



Perspective

Conservation of herpetofauna in northern landscapes: Threats and challenges from a Canadian perspective



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ABSTRACT

The scientific community is increasingly aware that many amphibian and reptile species have experienced dramatic decreases in abundance and distribution, with at least 43% of amphibian species exhibiting population declines and 19% of all reptile species threatened with extinction since 2000. Species suffer from a suite of threats including habitat destruction, alteration and fragmentation, introduced species, over-exploitation, climate change, UV-B radiation, chemical contaminants, diseases and the synergisms among them. These worldwide threats are also present in northern landscapes and in Canada in particular where 20 amphibian and 37 reptile species are listed as at-risk by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). In fact, with more than 80° in longitude and 40° in latitude, Canada presents both a diversity of northern ecosystems and a range of threats to its herpetofauna at least equal to other countries. The physical scale of Canada, its varied climate, its economic realities, and the legislative differences among levels of government and their respective mandates have long challenged traditional approaches to conservation. However, science and stewardship are leading forces in the conservation of emblematic species at risk in Canada and can serve to inform best practices elsewhere. Recent advances in data analysis and management have transformed our understanding of populations in northern landscapes. Canadian amphibians and reptiles, most of which are cold-adapted species at the northern edge of their distribution, can serve as case studies to improve modeling of population dynamics, create cogent, science-based policies, and prevent further declines of these taxa.

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1. Introduction

Modern amphibians and reptiles are the oldest extant groups of terrestrial vertebrates. They present vast diversity with more than 6800 amphibian species and 9700 reptile species currently known. These two groups occupy every terrestrial habitat apart from Antarctica and the high Arctic, but despite this they are in serious decline worldwide (Gibbons et al., 2000; Green, 2003; Wake, 2012; Böhm et al., 2013). According to the *International Union for Conservation of Nature* (IUCN), amphibians and reptiles have the highest proportions of threatened and Data Deficient species, and the lowest proportion of Least Concern species among vertebrate groups (Baillie et al., 2010; Böhm et al., 2013). Indeed, at the turn of the 21st Century, at least 43% of amphibian species showed evidence of decline, 32.5% were globally threatened, 37 species were confirmed extinct, with an additional 88 species also possibly extinct. Similarly, 19% of all reptile species were identified as threatened with extinction, including 12% that were critically endangered and 41% that were endangered. In Canada, these numbers are even higher with 42% of amphibian and 77% of reptile species currently diagnosed as at-risk by the Committee on the Status of Endangered Wildlife (COSEWIC).

There is now ample evidence of the vulnerability of northern ecosystems to climate and land-use change, increased human presence, and increased resource exploitation (Sala et al., 2000; Walther et al., 2002). Many northern species are at the periphery of their distribution in northern landscapes and peripheral populations may exhibit greater sensitivity to environmental changes because of reduced genetic variability (García-Ramos and Kirkpatrick, 1997). In Canada, where most amphibian and reptile species are at the northern limit of their range, understanding population declines is thus critical (Lesica and Allendorf, 1995; Eckert et al., 2008). Such knowledge will potentially help with design and implementation of conservation measures in other countries and benefit governmental and conservation agencies worldwide, especially in jurisdictions whose climate and governance are comparable to Canada. In this perspective article, we first discuss the different levels of governance in Canada, which like other countries may impede the success of conservation initiatives. We then present the threats and challenges associated with amphibian and reptile species in northern landscapes, allowing for better recommendations and adapted conservation measures in these areas.

2. Species conservation and legislation

Legislation is, or should be, the cornerstone of any effective framework for the conservation of endangered and threatened biota, including herpetofauna (amphibians and reptiles). Such legislation is typically complex and must represent a workable

compromise between conserving wildlife and safeguarding the legitimate interests of landowners and other stakeholders. In Canada, the long and difficult political process (Freedman et al., 2001) that culminated in the *Canadian Species at Risk Act* (SARA) being passed into law in 2003 produced a bill with tangible strengths, but also with many weaknesses and abundant compromises (Mooers et al., 2010). For example, while 7 of the 8 turtle species in Ontario are considered to be at risk, only the endangered Wood Turtle (*Glyptemys insculpta*) has an approved provincial Recovery Strategy and Government Response Statement under which the species' habitat is regulated. Moreover, SARA applies mainly to federal lands and waters, and thus is unable to override numerous other statutes, including aboriginal land claim agreements. SARA is thus a classic Canadian compromise, relying on federal/provincial/territorial co-operation and good will. This compromise is both its greatest strength and its most profound vulnerability. Indeed at the federal level, critical habitat has thus far been identified for only one freshwater turtle, the Nova Scotia population of Blanding's Turtle (*Emydoidea blandingii*).

SARA has three primary components: assessing conservation status and legal listing of wildlife species at risk, planning and fostering actions to promote recovery of listed species, and ensuring compliance with the law's intentions by imposing prohibitions, penalties and other measures. In practice, formulation of remediation measures under SARA has been slow and implementation of recovery strategies for amphibians and reptiles has been even slower. The assessment provisions, though, remain effective and COSEWIC, which evaluates species' conservation status and makes recommendations for listing, is probably SARA's most operational component. Such assessments are rigorous, consensual and proactive and based on the system of criteria established by the IUCN (Powles, 2011). To date, most species of amphibians and reptiles in Canada that might be at some risk have been assessed at the national level at least once (Mooers et al., 2010). However, assessment without remediation only suggests the potential for conservation rather than any real conservation.

In the northern hemisphere countries like Canada, amphibians and reptiles are most diverse and abundant at southern latitudes where the climate is warmest, but where anthropogenic development is typically intensive. With relatively few species' ranges extending as far north as the boreal forest in Canada (Cook, 1984), the geographic confluence of humans and herpetofauna in the south translates into many threats to the persistence of amphibians and reptiles (Green, 1997; Seburn and Bishop, 2007). Fortunately, the World Conservation Union and Conservation Measures Partnership (IUCN) has developed a threat classification system (Salafsky et al., 2008) providing a standardized way of classifying threats facing these species. The impact of each threat is an estimation of the interaction between the scope and severity of the threat to a species, which is generally based on expert

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