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## ALSODES PEHUENCHE (ANURA: CYCLORAMPHIDAE): PAST, PRESENT AND FUTURE

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**R E S U M E N.** — *Alsodes pehuenche* es una especie endémica del Valle Pehuenche, en los Andes centrales de la Argentina, en el límite con Chile. Su biología es pobremente conocida y, en consecuencia, ha sido incluida en la categoría de Datos Insuficientes por la UICN. En esta contribución se proporcionan nuevos datos para la especie y se describen las amenazas que está sufriendo. La pavimentación de la ruta nacional 145 ha modificado los cursos de agua de los arroyos habitados por *A. pehuenche*, produciendo una alteración del hábitat y una mortalidad cercana al 25% de la población. Se cita por primera vez a *A. pehuenche* para Chile, aumentando su distribución geográfica conocida que alcanza los 9 km<sup>2</sup>. En el futuro, partículas contaminantes provenientes del tránsito vehicular podrían alcanzar los arroyos modificando seriamente la calidad del agua. Tanto la alteración de los cursos de agua como la contaminación, junto a otras amenazas importantes como el ganado doméstico, eventos de crecidas naturales y el cambio climático, podrían afectar severamente la supervivencia de la especie, especialmente si se tienen en cuenta sus hábitos acuáticos y su peculiar ciclo de vida con un período metamórfico que dura varios años. Se están llevando a cabo acciones de conservación, pero el éxito de las mismas aún no está garantizado. El esfuerzo conjunto de investigadores y gobierno es esencial para lograrlo. Consideramos que en la actualidad hay datos suficientes para realizar un cambio de categoría de amenaza, de Datos Insuficientes a especie Críticamente Amenazada.

**PALABRAS CLAVE:** Conservación, ranita del Pehuenche, amenazas, peligro crítico.

**A B S T R A C T.** — *Alsodes pehuenche* is an endemic species of the Pehuenche Valley in the Central Andes of Argentina, on the border with Chile. Its biology is poorly known, and in consequence, has been categorized as Data Deficient by IUCN. In this contribution, we give new data on the species, and describe the threats it is facing. The paving of national route 145 modified the courses of the streams inhabited by *A. pehuenche*, producing habitat alteration and mortality of nearly 25% of the population. For the first time, *A. pehuenche* is cited for Chile, expanding its known geographical distribution area that reaches 9 km<sup>2</sup>. In the future, contaminant particles from vehicle traffic could arrive in the streams modifying water quality. Alteration of watercourses and contamination, as well as other important threats like domestic livestock, natural flooding events and climate change, could severely affect survival of the species, especially taking into account their aquatic habits and their peculiar life cycle with a metamorphic period that lasts many years. Conservation actions are in progress, but success is not yet guaranteed. A partnership between researchers and government is essential for success. We believe that information about *P. pehuenche* is now enough to make a category change from Data Deficient to Critically Endangered.

**KEYWORDS:** Conservation, Pehuenche's frog, Threats, Critically Endangered.

Conservationists agree that the major causes of decline or extinction of species are of anthropic origin (habitat destruction and fragmentation, contamination, introduction of exotic species, climate change) as well as emerging infectious diseases (Young *et al.*, 2001; Collins and Storfer, 2003; Stuart *et al.*, 2004; Pounds *et al.*, 2006). Species management is only possible when basic aspects of their biology are known in order to be able to take the right steps towards recovery of the populations, and red lists help conservationists to prioritize efforts directed toward biodiversity preservation.

