A Tale of Two Acts: Endangered Species Listing Practices in Canada and the United States

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Canada's Species at Risk Act (SARA) and the US Endangered Species Act (ESA) have adopted different approaches to achieve overlapping goals. We compare the ESA and SARA, focusing on the roles of science and policy in determining which species warrant legal protection. Our analysis suggests that each act could benefit from mimicking the strengths of the other, and both could be strengthened by greater clarity and transparency of listing determinations. A particular strength of SARA is that all evaluations of species' status are conducted by a single national scientific body. The ESA does not involve a comparable national body but has more stringent legal deadlines for listing actions, and listing decisions cannot by law consider socioeconomic factors (as can occur under SARA). The conservation of biodiversity would be enhanced if both acts were complemented by additional programs focused on broader efforts that protect more species before individual intervention is needed.

Keywords: endangered species, ESA, SARA, distinct population segments, designatable units

In spite of worldwide declines in biodiversity (Baillie et al. 2008, Butchart et al. 2010), relatively few countries have enacted national endangered species legislation. The United States was the first, when it established the Endangered Species Preservation Act in 1966, the predecessor of the Endangered Species Act (ESA; passed in 1973). Other countries have since followed suit, which has resulted in statutes such as the Biodiversity Law of Costa Rica (passed in 1992), Australia's Endangered Species Protection Act (passed in 2002), Canada's Species at Risk Act (SARA; also passed in 2002), and South Africa's National Environmental Management Biodiversity Act (passed in 2004).

Each of these laws articulates objectives for identifying species at heightened risk, protecting them from further harm, and establishing recovery programs. Despite these common goals, the mechanisms for achieving those statutory objectives exhibit some striking differences. For example, ESA listing determinations are made by US federal managers, after considering available scientific information but ignoring socioeconomic factors. In Canada, status assessments under SARA fall to an independent advisory body, but the government takes factors other than a species' status into account before deciding whether to list that species. These and other differences can influence which species receive formal protection and, more broadly, the effectiveness of efforts to conserve biodiversity.

In the present article, we compare the roles of science and policy in the listing process as they are implemented under these two national statutes, which, together, claim responsibility for approximately 13% of the world's landmass and approximately 10 million square kilometers of ocean. After some brief legislative and legal background to provide context, we summarize key steps in the listing processes for Canada and the United States. We focus on listing determinations, because these are well documented and are the key "from which all other consequences" (p. 203) of these laws flow (Bean and Rowland 1997). With a comparative analysis, we identify the strengths and weaknesses of each country's legislation and practices with respect to how the roles of science and policy are partitioned and how clear and transparent these roles are. The resulting insights promote improvements to both acts and are relevant to conservation practitioners around the globe.

Among the many factors that shaped the differences in endangered species legislation in the United States and Canada, two stand out. First, the three decades that elapsed between the enactments of the ESA and SARA witnessed revolutionary changes in public attitudes toward environmental issues (Czech and Krausman 2001, Illical and Harrison 2007). Adopted during a period in which many of the United States's most powerful environmental laws were written (e.g., the National Environmental Policy Act in 1969, the Clean Air Act in 1970, and the Clean Water Act

BioScience 63: 723–734. ISSN 0006-3568, electronic ISSN 1525-3244. doi:10.1525/bio.2013.63.9.8

in 1972), the ESA originally enjoyed widespread support, but that soon changed as the economic and social consequences of endangered species protection became apparent (Yaffee 1982, Peterson 2002). Successive administrations and Congress responded with a series of amendments intended to balance species protection, flexibility in implementation, and procedural requirements, and these amendments have shaped the ESA as it has been implemented over the past several decades (Bean and Rowland 1997, Goble 2006). By the late 1990s, when serious efforts were made in Canada to pass endangered species legislation, business and agricultural interests were well aware of the potential consequences and eager to avoid the divisive and costly battles that are common in the United States (Illical and Harrison 2007). Passage of SARA in December 2002 fulfilled a key obligation under the 1992 Convention on Biological Diversity, and SARA has not been revised since.

