cases to address focal environmental problems, and to a lesser extent to the preservation of the biodiversity of ecosystems or ecoregions. As a general rule, conservation projects have a component of outreach and awareness-raising about the problem of conservation of species, threats or regions. Local examples of conservation projects carried out in the last decade include face-to-face environmental education, graphic, audiovisual, multimedia platforms and social networks.

5. 1. 1 Goal. To coordinate conservation plans generated by research centers, researchers and / or museums with key stakeholders interested in the management of resources.

5. 1. 2 Proposed actions.

- 1) Promote participatory workshops in order to integrate the different actors with the ability to influence potential management decisions.
- 2) Develop dissemination material to involve the mentioned actors.

5. 1. 3 Indicators and terms. Action 1) By the second half of 2019, a document will have been drawn up identifying the main actors involved in the management and conservation of priority amphibian species of Argentina. By the beginning of 2020, a workshop with national and / or provincial authorities linked to the management and conservation of biodiversity will have been finalized to publicize the existing conservation plans and establish the necessary coordination.

Action 2) At the beginning of 2020, outreach material on the Action Plan will have been produced to

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disseminate among various stakeholders linked to the protection of biodiversity.

COMPONENT 6. INFORMATION, DISCLOSURE AND PARTICIPATION TOOLS



Information, Disclosure and Participation Tools



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6. 1 Identified problem. The general public has little knowledge about the diversity and biology of amphibians of Argentina.

The public is unaware that Argentina is one of the countries with the greatest diversity of amphibians in Latin America, presenting around 175 species, with a large proportion of endemic species, unique life cycles and physiological and / or behavioral adaptations to extreme environments (among others). The general view is that the diversity of amphibians is limited only to toads, frogs (including, the common misconception that frogs are the feminine version of toads) and horned frogs. One of the most problematic aspects when it comes to generating interest in community on the conservation of amphibians is the lack of knowledge about the role they play in ecosystems, as well as the benefits that this group can provide. Also, popular legends or myths proliferate about the dangerousness or harmful characteristics of amphibians. In large part, this lack of knowledge is based on the difficulty faced by the public, educators and / or those interested in nature to access quality information with simple and comprehensible language about amphibian fauna. Under the premise "you do not preserve what you do not know" is that you should be able to generate information about the diversity of amphibian species in Argentina and their conservation problems, which involves clear language and is accessible to all types of public. On the other hand, private or state (national, provincial and municipal) museums, are the most common places where the general public attends to learn the natural sciences. Although amphibians rarely occupy primary positions within permanent or temporary exhibitions, this trend has been reversed in recent years, mainly by initiatives such as "The Night of the Museums", where researchers can communicate about their research and study organisms directly with the public.

6. 1. 1 Goals.

1) To edit a periodic series of booklets on the amphibian fauna of Argentina.

- 2) To increase the representation of amphibians in permanent or temporary exhibitions of museums.

6. 1. 2 Proposed actions.

- 1) Assemble those interested in participating in the editorial board.
- 2) Invite researchers suggested by the editorial board to write about species of amphibians of Argentina.
- 3) Publish, both in digital and printed format, booklets on the amphibian species of Argentina.
- 4) Create a network with researchers who have links with public or private museums (national, provincial and municipal).
- 5) Promote the inclusion of exhibitions on species or diversity of amphibians of Argentina.

6. 1. 3 Indicators and terms. Action 1) By the beginning of 2019, the editorial board will have been formed.

Action 2) By the end of 2020, the first booklet will have been published electronically online in open access and free to download. Simultaneously, the search for governmental or non-governmental sponsors interested in its publication in a printed format will be encouraged.

Action 3) By the end of 2022, all of the booklets will have been published in electronic format and as a printed volume gathering the entire collection.

Action 4) By the beginning of 2019, a list of partners interested in collaborating on the initiative to increase the representativeness of amphibians in museums exhibitions will be compiled. At the beginning of 2021, at least one exhibition (permanent or temporary) will be incorporated into a museum as a result of the initiative.

Action 5) By the end of 2022, at least 50% of the number of exhibitions permanent or temporary stipulated at the beginning of the initiative is reached.

6. 2 Identified problem. The public has little knowledge about the problem of amphibian conservation and the daily actions that can be carried out in order to preserve the diversity of amphibians.

Accompanying the diversity of the amphibians of Argentina, there is a wide variety of threats that threaten the long-term preservation of their populations. For some of these threats there is a relative knowledge of the impact caused, in others there is no consensus on its possible effects and, for many, the real impacts on the diversity of amphibians are unknown. On the other hand, the members of the community have little knowledge about the situation of the decline of amphibian diversity and the threats that cause or contribute to it. Rarely, communication or awareness activities are addressed from a multidisciplinary approach that includes researchers, social communicators and educators. It would be desirable to implement an education and outreach campaign that not only provides biological information on the diversity of amphibians, but also reports on the threats they face along with their possible reversion or mitigation. Within these, it is important to reflect on the degree of responsibility of different social actors in the resolution or mitigation of the environmental conflict involved, highlighting the different ways in which the community can make contributions to preserve amphibians, even in their daily activities.

