



National attention to endangered wildlife is not affected by global endangerment: A case study of Canada's species at risk program



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ABSTRACT

With the number of endangered species increasing and budgets for protection remaining inadequate, there is an urgent need to judiciously prioritize management. Some potential approaches include prioritizing based on threat, uniqueness (i.e., full species prioritized before subspecies) or endemism. Here, we use Canada as a case study to test whether management under the national Species at Risk Act prioritizes endemic and globally at risk species, versus subspecies and populations of globally secure species. Canada is an ideal case study because it is a large country with many species that are at the northern edge of their ranges, but others that are globally at risk endemics. We show that Canada does a poor job of prioritizing globally at risk and endemic full species. Only a small proportion of species listed have legally required 'Action Plans' for management, and this proportion is not significantly greater for globally at risk species. In addition, reptiles, amphibians, mammals and fish are more likely to be managed as subspecies or populations compared to other taxa, possibly due to greater differentiation among populations, bias in research toward charismatic or economically-valued taxa, or to allow continuation of economic activities that threaten portions of species' habitats. Given the limited resources being allocated to conserving species at risk of extinction, we suggest that full, endemic threatened species for which host nations bear sole responsibility must be the highest priority, and that globally threatened species should also be given high priority.

1. Introduction

In the face of rapid biodiversity declines (Pimm et al., 2014; WWF, 2016), managers responsible for threatened species conservation must make difficult decisions about how to allocate their limited resources (Wilson et al., 2009). Typically, national legislation specifies that priorities for conserving threatened taxa should be set based on threat level (De Grammont and Cuarón, 2006). For example, in Canada, species that are assessed as being 'endangered' or 'threatened' are meant to be given higher priority than those with lower imperilment status. Managers are tasked with preparing a Recovery Strategy and then an Action Plan that outlines protection measures, following a legislated timetable. A similar general approach is followed in the United States, Europe, Japan, South Africa and Australia (ESA, 1973; Act on the conservation of endangered species of wild fauna and flora, 1992; EPBC Act, 1999; SARA, 2002; Biodiversity Act, 2004).

National legislation regarding biodiversity conservation typically uses "species" as the baseline taxonomic unit. Accordingly, most national extinction risk assessments and management decisions are conducted at the species level. However, national legislation often allows

subspecies or populations to be used as baseline taxonomic units for conservation (e.g., ESA, 1973; Act on the conservation of endangered species of wild fauna and flora, 1992; EPBC Act, 1999; SARA, 2002; Biodiversity Act, 2004). In Canada, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) uses Designatable Units (DUs) to identify subspecies, varieties or populations of a taxonomic species that are discrete, and important to the evolutionary legacy of the species as a whole (COSEWIC, 2017). This is based on knowledge that genetically or geographically isolated subspecies or populations may be best managed as distinct entities (Vogler and Desalle, 1994; Walpes, 1995). For example, Thiemann et al. (2008) discovered that threats to the conservation of polar bears (*Ursus maritimus*) are not spatially uniform and concluded that the use of subspecies units can provide a biologically-sound framework for polar bear conservation. However, guidelines for classifying DUs are subjective, and such approaches may be subject to uncertainty and debate (Pennock and Dimmick, 1997; Walpes, 1998). For example, the lake sturgeon (*Acipenser fulvescens*) is managed at the population level in Canada (currently four Designatable Units), while in the United States the entire species is unlisted, despite the fact that many of the DUs ranges span the

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Table 1
Definitions of categories used in analysis.

Globally threatened species	A species that has an IUCN designation of Critically Endangered, Endangered or Threatened, or any full species recommended by COSEWIC that is endemic to Canada and therefore is threatened throughout its range
Endemic species	Any species that occurs exclusively in Canada. If a species was determined to be shared to any extent with another country, whether this was by an overlap in range or a species which spends part of its time outside Canada due to migration it was not considered endemic. COSEWIC assessment reports were reviewed to determine species range, and if there was any uncertainty ESA assessments were also consulted
Designatable Unit	Species, Subspecies, variety, or geographically or genetically distinct population that may be assessed by COSEWIC, where such units are both discrete and evolutionary significant
Population	As defined by COSEWIC, distinct subgroups in the Canadian population between which there is little demographic or genetic exchange
Subspecies	A designatable unit recognized as a subspecies by COSEWIC

Canada-USA border (ESA, 1973; COSEWIC, 2017; SARA, 2017).

In addition, many national conservation agencies manage species that are nationally rare but globally secure. There may be rational biological reasons for this approach. Peripheral populations at range edges may have unique local adaptations, which can allow range expansion and may provide an increased resilience to climate change (Lenormand, 2002). However, peripheral populations can also be subject to gene swamping from core populations (Kirkpatrick and Barton, 1997), preventing adaptation (Lammi et al., 1999; Hamilton and Eckert, 2007). In addition, jurisdictions may be interested in conserving biodiversity within their boundaries, rather than globally, and thus may be motivated to conserve range-edge species that are secure elsewhere.