The second major factor is institutional. The US political system depends on an uneasy balance of power between the executive, legislative, and judicial branches of government. To limit executive discretion, Congress tends to pass laws prescribing nondiscretionary actions or rules for the executive branch to implement; this and the citizen-suit provision in the 1982 amendments to the ESA provide ample opportunity for litigation to ensure compliance with congressional intent (Kagan 2001, Butler 2007). In Canada's parliamentary system, the legislative and executive functions are essentially fused, which tends to produce discretionary laws that authorize federal actions but do not require them. With federal actions largely discretionary, rather than mandatory, litigation on environmental issues is much less common in Canada than it is in the United States (Illical and Harrison 2007).

The US secretaries of the interior and of commerce are responsible for implementing the ESA, although routine management has been delegated to two federal agencies: the US Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS). The USFWS has primary responsibility for terrestrial and freshwater species, whereas the NMFS administers marine and anadromous species.

SARA (section 14) charged the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), a preexisting body, with the responsibility for assessing species status. COSEWIC is internationally unique in terms of its breadth of mandated responsibilities, its incorporation of aboriginal traditional knowledge (ATK), and the broad representation from both inside and outside government. COSEWIC is an independent, national advisory body; it is not a conservation organization or a federal agency or department. The original rationale for establishing this national committee was that several Canadian groups had been producing lists of species at risk on the basis of different criteria, which resulted in considerable confusion about true conservation status (Shank 1999).

COSEWIC was first convened in 1977, with its initial status assessments restricted to birds and terrestrial mammals. Its taxonomic breadth subsequently expanded between 1977 and 1997 to encompass the full range of animals and plants (Hutchings and Festa-Bianchet 2009a). When SARA came into legal force in 2003, all of the species that had been determined to be at risk by COSEWIC from 1978 to 2001 (233) were automatically listed, in accordance with section 42(2). By January 2013, COSEWIC had determined that 668 species were at risk, with 456 of these labeled as *endangered* or *threatened* (33% of those were plants, and 67% were animals; see table 1a). For a comparison, by January 2013, 1436 US *endangered* and *threatened* species (57% of those were plants, and 43% were animals; see table 1b) were listed under the ESA.

What biological units can be listed?

The ESA allows protection of any entity that meets its definition of *species*, which includes not only formally recognized species and subspecies but also any *distinct population segment* (DPS) of a vertebrate species (section 3[15]). The term *DPS* has no accepted biological interpretation, and the ESA offers no guidance on how to identify DPSs. To provide a consistent framework for addressing DPS issues, the USFWS and the NMFS issued a joint policy (USFWS and NMFS 1996) applicable to all vertebrates. The joint policy uses a two-part test (discreteness and significance) that closely parallels the previously developed approach for Pacific salmon (*Oncorhynchus* spp.), which was based on evolutionarily significant units (NMFS 1991, Waples 1991).

SARA is intended to provide for legal protection and recovery of any *wildlife species*, which is defined as

> A species, subspecies, variety, or geographically or genetically distinct population of animal, plant, or other organism, other than a bacterium or virus, that is wild by nature and is either native to Canada or has extended its range into Canada without human intervention and has been present in Canada for at least 50 years. (section 2[1])

Like the ESA, SARA considers biological entities below species and subspecies but provides no guidance on what constitutes a meaningful level of distinctiveness. COSEWIC has interpreted this definition of *wildlife species* as an intention to provide legal protection for irreplaceable units of biodiversity critical to the persistence of formally recognized biological species (*www.cosewic.gc.ca/eng/sct2/sct2_5_e.cfm*). These units are termed *designatable units* (DUs) and apply to all taxa. COSEWIC uses discreteness and evolutionary significance (modeled after the US DPS policy) as the primary criteria for recognizing DUs.

What criteria are used for assessing risk and assigning listing categories?

Although the ESA stipulates that listing determinations be made "solely on the basis of the best scientific and commercial data available" (section 4[b][1][A]), the definitions

Table 1a. The numbers of species assessed by the Committee on the Status of Endangered Wildlife in Canada as* endangered, threatened, *and* special concern *as of January 2013.