6. 2. 1 Goal. To generate an educational guide that includes instructional material on general aspects of the biology of amphibians, their diversity, the importance of their conservation and the daily actions that can be performed for the preservation of this group. This material may be used and replicated by teachers and environmental educators in areas of formal and non-formal education.

6. 2. 2 Proposed actions.

- 1) Invite researchers, professionals of the educational sciences, artists and computer technicians to

generate educational proposals that will make up the educational guide.

2) Define the format to publish the guide.

3) Publish and disseminate the guide in different levels of the formal and non-formal educational system.

6. 2. 3 Indicators and terms. Action 1) By the beginning of 2019, an editorial board will be constituted, and authors will be invited to collaborate on the educational guide.

Action 2) By the end of 2022, the material will have been published in the agreed format.

6. 3 Identified problem. The majority of protected natural areas within the jurisdiction of the National Parks Administration (NPA) and provincial or municipal authorities, lack basic information on amphibian diversity.

Protected natural areas are visited by the community in a recreational way and by the public more focused on the knowledge of biodiversity that these areas protect. Although these are excellent places for the dissemination of amphibian diversity of Argentina and to raise awareness in the community about the importance of preserving it, this information is rarely available. The inventories of flora and fauna constitute the baselines to establish a protected natural area and to develop appropriate management plans that, in general, are based on rapid surveys of diversity, where amphibians are usually under-represented and these data are not usually available to the general public or researchers.

6. 3. 1 Goal. To contribute to the generation of audiovisual material on the diversity of amphibians (flyers, posters, identification guides, bioacoustic and video records) present in the protected natural areas of the NPA jurisdiction (*).

6. 3. 2 Proposed actions.

1) Form an organizing committee that will contact the authorities of the NPA to present the proposal.

2) Conduct a workshop with stakeholders (researchers, students, naturalists, authorities of the NPA) to establish priorities of protected natural areas, work schedules, availability of funds and formats for the publication of the dissemination material.

3) Promote the production of the material to be delivered among the visitors of the protected natural areas.

6. 3. 3 Indicators and terms. Action 1) By the beginning of 2019, the organizing committee will be formed and will contact the authorities of the NAP to communicate the initiative and coordinate the activities.

Action 2) By the end of 2020, a workshop will have been held to prepare the list of protected natural areas and the format of the dissemination material.

Action 3) By the end of 2022, at least one of the agreed natural areas will have dissemination material available.

(*) This can be replicated for protected natural areas of any jurisdiction (provincial and municipal) or status (public or private).

6. 4. Identified problem. Disparate access to funds for amphibian conservation and / or environmental education projects.

The recent crisis of the global decline of amphibians has generated a growing interest reflected in the development of conservation projects financed by NGOs. In general, most of these conservation funds are destined for species-based conservation, in other cases to address focal environmental problems and, to a lesser extent, the preservation of the biodiversity of ecosystems or ecoregions. As a rule, conservation projects have a component of outreach and awareness-raising about the problem of conservation of species or regions, with emphasis on direct and potential threats. Examples, at the local level, of conservation projects carried out in the last decade include face-to-face environmental education, graphic, audiovisual, multimedia platforms and social networks.

6. 4. 1 Goal. To bring stakeholders (researchers, educators, natural resource managers, etc.), information on strategies to access funds for the conservation of amphibian diversity and / or environmental education.

6. 4. 2 Proposed actions.

- 1) Invite researchers and conservationists with experience in the execution of conservation projects to dictate a course on strategies to funding access destined to conservation of amphibian diversity and / or environmental education.
- 2) Dictate a course during the National Congresses of Herpetology.

6. 4. 3 Indicators and terms. Actions 1 and 2) By the end of 2018 and 2020, the course will have been given at the respective annual National Herpetology Congresses.

6. 5. Identified problem. Underutilization of online communication tools and apps for mobile devices for the diffusion of the conservation of amphibians of Argentina.

In coincidence with a global tendency to use the internet as a mass medium of diffusion, the increasing use of internet and social networking sites for the publication of information on the diversity and conservation of amphibians in Argentina (mainly Facebook® and to a lesser extent other such as Instagram® and Twitter®) is remarkable. Another emerging technology, which is not yet being exploited to disseminate information and involve the community in the conservation of amphibian diversity, is the applications for mobile devices and smartphones (apps). This is a communication channel of enormous potential due to its massiveness, speed of transmission and capacity for community integration.