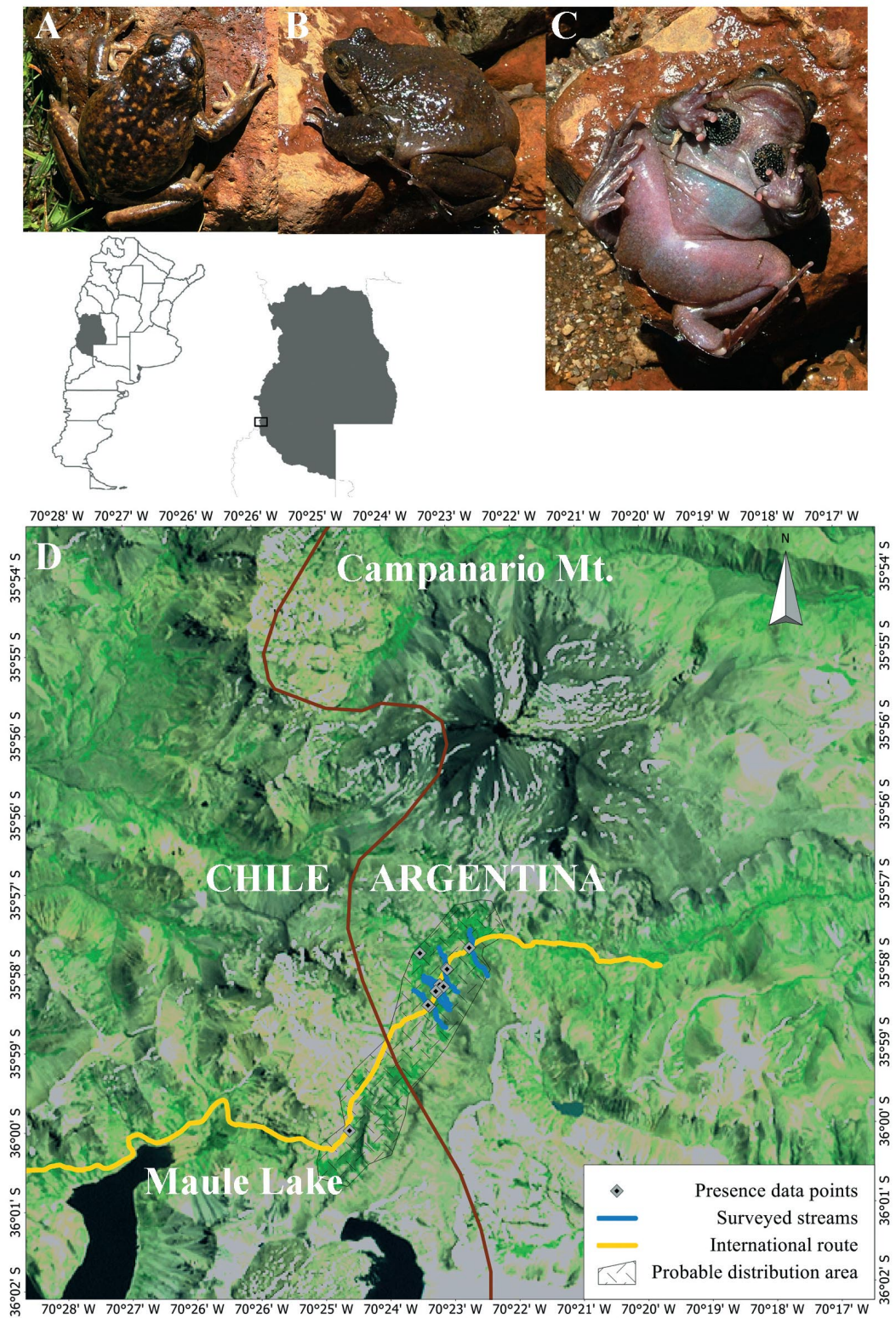
*Alsodes pehuenche* (Ceí, 1976) (Fig. 1A-C) was described from mountain snowmelt streams of the Pehuenche Valley in the Central Andes of Argentina, on the border with Chile (WGS 84, 35.97342° S, 70.38181° W, 2523 m asl) (Fig. 1D). During 30 years no studies were made on its biology, and no new localities were reported for the species, which remains as endemic to this area. Because of the absence of biological data, this species has been categorized as Data Deficient by IUCN (Lavilla and Basso, 2004) as well as by Lavilla *et al.* (2000) at national level, and no attention to its actual conservation status has been manifested by biologists or governmental authorities up to the present time.

