Short Communication

Dramatic decline and range contraction of the Endangered Patagonian frog *Atelognathus patagonicus* (Anura, Leptodactylidae)

María Elena Cuello, María Gabriela Perotti and Gustavo José Iglesias

Abstract The Endangered frog *Atelognathus patagonicus* is endemic to the Laguna Blanca wetland system, Patagonia, Argentina. This species has undergone a significant contraction of its original distribution, including loss of the main population from the largest lagoon, Blanca. The decline of *A. patagonicus* was first perceived in 1986 and was thought to be at least partially associated with the anthropogenic introduction of the perch *Percichthys colhuapiensis* for sport. To evaluate the potential impact of *P. colhuapiensis* on *A. patagonicus* we surveyed for both species in 28 lagoons, and found *A. patagonicus* present in 23. These lagoons represent, however, only a small percentage of the total wetland area. The presence of *A. patagonicus* was associated with lagoons characterized by absence of *P. colhuapiensis* and high abundance of macrophytes. The most severe problem facing the remaining populations is in the many lagoons currently not protected by Laguna Blanca National Park. Conservation efforts need to focus on the prevention of fish introductions in the wetlands areas on private land. A project to restore *A. patagonicus* to Laguna Blanca, and educational programmes emphasizing the protection of Patagonian wetlands as reservoirs of regional biodiversity, are currently under development.

Keywords *Atelognathus patagonicus*, Amphibia, endangered species, fish, range contraction, Patagonia.

Introduced predators can drive local populations to extinction (Bradford, 1991; Bradford et al., 1994; Gamradt & Kats, 1996; Matthews et al., 2001) and native species that inhabit permanent wetlands, such as amphibians, are frequently the most affected by introduced predators (Wellborn & Skelly, 1996; Kats & Ferrer, 2003). In Patagonia, Argentina, several endemic amphibians are potentially vulnerable to, or have been affected by, introduced species (Perotti et al., 2005; Ortubay et al., 2006). An emblematic example is *Atelognathus patagonicus,* an amphibian endemic to the Laguna Blanca wetland system, Neuquén province (Cei, 1980). This species, categorized as Endangered on the IUCN Red List (IUCN, 2008) and the only native aquatic vertebrate in this lagoon system, was formerly abundant in the 1,667 ha Laguna Blanca, the main lagoon (Péfaur & Duellman, 1980; Administración de Parques Nacionales, 1993). However, it is now restricted to small lagoons inside and outside the National Park (Fox et al., 2005; Cuello & Perotti, 2006). Hypotheses to explain why *A. patagonicus* no longer occur in Laguna Blanca include habitat loss, competition, and predation by perch *Percichthys colhuapiensis* (Fox et al., 2005; Cuello & Perotti, 2006; Ortubay et al., 2006), which were introduced to Laguna Blanca and other small lagoons that are naturally fishless (Ortubay et al., 2006).

The first step in evaluating the potential impact of *P. colhuapiensis* on *A. patagonicus* is to compare presence/absence patterns between similar habitats that currently have and do not have *P. colhuapiensis*. The goals of the study reported here were to (1) determine the current distribution of *A. patagonicus* and *P. colhuapiensis* in the Laguna Blanca wetland system, (2) quantify environmental descriptors (wetland area and other characteristics), and (3) examine how *P. colhuapiensis* presence and environmental variables may influence the distribution of *A. patagonicus*.

From January 2003 to March 2006 we surveyed 28 wetlands in the Laguna Blanca wetland system (Fig. 1). Wetlands were identified using topographic maps (Instituto Geográfico Militar, Argentina) and aerial photographs. The perimeter and area of each lagoon was determined using the geographical information system *ArcView v. 3.1* (ESRI, Redlands, USA) and a LANDSAT TM image (Path 232 Row 88). For each site we quantified coverage of aquatic vegetation by estimating the percentage of within-wetland aquatic vegetation (emergent *Myriophyllum*) in three coverage categories: low (< 20%), moderate (20–60%) and high (60–100%).

To determine presence/absence of *A. patagonicus* and *P. colhuapiensis* we used visual encounters at the water's edge,

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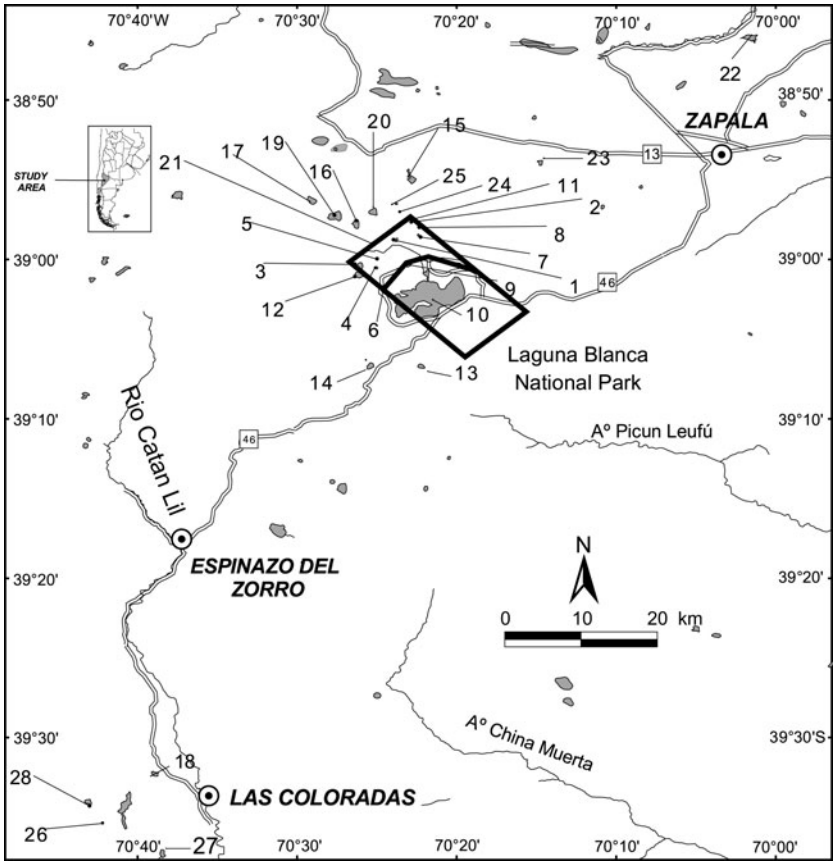