Taxon	*Endangered*	*Threatened*	Combined *endangered* and *threatened*	*Special concern*	Combined *endangered, threatened,* and *special concern*
Amphibians	10	5	15	8	23
Arthropods	34	6	40	8	48
Birds	29	28	57	21	78
Corals	0	0	0	0	0
Fishes	54	40	94	52	146
Lichens	5	3	8	6	14
Mammals	24	17	41	30	71
Molluscs	18	3	21	7	28
Mosses	8	3	11	4	15
Plants	96	44	140	44	184
Reptiles	19	10	29	10	39
Total	297	159	456	190	646

Note: For a current list, see *www.cosewic.gc.ca/rpts/Full_List_Species.html.*

Table 1b. The numbers of species listed in the United States under the Endangered Species Act as* endangered *and* threatened *as of January 2013.

Taxon	*Endangered*	*Threatened*	Combined *endangered* and *threatened*
Amphibians	16	10	26
Arthropods	88	13	101
Birds	78	15	93
Corals	0	2	2
Fishes	83	70	153
Lichens	2	0	2
Mammals	70	15	85
Molluscs	99	24	123
Mosses	0	0	0
Plants	665	150	815
Reptiles	14	22	36
Total	1115	321	1436

Note: Although the Endangered Species Act (ESA) allows the listing of species occurring entirely outside the United States's national boundaries, to be comparable with the Canadian data in table 1a, this table includes only those ESA species that occur in the United States or its territories. For a current list, see *http://ecos.fws.gov/tess_public/pub/Boxscore.do#ij.*

of *endangered* and *threatened* species (section 4; see table 2) include normative terms (e.g., *in danger of*, *likely*, *foreseeable future*, *significant portion*) that have no precise biological interpretation and have not been defined in a legal or policy context (Yaffee 1982, Rohlf 1991, Doremus 1997, Vucetich et al. 2006). The ESA also requires that the USFWS and the NMFS consider protective efforts; since 2003, they have followed published policy on information standards and analyses required in evaluating the certainty and effectiveness of conservation efforts when deciding whether to list a species (USFWS and NMFS 2003).

ESA listing determinations must indicate whether a species is at risk because of any of the following five factors: destruction or modification of its habitat, overuse, disease or predation, inadequacy of existing regulatory mechanisms, and other natural or "manmade" factors (section 4[a][1]). By itself, however, this five-factor analysis does not determine whether the risks are substantial enough that the species can be considered *threatened* or *endangered*. Although joint NMFS–USFWS efforts have been made to develop generalized, quantitative listing criteria (DeMaster et al. 2004, Regan et al. 2009), neither service has adopted a formal policy defining *threatened* and *endangered* status in scientific terms or developed procedures for the integration of information on the five factors listed above into overall risk assessments. Even when quantitative assessments of extinction risk are available, professional judgment is still required in order to interpret such information in the context of the ESA definitions. USFWS evaluations often discuss risk in terms of the magnitude and immediacy of threats (USFWS 1983) or, for delisting evaluations, in terms of redundancy, resiliency, and representation (Schaffer and Stein 2000), whereas the NMFS often uses the four criteria for viable salmonid populations: abundance, productivity, spatial structure, and diversity (McElhany et al. 2000).

The phrase *significant portion of its range* is particularly problematic to interpret and has attracted judicial attention (*Defenders of Wildlife v. Norton* 2001, *Defenders of Wildlife v. Salazar* 2010). The USFWS and the NMFS (2011) jointly proposed a policy that largely follows the approach suggested by Waples and colleagues (2007) for defining *significant portion of its range*: A portion of the range of a species is significant if, without that portion, the species would be in danger of extinction.

Table 2. A comparison of key elements of Canada's Species at Risk Act (SARA) and the US Endangered Species Act (ESA) with respect to the assessment, recovery, and protection of species.

