



What is an endangered species worth? Threshold costs for protecting imperilled fishes in Canada

Jessica A. Schultz^{a,1}, Emily S. Darling^a, Isabelle M. Côté^{a,b,*}

^a Earth to Ocean Research Group, Department of Biological Sciences, Simon Fraser University, Burnaby, BC, Canada V5A 1S6

^b Department of Biological and Environmental Sciences, University of Göteborg, Box 463, SE-405 30 Göteborg, Sweden

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ABSTRACT

The protection of imperilled fish species is increasingly urgent given ongoing fisheries declines and the degradation of aquatic habitats. In Canada, threatened aquatic species were less likely than terrestrial species to be listed under the Species at Risk Act (SARA), the main legal instrument for bestowing protection, in the early years of the Act's implementation. In this paper, the existence of economic thresholds that might have hampered the protection of Canadian marine and freshwater fishes is examined. The analysis of the socio-economic data used to inform listing decisions about threatened fish taxa over the past decade reveals that the likelihood of being listed declines non-linearly with increasing estimated costs of protection but does not vary with proposed threat status. The estimated threshold cost (i.e., the point at which the likelihood of not being listed=0.5) was ~\$5,000,000 (~\$1,400,000 to ~\$31,400,000, 95% CI) per decade for freshwater species but only ~\$90,000 (~\$50,000 to ~\$140,000, 95% CI) per decade for marine fish taxa. In fact, no marine fish species with an anticipated cost of listing greater than zero was listed for protection. The presence of existing management legislation and qualitative statements about negative impacts of listing on exploitation generally led to denying protection to marine but not to freshwater species. These findings highlight both a large and inconsistent emphasis on costs of protection in SARA listing decisions, to the detriment of marine fish species.

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1. Introduction

Many fish species, and the fisheries they support, are in decline around the world [1]. In the marine realm, three-quarters of fish stocks are either fully exploited or overexploited [2]. Many targeted fisheries for large predatory species, as well as those targeting small fish at low trophic levels, have collapsed [3,4]. Furthermore, incidental bycatch has been implicated in the endangerment of many marine taxa [5,6]. Freshwater ecosystems are also under intense pressures [7,8], with inland fish biodiversity threatened by overfishing, habitat destruction and pollution [9]. Effective protection of fish species and their habitats is urgent.

Conservation legislation has been implemented in many countries to address the general biodiversity crisis. In Canada, the Species at Risk Act (SARA) was implemented in 2003. Under SARA, Canadian imperilled species can be legally protected from harm, capture and habitat destruction [10]. Although SARA has been lauded for clearly separating scientific assessment from policy

[11], its implementation has been slow and uneven. In particular, there appears to be a clear bias against listing fishes [12–14]. In the first five years of SARA, approximately half of freshwater fishes and all marine fishes recommended for listing by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) – the independent scientific body which assigns a risk status to species based on scientific criteria – were rejected by the Canadian government, while most birds, reptiles, amphibians and plants were protected [12]. In those early years, there was a close association across all taxa between the likelihood of being rejected and being harvested as well as having Fisheries and Oceans Canada (DFO) as the authority responsible for recovery [12]. In 50% of cases where species were denied protection, socio-economic costs were cited as a reason [12]. In the case of fishes, whether or not to protect a species appeared to be based on politically driven decisions and concern over fishery closures [15], such that even relatively small economic impacts could prevent listing [14].

This study builds on previous work [12,14] by quantifying the magnitude of the economic impacts that prevent listing. In other words, is there an economic ‘glass ceiling’ that prevents the protection of imperilled fish species in Canada? Specifically, the three goals were to measure the threshold costs that jeopardize the likelihood of being protected under SARA, to determine whether these thresholds are consistent across marine and

* Corresponding author at: Simon Fraser University, Department of Biological Sciences, Earth to Ocean Research Group, 8888 University Dr, Burnaby, British Columbia, Canada V5A 1S6. Tel.: +1 778 782 3705; fax: +1 778 782 3496.

E-mail address: imcote@sfu.ca (I.M. Côté).

¹ Current address: Department of Zoology, University of British Columbia, Vancouver BC, Canada V6T 1Z4.

freshwater fishes, and to examine the relative importance of costs and threat status for the probability of being listed. By focusing on fishes, the influence of responsible authority – an important correlate of the likelihood of being listed – was removed since all fishes fall under the purview of Fisheries and Oceans Canada. As did [12], but now with a decade of listing decisions, the qualitative reasons invoked for listing and not listing fish species were examined, but with a focus on asking whether the same reasons consistently led to the same listing outcome for marine and freshwater fishes. In this way, transparency in the application of one of the most important legislative tools for species protection in Canada was assessed in terms of process and consistency across taxonomic groups.