FIG. 1 Laguna Blanca National Park and the surrounding area in Neuquén province. The numbered lagoons are as follows: 1, Antiñir; 2, Antonio; 3, Del Hoyo; 4, Del Molle; 5, Hueso; 6, Batea; 7, Jabón; 8, Montesinos; 9, Verde; 10, Blanca; 11, Blanca Chica; 12, Del Overo; 13, Del Burro; 14, Del Tero; 15, De los Flamencos; 16, Encerrada; 17, El Alamo; 18, La Honda; 19, Panteón; 20, Without name C; 21, Without name B; 22, Solitaria; 23, El Toro; 24, Los Alamitos; 25, Without name A; 26, Los Juncos; 27, Agnata; 28, Colorada. The inset indicates the location of the main figure in Argentina.

and dip net and funnel trap surveys (Heyer et al., 1994). Each lagoon was visited on at least two occasions. We took preventive measures to avoid transporting amphibian pathogens between lagoons by following the guidelines of the DAPTF Fieldwork Code of Practice (DAPTF, 1998).

We used the Fisher exact test to examine the relationship between presence/absence of amphibians and fish. Specifically, we tested the null hypothesis that the presence of fish does not affect amphibian presence. Binary logistic regression (Hosmer & Lemeshow, 1989), performed with *SPSS v. 9.0* (SPSS, Chicago, USA), was used to examine any pattern between the physical attributes of the lagoons and the presence/absence of *A. patagonicus* and *P. colhuapiensis*.

A. patagonicus was found in 23 of the 28 lagoons surveyed. We reconfirmed the species' presence in 14 lagoons where it had been previously documented (Fox et al., 2005) and in nine new localities, Encerrada, La Honda, Panteón, Unnamed A, B and C, Los Alamitos, Los Juncos and Colorada. The presence of *A. patagonicus* was associated with lagoons characterized by absence of *P. colhuapiensis* and high abundance of macrophytes. *P. colhuapiensis* were present in Blanca and Del Alamo lagoons. Colorada lagoon was stocked with the salmonid *Oncorrhynchus mykiss* 10 years ago but *A. patagonicus* are still present. Solitaria, El Toro and Agnata had neither fish nor amphibians.

Twenty-three of the surveyed lagoons that do not have fish are inhabited by *A. patagonicus*. The null hypothesis that fish presence does not affect amphibian presence/absence was rejected ($P = 0.01$). A logistic regression model showed that presence of *A. patagonicus* was positively associated with presence of aquatic vegetation ($\chi^2_1 = 11.21$, $P < 0.001$, $R = 0.47$) and that presence of *P. colhuapiensis* was negatively associated with presence of aquatic vegetation ($\chi^2_1 = 4.92$, $P < 0.0265$, $R = -0.36$).

Fine sediment shorelines and shallow water characterize Solitaria and Agnata and the absence of complex microhabitats may thus explain the absence of *A. patagonicus*, which requires coarse sediments and submerged vegetation to breed and develop (Cuello & Perotti, 2006). Anthropogenic disturbance over the past 10 years, for water use, may have negatively affected *A. patagonicus* in the more complex El Toro lagoon, where fish have not been introduced.

A. patagonicus were found in La Colorada where introduced salmonids and abundant macrophytes are present. It is possible that the salmonids may be feeding on benthic invertebrates, which will be commonly available amongst the macrophytes (Macchi et al., 1999).

The percentage of the surveyed lagoons inhabited by *A. patagonicus* was high (c. 86%) but extirpation of *A. patagonicus* from Laguna Blanca (the last time it was observed there was in 1986; Iglesias & Pérez, 1998) represents

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the loss of the largest population. The most severe problem facing the remaining populations is in the many lagoons currently not protected by the National Park. Conservation efforts need to focus on the prevention of fish introductions in the wetland areas on private land.

Many examples have been documented of the negative impacts on native amphibians of fish introduced into historically fishless habitats. The mountain yellow-legged frog *Rana muscosa* of Kings National Park in California, USA, declined severely as a result of salmonids introduced into previously fish-free lakes (Bradford & Tabatabai, 1993; Knapp & Matthews, 2000) and prevention of this practice along with the removal of non-native fish in several lakes facilitated the recovery of some of the anuran populations (Vredenburg, 2004). Fish were introduced to the Laguna Blanca wetland system for sport.

Currently a project to restore *A. patagonicus* to Laguna Blanca, with participation of Neuquén province, the National Parks Administration and villagers, has begun. In addition, education programmes for villagers and visitors are under development by researchers and rangers, emphasizing the protection of natural Patagonian wetlands as reservoirs of regional biodiversity.

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Biographical sketches

Maria Elena Cuello has been carrying out research on *Atelognathus patagonicus* in Laguna Blanca National Park and the

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