Element	SARA	ESA
Purpose	"To prevent wildlife species from being extirpated or becoming extinct, to provide for the recovery of wildlife species that are extirpated, endangered or threatened as a result of human activity and to manage species of special concern to prevent them from becoming endangered or threatened" (section 6)	"To provide a means whereby the ecosystems upon which *endangered* species and *threatened* species depend may be conserved, [and] to provide a program for the conservation of such… species" (section 2[b])
Status categories	*Extirpated*, *endangered*, *threatened*, *special concern*	*Endangered*, *threatened*, *warranted but precluded by other actions*; agency-specific *candidate species* and *species of concern* categories
Definition of *extirpated*	"No longer exists in the wild in Canada, but exists elsewhere in the wild" (section 2)	Not defined
Definition of *endangered*	"Facing imminent extirpation or extinction" (section 2)	"In danger of extinction throughout all or a significant portion of its range" (section 3)
Definition of *threatened*	"Likely to become an *endangered* species if nothing is done to reverse the factors leading to its extirpation or extinction" (section 2)	"Likely to become an *endangered* species throughout all or a significant portion of its range in the foreseeable future" (section 3)
Definition of *special concern*	"May become a *threatened* or an *endangered* species because of a combination of biological characteristics and identified threats" (section 2)	Not in the ESA. If information is insufficient to indicate a need to list but concerns exist regarding status and threats, the National Marine Fisheries Service (NMFS) labels it a *species of concern*
Initiation of an assessment	Over 95% of listed species originate from decisions made by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC); the others are from unsolicited requests from government and the public	The US Fish and Wildlife Service (USFWS) and the NMFS conduct most status reviews in response to petitions; however, reviews can also be initiated by the services
Assessors of species status	Independent advisory body (COSEWIC)	Staff in the USFWS and the NMFS, following input from government scientists and others
Who makes listing decisions	The governor in council, a subcommittee of ministers of the federal cabinet	The secretary of the interior (USFWS species) or of commerce (NMFS species)
Protective regulations for listed species	Automatically apply to *endangered* and *threatened* species	Automatically apply to *endangered* species; regulations for *threatened* species are promulgated as needed
Review of status	By COSEWIC, every 10 years, or sooner if there is reason to believe that status has changed	At least every 5 years by the USFWS and the NMFS
Status assessment criteria	IUCN criteria are used as a guide	No standardized criteria
Geographical range of listed species	Limited to the species range within Canadian territory	Wherever species occur; not limited to US territory
Rescue effect	Status can be adjusted on the basis of immigration from adjacent, non-Canadian populations	Not explicitly considered, but the unit to be assessed can include adjacent, non-US populations
Is prelisting scientific advice on status publicly available?	All COSEWIC species status reports and status assessments are publicly available	All listing determinations are published in the *Federal Register* and supporting information is publicly available; stand-alone, publicly available science reports are common within the NMFS but not the USFWS
Population units eligible for listing consideration	Designatable units of all species can be listed if they are determined to be at risk	Ability to list distinct population segments is restricted to vertebrates
Scientific basis of listing decisions	A decision not to list can be based on perceived socioeconomic consequences of listing decisions	Listing decisions are based solely on best scientific and commercial data available
Steps and time lines following a proposed listing determination	(a) Issuance of a response statement by the minister of the environment (3 months) (b) Preparation of a listing-decision recommendation by the minister to federal cabinet (c) listing decision by cabinet following receipt of COSEWIC assessment from the minister of the environment (9 months)	(a) Public review and comment (no less than 60 days) (b) Final listing decision by the responsible secretary within 12 months of a proposed listing determination
Time lines for preparation of recovery strategy	*Endangered* species: 12 months after listing; *extirpated* and *threatened* species: 24 months after listing	No statutory time frame, but the USFWS and the NMFS are required to develop and implement recovery plans unless doing so would not promote conservation; a progress report to Congress is required every 2 years
Public participation in species assessment process	Anyone can submit a request for *observer* status at a COSEWIC meeting; none has been denied; observers typically include environmental nongovernment organization representatives, government managers and scientists, university students, and other interested members of the public	Participation by individuals from outside government agencies is generally constrained by provisions of the Federal Advisory Committee Act

Abbreviations: COSEWIC, Committee on the Status of Endangered Wildlife in Canada; NMFS, US National Marine Fisheries Service; USFWS, US Fish and Wildlife Service.

In addition, if a species were determined to be threatened or endangered over a significant portion of its range, the entire species would be listed.

