

A call to amphibian biologists to share innovative ideas to minimize loss of species under climate change

By L.P. Shoo, D.H. Olson and J-M. Hero

Climate change is likely to exacerbate ongoing threats to amphibian populations such as disease, habitat loss, pollution and over-utilization. Existing conservation strategies will remain relevant, but additional management actions may be needed to reduce emerging impacts of climate change. There are currently few practical examples where novel management actions have been enacted and properly evaluated for feasibility and effectiveness.

In a recent paper published in the *Journal of Applied Ecology*, an international team of amphibian biologists assemble a preliminary set of local-scale management actions that are specifically relevant to minimizing loss of amphibians at risk (Shoo et al., 2011). We focus heavily on poorly tested but potentially valuable engineering solutions designed to ameliorate impacts and provide more effective recovery of amphibian populations under uncertain climate (e.g. temperature extremes and variable rainfall).

For example, in South Australia, it has been demonstrated that portable irrigation frames can be used to increase water availability at breeding sites for the terrestrial toadlet *Pseudophryne bibronii* resulting in increased calling activity, matings and egg laying (Mitchell, 2001). There is potential to trial such interventions for other geographically restricted terrestrial-breeding frogs for example Central American rain frogs that undergo population crashes during extended periods of dry weather (Pounds, Fogden and Campbell, 1999).

In the arid USA southwest, wind- and solar-powered pumps have been used to retain water levels in constructed and earthen stock ponds – an action that has been essential in maintaining the threatened Chiricahua leopard frog *Lithobates chiricahuensis* during dry



Portable irrigation frames manipulate water potentials at breeding sites for the terrestrial-breeding toadlet *Pseudophryne bibronii* in South Australia. Photo: Nicola Mitchell



Terrestrial toadlets (*Pseudophryne bibronii*) in amplexus. Photo: Nicola Mitchell



The threatened Chiricahua leopard frog *Lithobates chiricahuensis*. Photo: Bruce Christman

periods. Other options include retention or supplementation of natural and artificial shelters (e.g. logs, cover boards) to reduce desiccation and thermal stress; manipulation of canopy cover over ponds

to reduce water temperature; and, creation of hydrologically diverse wetland habitats capable of supporting larval development under variable rainfall regimes.

Our intention is not to engender false hope and complacency toward stemming the overarching problem of environmental deterioration (Pounds et al., 2006). However, human-induced emissions of greenhouse gases have already committed the Earth to warmer global temperatures and associated changes in the climate system through the 21st century (Meehl et al., 2007). Therefore, innovative strategies are needed to reduce the impact of emerging changes on animal and plant communities. We encourage amphibian biologists to help build a knowledge bank of effective management interventions. We are establishing a web portal to facilitate this process (soon available at: <http://www.parcplace.org>). For inclusion on this webpage, send your innovative climate change adaptation management strategies for amphibians to Dede Olson: dede.olson@oregonstate.edu. Photographs are encouraged, along with a text explanation including geographic area of use, habitat type, and amphibian species likely to benefit from the action.

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Solar-powered pumps and cattle enclosures retain water levels and habitat for the Chiricahua leopard frog *Lithobates chiricahuensis* in New Mexico. Credit: Bruce Christman



Complete management scheme of populations: the usage of physiological indicators to assess the impact of habitat availability and fragmentation.

By Agnès Janin, Jean-Paul Léna and Pierre Joly

Habitat loss and fragmentation are today largely identified as large threats to amphibian populations (Cushman 2006). Unfortunately, tools to evaluate healthiness of populations are not fully developed, since distribution data are very often used in landscape-scale studies. However, conservationists and researchers need to identify populations in danger before extinction. We proposed and investigated three scenarios to assess the respective effects of habitat availability and fragmentation on common toad (*Bufo bufo*) populations: (1) survey of occurrence on a large sample of ponds which is time consuming but not financial consuming, (2) survey of body condition, a physiological indicator directly related to fitness in amphibians, evaluated in a sub-sample of populations, which is less time consuming and not financial consuming, (3) survey of hormonal status, potentially related to fitness in a non-linear way, in a very reduced sample of populations, which is also less time consuming but financial consuming. The objectives of our work (see in details

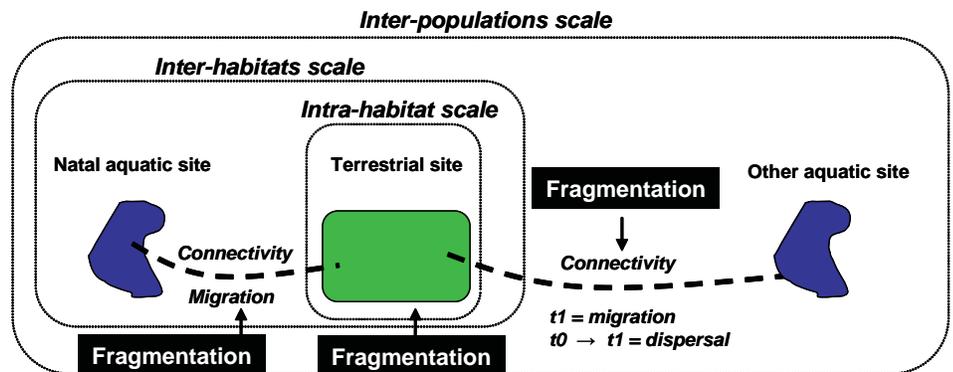


Figure 1. Different influences of fragmentation according to the different movement scales of amphibian species with aquatic larvae: the intra-habitat scale affecting supplementation movements; the inter-habitats scale affecting complementation movements; the inter-populations scale at which take place dispersal events.

Janin et al. 2011) were first to estimate respective effects of habitat availability and fragmentation on toad occurrence and physiological state and, second, to examine whether these approaches lead to a different interpretation of landscape effects, notably in order to draw a complete management scheme of landscape surrounding amphibian populations. We notably discuss how fragmentation is likely to affect the different types of movement of amphibians: supplementation ones (movements between multiple habitat fragments in order to acquire a sufficient

amount of resources), complementation ones (seasonal migrations between two different habitats required to complete complex life cycle) and dispersal ones (change of population for reproduction) (Fig. 1) and what proxies (occurrence, physiological indicators, ...) are linked to each types of movements (Dunning et al., 1992).

Our study was conducted in lowlands of the Rhone-Alps region (south-eastern France) (Janin et al., 2009). We investigated landscape structures with special emphasis to the landscape