2. Methodology

2.1. How SARA works

The process of listing species, subspecies, or distinct populations under SARA has been reviewed in detail elsewhere [11,12,15]. Briefly, COSEWIC undertakes status reviews of taxa found within Canadian borders. The choice of species for review does not depend on economic value or on the likelihood of federal consent to listing, but on perceived level of threat (J.D. Reynolds, COSEWIC Marine Fishes Species Specialist Committee, personal communication). COSEWIC scientific reports and listing recommendations are submitted annually to the federal Minister of the Environment (MoE) – a post held by an appointed politician – who reviews them in light of a socio-economic assessment and consultations with stakeholders and the public. Beyond having 90 days to declare how the Minister intends to respond to a COSEWIC recommendation, no timeline is specified for the consultation period, and species recommendations may undergo an extended consultation period if so designated by the Minister. Once the consultation is complete, the Minister forwards all information to the Governor in Council (i.e., Canada's House of Commons), which must decide within nine months either to list a species as recommended by COSEWIC, not list the species, or refer the species back to COSEWIC for further evaluation. Species listed as Extirpated, Endangered or Threatened receive automatic legal protection (i.e., immediate prohibitions on direct take and destruction of residence, but 'critical habitat' is not protected until identified in a recovery strategy or action plan), while listing a species as Special Concern initiates a management plan but entails no prohibitions of deleterious activities. To maintain transparency, justification for each decision is published in the *Canada Gazette*, which publishes new laws, acts, regulations, official appointments and public notices on a weekly basis (www.canadagazette.gc.ca). The justifications include a Regulatory Impact Analysis Statement (RIAS), which is prepared by the sponsoring department (without external peer-review) and must include a cost–benefit analysis (for more details, see [11]). Once species are listed, their status may change with a new COSEWIC assessment, which occurs at least every 10 years, and subsequent listing process [16].

2.2. Species status information

Information was collected on the status of marine and freshwater fishes from the SARA Registry (www.sararegistry.gc.ca), including the COSEWIC recommended status and current SARA status. The realm occupied by each taxon was determined by the COSEWIC Species Specialist Committee (SSC) (i.e., Marine Fishes SSC or Freshwater Fishes SSC) that assessed the taxon. Thus all anadromous fishes were classified as marine, which is justified in

this study since most of the anticipated costs of listing such species pertained to prohibitions of marine activities. Where the COSEWIC status and SARA status were the same, the taxon was considered 'listed'. Otherwise, the taxon was scored as 'not listed' if a decision had been published and listing was denied. This study therefore did not include taxa for which recommendations were returned to COSEWIC for further evaluation or for which a listing outcome had yet to be published. Because COSEWIC often assesses distinct populations or subspecies separately [17], using units of assessment that are analogous to Distinct Populations Segments in the USA [18], the term 'species' is used to indicate any taxon for which COSEWIC conducted an assessment. This study was restricted to species with a COSEWIC recommended status of Extirpated, Endangered, Threatened or Special Concern, since species designated Extinct, Not at Risk or Data Deficient trigger no socio-economic assessment.

Initially, the intention was to compare the costs and benefits of listing marine species with that for terrestrial or freshwater species, focussing on mammals, molluscs and fishes. However, for species other than fishes, socio-economic data in the *Canada Gazette* either lacked dollar amounts (e.g., [19]), or multiple species were accounted for in general terms (e.g., [20]). Socio-economic impact reports on non-fish species from other sources were not publicly available.

The present study thus included marine and freshwater fish species that had undergone the SARA process outlined above and for which a listing decision had been made between 2003 and the end of 2010. The 30 species that were automatically listed when SARA came into force in 2003 (SARA 2003, Schedule 1) were not included, unless a species had been re-evaluated by COSEWIC, with a recommendation for change of status.

2.3. Analysis of quantitative costs and benefits

Listing notifications published in the *Canada Gazette* were examined to extract the anticipated costs and benefits of protecting freshwater and marine fishes. Costs were often assigned to specific economic activities that could be affected by species protection. These activities included: commercial and recreational fishing restrictions or closures, fish processing industry losses, impacts due to required reductions in bycatch in other fisheries, costs to other industries such as tourism and shipping, and indirect impacts on the economy. Also listed were some of the costs of implementing protection, such as the costs of habitat protection, monitoring fish populations in the absence of a fishery, research and public education. Listing a species also entails costs in terms of developing a management plan, recovery strategy or recovery action plan; however, since dollar values for these planning activities were not given, they could not be considered. In one case (the winter skate, *Leucoraja ocellata*), dollar amounts were not provided in the *Canada Gazette*, but were available in Department of Fisheries and Oceans (DFO) Socio-Economic Analysis Reports [21,22]. The information provided for this species was included because these reports are used in listing decisions [12], and the costs they provide are consistent with those published in the *Canada Gazette* when both are available (e.g., Atlantic cod, *Gadus morhua* [21,23]). The sum of all dollar amounts given for a particular species was recorded as the cost of listing, and scaled to a 10-year period because most amounts provided were per decade. For species for which no dollar amounts were given, the cost of listing was recorded as zero since impacts on economic activities were invariably described as negligible.

Economic benefits were seldom provided in dollar amounts (see Section 3 results). When they were provided as a range, the mid-range value was recorded and scaled to a 10-year period.

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