COSEWIC assessments are based only on status reports that summarize the best available information (including Western science, ATK [e.g., Inuit *Qaujimajatuqangit*], and community or industry knowledge; section 2[1]). COSEWIC assesses the status of around 40 species at each of its twice-yearly meetings. The committee uses quantitative criteria similar to those developed by the International Union for Conservation of Nature (IUCN 2013). The viability criteria are (a) a reduction in the species' population size (determined using numerical criteria based on the species' rate of decline), (b) a reduction in its geographic range (determined using numerical criteria for the extent of occurrence and the area of occupancy), that the species' population size is (c) small or (d) extremely small (determined using numerical criteria based on mature individuals), and (e) quantitative estimates of extinction risk. Species are assessed according to the criterion that indicates the highest risk.

The IUCN criteria are used as a point of departure for considering status. COSEWIC can adjust the IUCN-determined status to a higher or lower risk category, for example, on the basis of the species' life history. Such modifications of status have occurred for 15% of 640 species determined to be at risk (listed as *endangered*, *threatened*, or *special concern*) between 2001 and 2011, a figure based on our examination of species assessment data provided by the COSEWIC Secretariat. Among the 95 affected species, 20 were labeled as being at lower risk (e.g., *threatened* instead of *endangered*) because of a perceived high probability of rescue (dispersal, followed by successful reproduction) from non-Canadian populations, in accordance with the approach suggested by the IUCN for regional assessments (IUCN 2012).

SARA has no counterpart to the *significant portion of its range* provision of the ESA.

Who conducts status assessments?

Neither the USFWS nor the NMFS has a national science body that reviews and assesses species' status. Procedures for conducting status reviews vary between (and within) the two services. The USFWS has a much larger and more decentralized ESA program than does the NMFS. Initial status assessments are generally assigned to an individual field biologist, who solicits public input and compiles available status and threat information. Occasionally, status reviews are completed by contracted scientists; for complex cases, the USFWS might convene meetings of species experts as part of its information gathering and analysis. Field staff prepares a preliminary listing determination in legal publication format (USFWS 1994), and this draft document undergoes lengthy internal review before being published for public comment (e.g., USFWS 1999, 2011).

A common practice within the NMFS is to appoint a status review team of federal biologists to compile and analyze the relevant status and threat information. The status review team generally produces a stand-alone document that explains the team's scientific conclusions and the associated uncertainties (e.g., Gustafson et al. 2006, Hobbs et al. 2008). The NMFS management staff then determines whether this information indicates that a listing is warranted, after considering conservation measures. ESA status assessments by both the USFWS and the NMFS must comply with the information-quality and peer-review practices established by the US Office of Management and Budget (2004).

COSEWIC oversees status assessments and makes final determinations regarding status. Each of the 60 or so members of COSEWIC (section 16[1]) and the members of the ATK subcommittee (section 18[3]) is appointed on the basis of his or her expertise (section 16[2] describes the qualifications of the members). Jurisdictional members of COSEWIC are nominated by federal, provincial, or territorial government ministers. Cochairs of the Species Specialist Subcommittees (SSCs; see below) and nongovernment scientist members (not formally affiliated with an SSC) are nominated by COSEWIC after a public competition. ATK subcommittee members are nominated by five national aboriginal organizations. Most SSC cochairs and nongovernment scientist members are university faculty members; the others are self-employed independent scientists, employees of nongovernmental organizations, or government scientists. Therefore, although COSEWIC is inclusive of government (jurisdictions are given representation), status assessments are made independently of government (the members are biologists who convey knowledge but do not represent their jurisdictions).

Most preliminary scientific analyses considered by COSEWIC are prepared by the 10 SSCs, which collectively include over 100 members (see *www.cosewic.gc.ca/eng/sct0/assessment_process_e.cfm#sec2* for details). SSC members are experts in one or more field (e.g., genetics, population biology, taxonomy, ecology, life history) associated with a specific taxonomic group. SSC members are directed not to consider social, political, economic, or personal consequences but to use their best professional judgment and knowledge to oversee the preparation, by third-party contractors, of reports for COSEWIC; to review or revise these reports; and to present the reports and the SSC recommendations to COSEWIC. Draft reports undergo extensive and open external review (typically lasting 1–2 years) by jurisdictions (e.g., government, aboriginal wildlife management boards), self-employed species experts, university scientists, and industry-employed biologists. Powles (2011) described how one SSC worked through these processes.