6. 5. 1 Goal. To bring interested partners information on communication strategies in digital media.

6. 5. 2 Proposed actions. Invite experts in communication in social networks and digital media to give introductory courses on online communication tools and apps for mobile devices during the annual National Herpetology Congresses.

6. 5. 3 Indicators and terms. By the end of 2019 and 2021, the course will have been given during the respective annual National Herpetology Congresses.

Appendix I: Compilation of audiovisual and graphic material published for the recognition of the amphibian diversity of Argentina

- Agostini M.G. 2012. Ranas y sapos del fondo de tu casa. Anfibios de agroecosistemas de La Plata y alrededores. Editorial EDULP.
- Aguilar, R. & Aros, L. 2014. La Payunia. Reptiles y anfibios. Independiente.
- Aguilar, R. & Barauna, A.A. 2014. Reptiles y anfibios de la reserva de la biosfera de Ñacuñán. Guía educativa sobre las especies. Independiente.
- Akmentins, M.S.; Pereyra, L.C.; Bonduri, Y.V.; García, C.G.; Contreras, P.M.; Lépez, M. & Vaira, M. 2014. Guía de Campo. Anfibios de las Selvas de Yungas de Argentina. Conservation Leadership Programme. DOI: 10.13140/RG.2.1.3415.2480.
- Álvarez, B.B.; Aguirre, R.H.; Céspedes, J.A.; Hernando A.B.; & Tedesco, M.E. 2002. Atlas de Anfibios y Reptiles de las provincias de Corrientes, Chaco y Formosa (Argentina). I. Anuros, Cecílicos, Saurios, Anfisbénidos y Serpientes. EUGENE. Corrientes.
- Carrizo, G. R. & E. A. Varela de Olmedo. 1993. Anfibios de la provincia de Buenos Aires. El Naturalista, 5 (suplemento 5).
- Gallardo, J.M. 1987. Anfibios y Reptiles del Partido de Magdalena (provincia de Buenos Aires). Fundación E. Shaw de Pearson. Buenos Aires.
- Guzmán, A. & Raffo, L. 2011. Guía de los anfibios del Parque Nacional el Palmar y la Reserva Natural Otamendi. Editorial APN. Buenos Aires.
- Ghirardi R. & López J.A. (Coords.). 2017. Anfibios de Santa Fe. Ediciones UNL. Santa Fe.
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- Lescano, J.N.; Leynaud, G.C.; Lascano, E.; Haro, G. & Bonino, E.E. 2009. Anfibios de Córdoba. Serie Educación Ambiental N° 12. Centro de Zoología Aplicada Facultad de Ciencias Exactas, Físicas y Naturales. Córdoba.
- López, A. & Prado, W. 2012. Anfibios y reptiles de Misiones: guía de campo. Independiente.
- Quiroga, L.; E. Sanabria; J. C. Acosta & G. Blanco. 2008. Guía de sapos y ranas del departamento Calingasta, San Juan. Independiente.
- Sanabria E. & L. Quiroga. 2008. Guía Sonora de Anfibios de la Provincia de San Juan. Independiente.
- Zaracho, V. H.; Céspedes, J.A.; Álvarez, B.B. & Lavilla, E.O. 2012. Guía de Campo para la identificación de los anfibios de la provincia de Corrientes (Argentina). Fundación Miguel Lillo. Tucumán.

Appendix II: Web pages and pages on social networks on amphibian conservation in Argentina

- Anfibios de Córdoba: Diversidad y Conservación

<https://www.facebook.com/cbanfibios/>

- Anfibios del Litoral, Ecotoxicología y Conservación

http://anfibios-ecotox-conser.blogspot.com.ar/2013/10/area-de-estudio_22.html

- Conservación de Anfibios en Agroecosistemas (CoAnA)

<http://coana.com.ar/>

<https://www.facebook.com/coanaarg/>

<https://soundcloud.com/anfibiosargentinos>

@AnfibiosCoAnA (Twitter)

@coana_arg (Twitter)

- CANOA – Conservación de Anfibios del Noroeste de Argentina

<https://www.facebook.com/canoaanfibios/>

@canoa_anfibios (Instagram)

- Cururu: Programa de Conservación y Rescate de Anfibios Argentinos

<https://www.facebook.com/programacururu/>

- Gigante de las Pampas / Gigante dos Pampas

<https://www.facebook.com/gigantedelaspampas/>

Conservation Action Plan for the Amphibians of Argentina

- **Meseta Salvaje**

<https://www.facebook.com/MesetaSalvaje/>

- **SAVE THE FROGS! Buenos Aires**

<https://www.facebook.com/buenosairesstf/>

@buenosairesstf (Twitter – Instagram)

- **Proyecto Rana Andina Austral**

<https://www.facebook.com/proyectoranaandinaaustral/>

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