In 2006, the beginning of the paving of national route 145, which includes a mountain pass toward Chile, alerted us about the possible impact of these works on the population of *A. pehuenche*, since this road cuts across the streams inhabited by the frog. Since February 2007 to date, we assessed the population status and the possible impact of the paving works and consequent vehicular traffic on the habitat of *A. pehuenche*, detecting serious risks for the species' survival. The aim of this contribution is to present the actual status of the population and its risks in order to set precedent for changing

this species' conservation status at local and global level.

## DISTRIBUTION AND POPULATION SIZE

The attempts to find individuals of *A. pehuenche* in streams other than those near the International Pehuenche Pass failed (Corbalán *et al.*, 2008). We found suitable conditions for this species only in five streams that flow down towards the Argentinean side from the northwest-facing slopes of the Pehuenche Valley (Fig. 1D and Fig. 2). In the Chilean side, at least in one stream from the same slope (WGS 84, 36.0004° S, 70.4041° W, 2450 m asl) were observed high concentration of different aged tadpoles, especially in small ponds near the route. Thus, this is the first known record of *Alsodes pehuenche* for Chile, although more studies are necessary to determine the geographic distribution and population status of this species in that country. Only a few metamorphosed isolated individuals were found in streams located on the opposite side of the Pehuenche valley (facing southeast) in Argentina. According to these data, the known distribution area for the species is about 9 km<sup>2</sup> (Fig. 1D), which encompasses all the above cited streams. This area is smaller than the minimal area considered by IUCN (criteria B1 and B2) for species in critical risk of extinction (UICN, 2001). However, taking into account that this species occupy only those streams and swamps inside of this distributional area, the effectively geographic occupation is clearly lower than the 9 km<sup>2</sup> estimated. A study conducted in January 2008 in the Argentinean side (unpubl. data.) allowed us to count 350 metamorphosed individuals (juveniles and adults) and approximately 1000 tadpoles of different stages and ages. We infer that the population at that time did not exceed 500 metamorphosed individuals, a low number



**Figure 1.** *Alsodes pehuenche*. A: Adult female, dorsal view. B: Adult male, lateral view. C: Adult male, ventral view. D: Known geographic distribution for *Alsodes pehuenche*.



taking into account that this is an endemic species and that it is only present at one locality.

### HABITAT ALTERATION

The habitat of *A. pehuenche* (Fig. 2) was described as snowmelt streams with stony banks covered by herbaceous vegetation and ponds of spring water, probably thermal, rich in sulfur deposits (Cei, 1965; Cei and Roig, 1965; Cei, 1976). However, our studies demonstrated that neither the streams nor the ponds where the species currently occurs are thermal, and that the proportion of sulfur is very low (Corbalán *et al.*, 2008). In contrast, water temperature could be very low in the morning (2-3°C in summer months, -0.5°C in autumn), reaching 19°C at midday. As is expected for snowmelt streams, water is

transparent, with pH ranging from 6.08 to 7.66, very low conductivity (7.3-66.6  $\mu\text{S}/\text{cm}$ ), and very high dissolved oxygen (72-108%).

All five streams inhabited by *A. pehuenche* on the Argentinean side are crossed by the road. In December 2008 we confirmed that the courses of three streams were modified by the paving works, with the consequent drying of original streams and mortality of the individuals present, including metamorphosed individuals and differently aged tadpoles (about 25% of the total population). After many attempts to reverse this situation by the authors and authorities of the environmental agency of Mendoza province, watercourses were reconnected and the habitat is now again ready for colonization by new individuals.