What is the listing process?

Reviews of species can be initiated proactively by either the USFWS or the NMFS, as was done with several status reviews of Pacific salmon in the 1990s (NMFS 1994). In practice, however, most status reviews are conducted in response to petitions by private citizens or interest groups. Any delay

in meeting statutory ESA deadlines is vulnerable to litigation, and lawsuits by parties wanting to reduce or increase legal protections pervade all aspects of the listing process (Greenwald et al. 2005). Because court orders or settlements are the highest USFWS funding priority, few resources are available for discretionary status reviews and listing actions.

Following the receipt of a petition, the responsible service (the USFWS or the NMFS) must make a finding within 90 days (to the maximum extent that is practicable) as to whether it presents "substantial evidence that a petitioned action may be warranted" (section 4[b][3][B]); if so, the service must make a determination within 1 year from the receipt of the petition whether to propose to list the species, to find that the petitioned action is not warranted, or to find that the action is warranted but precluded by higher-priority listing actions. Proposed listing actions are published in the *Federal Register*. A public comment period then follows, and a final determination must be published within 1 year (a 6-month extension can be granted in the case of "substantial scientific disagreement" about the data; see figure 1) (section 4[b][6][A]).

The USFWS has a long list of *warranted but precluded* species (USFWS 2012). These are added to a list of candidate species and given a priority status for future listing consideration (section 4[h][3]), which depends on published criteria that consider taxonomic uniqueness and the magnitude and immediacy of threats (USFWS 1983).

Responsibility for selecting species for assessment is one of the statutory functions of COSEWIC (section 15[1][b]). COSEWIC follows a systematic process to commission new status reports by selecting, from a list of candidate species, those considered to have the highest priority on the basis of perceived extinction risk. The candidate species list is assembled almost exclusively from lists provided by the SSCs. The public can propose species for consideration, but such petitions are rare. In prioritizing the overall list, COSEWIC considers the apparent risk of extinction to the species, its taxonomic distinctiveness,