Given limited resources, national conservation programs either implicitly or explicitly prioritize some taxa over others. For example, in New Zealand and the Australian state of New South Wales, management agencies have openly used cost-effectiveness approaches to prioritize as many species as possible (Joseph et al., 2009; Biodiversity Conservation Act, 2016). Although North American management agencies are typically mandated to prioritize based on threat level, many species that are recognized as threatened with extinction receive little or no active management (Findlay et al., 2009; Mooers et al., 2010; Evans et al., 2016), suggesting both limited resources and management bias (Mooers et al., 2010; Evans et al., 2016). Given the fact that some species are clearly being prioritized over others, it is logical that species in a jurisdiction that are globally at risk be the top priority, as their continued existence is highly dependent on effective management in this jurisdiction (Bennett et al., 2014). This is especially true for endemic threatened species, which are entirely dependent on effective management in the jurisdiction in which they are found. The concept of regional responsibility has been previously suggested as a criterion for prioritization (Schmeller et al., 2008; Gauthier et al., 2010) but has yet to be adopted into national level endangered species legislation, although some countries do emphasize protection for endemic threatened species (USFWS, 1983; Bennett et al., 2014). In Canada, COSEWIC does include these criteria when making listing and management decisions (COSEWIC, 2010), but this has not been incorporated into the national species at risk legislation.

Here, we use Canada as a case study to test the extent to which a national threatened species conservation program prioritizes globally threatened species, versus subspecies units. To do so, we partitioned listings for Canadian threatened species using two criteria: 1) full species status; and 2) global risk. We then tested these groups to examine actual national priorities, using advancement from recognition as 'at-risk' (i.e., 'endangered', 'threatened', or 'special concern') by the non-legal listing body (COSEWIC) to the final stage of management planning (publication of an Action Plan) as an indicator of priority. Specifically, we ask the following question: Are globally threatened species given priority over subspecies and peripheral populations of secure species? Canada is an excellent case study for a number of reasons. First, because of the country's vast size and diverse geography, species with large ranges might often be managed as subspecies or population units, providing a larger sample size for analysis. Second, there are also sufficient endemic, globally threatened species to test whether management favours these versus other species. Assuming resources are

limited, we predicted that globally threatened full species would be the top conservation priority, and therefore would have a higher proportion of Action Plans.

2. Methods

2.1. Data collection

We conducted our analysis in R using the 729 DUs (i.e., species, subspecies or populations) listed, or recommended to be listed, under SARA Schedule One, which provides legal protection and mandates recovery efforts (R Development Core Team, 2016; SARA, 2017; Table S1). To be added to Schedule One, a species first must be assessed by COSEWIC, and then can only be added to the list after recommendation by the Minister of Environment and Climate Change. For Schedule One species, management stages include production of Recovery Strategies (for endangered or threatened species) or Management Plans (for species designated as 'special concern'), followed by Action Plans that dictate actual management. Our analysis assumes that production of an Action Plan for a species means that this species is given high priority, since Action Plans are the final planning stage, and dictate on-the-ground actions to address threats. Using information gathered from SARA (SARA, 2017), COSEWIC (COSEWIC, 2017), the International Union for Conservation of Nature (IUCN, 2016), and US ESA (ESA, 1973) websites we scored each DU for a set of eight attributes: taxonomic group, SARA classification, IUCN threat category, COSEWIC threat status category, endemism to Canada, stage of conservation planning under SARA, whether the unit was a full species, subspecies or population and the year that unit was designated. Detailed definitions of each category can be found in Table 1. Results are reflective of data gathered as of November, 2017.

We partitioned the 729 entries using two criteria. First subspecies and population units were separated from full species units. We then further sub-divided the full species by global risk factor. A unit was considered globally threatened if it was ranked as critically endangered, endangered or threatened by the IUCN, or if it was endemic to Canada. Endemic full species not listed by the IUCN were considered to be globally threatened if they were recommended by COSEWIC because this implies they are threatened throughout their global range (see Fig. S1 for details).

2.2. Statistical analysis

To answer our primary question regarding prioritization of globally threatened species, we used Fisher's exact tests to compare the proportions of DUs with finalized Action Plans across three categories: DUs that are subspecies and populations, full species (that are not globally threatened), and full species that are globally threatened (including endemics, which, since they are considered to be at risk in their endemic ranges, we assumed to be globally threatened). Supplemental analysis treating endemics as a separate category yielded similar results to our main analysis (see supplementary material Table S3 for details).

To determine whether some DUs were more likely than others to be managed as subspecies or populations, we compared the proportions of

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