In the future, the paved road could seriously modify water quality, particu-



**Figure 2.** Habitat used by *Alsodes pehuenche* in streams near Paso Pehuenche, 2523 masl, Mendoza Province, Argentina.

larly in the lower reaches of the streams. Contaminant particles from vehicular transit, like Pb, Zn, Cu, Mo, antimony, asbestos, and Polycyclic Aromatic Hydrocarbons (PAHs) (Stadler *et al.*, 2006), could arrive in the streams via lixiviation or winds. Also the salt used for snow melting on the road during winter could alter the ionic composition, conductivity and salinity of water. Actions to avoid or mitigate this kind of contamination are in progress, but success is not guaranteed.

The waste left by tourists is also an important factor to take into consideration. Large amounts of plastics and other non-biodegrading items are found in the streams, especially after bi-national annual meetings at the international border. Increased traffic once the road is paved could also increase the amount of waste in the area.

#### LIFE CYCLE

We have solid evidence suggesting a long metamorphic period that includes more than two winters, as was reported for other congeneric species like *A. gargola*, *A. tumultuosus* and *A. montanus* (Díaz and Valencia, 1985; Logares and Úbeda, 2004; Úbeda *et al.*, 2005; Casanovas *et al.*, 2006). Most of the larvae marked with elastomers in December 2008 with an average of 41 mm total longitude, were found again by April 2010 with 63 mm in average of total longitude and without forelimbs developed, and will probably remain in the same stage throughout the winter until the next favorable season (December–March). Since cohorts at different larval stages coexist at the same microsites, a drastic change in habitat conditions, such as an alteration of watercourses or contamination, could affect several tadpole generations at the same time and compromise the future age structure of the population.

#### EXOTIC SPECIES

Because the streams inhabited by *A. pehuenche* have a maximum width of 2 m and carry a low volume of water, there is no presence of introduced salmonids nor possibility of further colonization. However, these streams flow into the Pehuenche River where exotic trouts (*Oncorhynchus mykiss*) can reach to. The presence of these exotic fishes could prevent dispersal of *A. pehuenche* toward streams located on the opposite slope of the Pehuenche Valley.

The area is also impacted by domestic livestock (cows and goats) that could have an adverse effect on the population of *A. pehuenche*, especially on tadpoles, by trampling on swamps and small ponds, which can change the course of small shallow streams.

#### NATURAL THREATS

Strong storms and snowmelt events common in the area could drag individuals out into the more rushing Pehuenche River, especially tadpoles. A decrease in the number of tadpoles was observed from January to December 2008, which was probably caused by a sudden increase in water volume during May 2008 after an important rainstorm. As adults remain within galleries in the banks of streams, storms and snowmelt may not affect them in the same way as it affects tadpoles.

In addition, climate change would be an important threat to be dealt with by this species. Most precipitation in the Pehuenche Valley falls as snow that accumulates during winter on the tops of hills. Slow snow melting during the warmer season produces water infiltration that supplies water to the streams inhabited by *A. pehuenche*. A change in this hydrological cycle can directly affect the frog population. Less winter precipitation falling as snow and melting of winter snow occurring earlier in

spring are the climate change effects expected for snow-dominated regions (Barnett *et al.*, 2005). According to this, there can be water supply shortage during the summer months, when most of the growth of tadpoles should occur.

### CONSERVATION ACTIONS

Our concern about the future of this endemic species grows by the day. *Alsodes pehuenche* is subjected to several negative actions which, added to its particular lifestyle (strongly associated to pure water, long metamorphic period), could affect its survival. From 2007 to date we have been informing the government environmental authorities about this problem and proposing some mitigation actions. Sometimes we have been listened to, sometimes not. A monitoring program has been set up to control water quality, and several larvae and adults individuals have been marked with elastomers to follow their life cycle and movements. The partnership between research institutions and government is essential to carry out these actions in a successful manner.

### CONCLUSIONS

We believe that there is now enough information about this species to make a category change. Due to its small population size, reduced range extent, as well as to the probability of a strong reduction of the population size in the next few years, we think that IUCN should change the threat category for this species from Data Deficient to Critically Endangered.

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