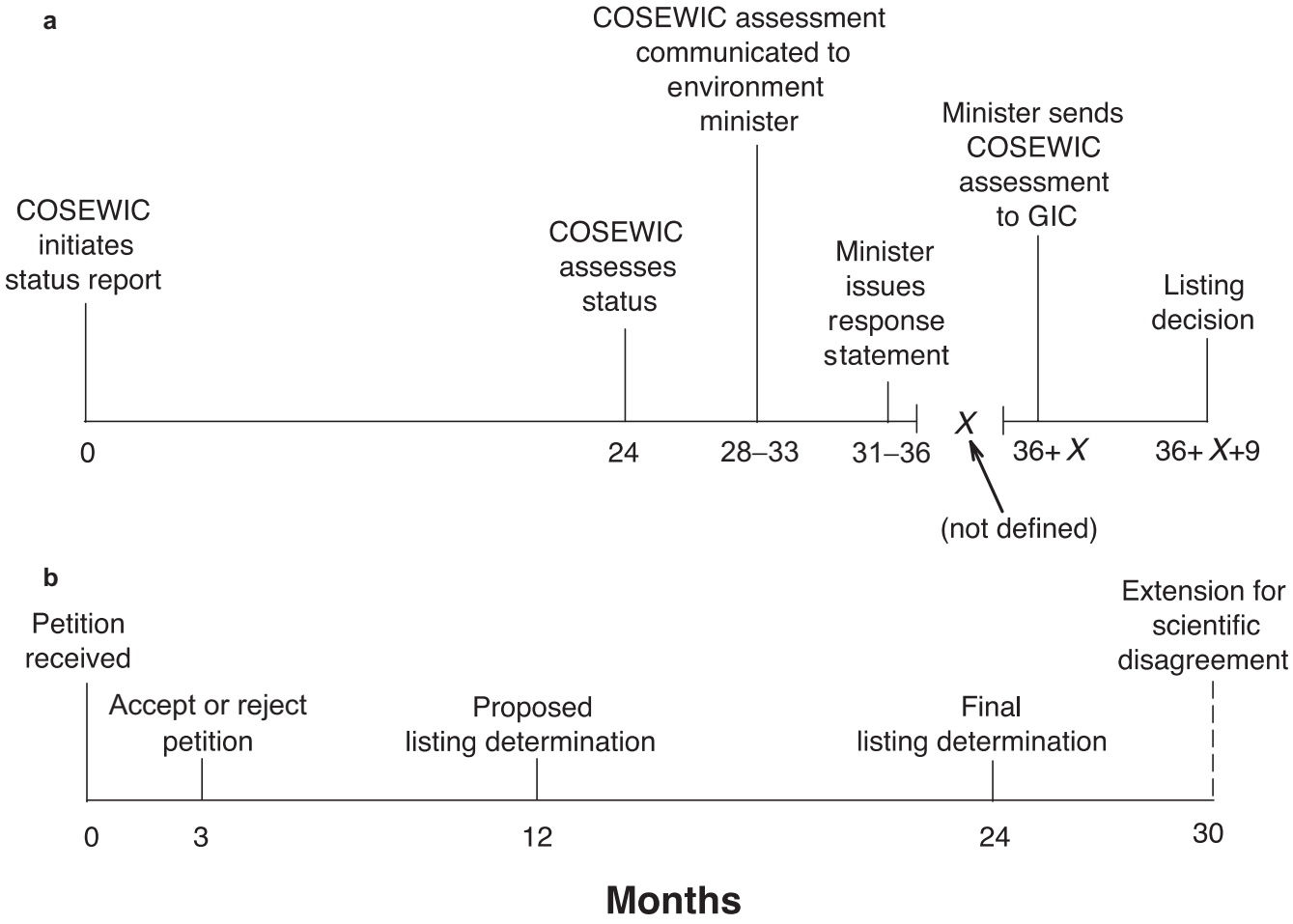

Figure 1. Time lines for listing under (a) Canada's Species at Risk Act and (b) the US Endangered Species Act. The legally mandated time lines in Canada are those for the ministerial response statement and listing decision (the 24-month period for the Committee on the Status of Endangered Wildlife in Canada [COSEWIC] assessments can be considered typical); all time lines indicated for the United States are legally mandated. X is an undefined length of time between two stages of the process. Abbreviation: GIC, governor in council, a subcommittee of federal cabinet ministers.

its global distribution, and the proportion of the species' range that occurs in Canada.

COSEWIC submits an annual report to the minister of the environment that details its status assessments. Within 90 days, the minister must either submit COSEWIC's assessments to the governor in council (a subcommittee of federal cabinet ministers) for listing consideration or declare a period of extended consultation (the *X* in figure 1a) involving those perceived to be negatively affected by a listing. The governor in council has 9 months after the receipt of an assessment to decide whether to accept the assessment and add the species to the legal list, to decide not to list the species, or to return the assessment to COSEWIC for further consideration. Rationale for the second option must be published in the SARA public registry. To date, more than 85% of the species determined to be at risk by COSEWIC have been listed; notable exceptions are marine fishes determined by Fisheries and Oceans Canada to have commercial value (Hutchings and Festa-Bianchet 2009a, Powles 2011).

Consequences of a listing

ESA prohibitions on take, export, and import automatically apply to species listed as *endangered* (section 9[a]). The USFWS and the NMFS can (optionally) extend any or all prohibitions to *threatened* species by issuing protective regulations under section 4(d). Federal agencies must consult with the services to ensure that actions are not likely to "jeopardize the continued existence" of the species or to adversely modify critical habitat (specific geographical areas with features essential to the species' conservation, for which special management actions might be required; section 4[b][6][C]).

Under SARA, if a species is listed, it immediately becomes illegal to harm, sell, buy, or trade it or to destroy its "residence" (section 2; e.g., a den or nest). However, these prohibitions apply only to aquatic species, birds protected under the Canadian Migratory Birds Convention Act, and those species on federal lands (section 34[1]). Federally listed species on private and provincial or territorial lands are subject to prohibitions articulated by provincial or territorial statutes. If the minister of the environment concludes that provincial or territorial laws do not provide effective protection, the federal government can invoke prohibitions on provincial or territorial and private lands (sections 34[2] and 34[3]), but such actions have yet to be taken.

Similarities and differences between SARA and the ESA

SARA and the ESA share a number of important features, including opportunities for public participation and peer review, the application of conservation measures scaled to the listing category, the initiation of recovery planning, and provisions for regular review and updating of species status. Both statutes also mandate the use of the best available science, although in neither case is science the only factor involved in the listing decisions. Science inevitably involves subjectivity; biological systems are inherently messy and seldom fit neatly into the arbitrary categorical determinations required by national species-at-risk legislation (Yaffee 1982, Doremus 1997, Hey et al. 2003, D'elia and McCarthy 2010). Purportedly "scientific" outcomes can depend on whether one is inclined to be a lumper or a splitter, one's tolerance for risk, one's discount rate for events that might occur at some time in the future, or how one apportions the burden of proof in the face of substantial uncertainty—all of which depend on personal experience; training; personality; and the professional context, including employer expectations (Cochrane et al. 2011).

These subjective aspects of the scientific process can be reduced but not eliminated entirely. Furthermore, science alone cannot answer value-laden questions such as *How much risk is acceptable?* and *How much biodiversity should we conserve?* In an ideal program for national biological conservation, these different roles for science, policy, and societal values would be transparent and the processes would be separated to the maximum practicable extent (Doremus 1997, Robbins 2009). The two acts differ in this respect in important ways. Below, we discuss this theme in the context of two types of differences between the ESA and SARA: statutory differences, which could not be reconciled without amending the laws themselves, and discretionary differences, which could be changed by agency rulemaking or adoption of a formal policy or operating guidelines.

Statutory differences. SARA allows the listing of populations of any taxon, whereas under the ESA, this provision is restricted to vertebrates. This latter feature of the ESA reflects the importance of charisma and political expediency in species conservation (Rohlf 1991, Bean and Rowland 1997). We agree with the conclusion of the US National Research Council panel that reviewed science and the ESA (NRC 1995): There is no scientific basis for excluding plants and invertebrates from protection at the population level.

A question of considerable interest is whether, given the same biological data for a hypothetical species, a listing would be more likely under the ESA or under SARA. Unfortunately, no simple answer is possible, because listing determinations depend on a variety of both scientific and normative factors, whose influence in practical applications has not been evaluated by comparative analyses. Nevertheless, it is possible to identify features of the two acts that tend to make listings more or less likely. First, SARA has a more restrictive definition of *endangered* (i.e., "facing imminent extirpation or extinction"; section 2) than does the ESA (i.e., "in danger of extinction"; section 3), and this might at least partially explain the lower ratio of *endangered* to *threatened* species in Canada (1.9:1 versus 3.5:1 in the United States; see tables 1a and 1b). In addition, an ESA species can be listed if it is at risk only in a significant portion of its range—a provision that can result in legal protection for species that would not otherwise qualify. However, the IUCN criteria used by COSEWIC are designed to be

precautionary in that status is assigned on the basis of the single highest-risk characteristic (Mace and Hudson 1999, Mace et al. 2008). In contrast, information standards in the ESA require that all available information be considered collectively, and species status is typically determined by weight of evidence (section 4[a][1]; Ruhl 2004). Finally, the ESA prohibits explicit consideration of factors other than science in listing determinations, whereas SARA provides a mechanism by which the federal government can, for socioeconomic reasons, decline to list species considered at risk by COSEWIC. This has been the primary reason for the rejection of most of COSEWIC's advice to list marine fishes (Mooers et al. 2007).

Unlike the ESA, SARA does not articulate time lines for every step of the listing process (figure 1). Notably, SARA does not provide a time line for the minister of the environment to send a COSEWIC assessment to the governor in council, which allows for extended delays that can be a significant factor associated with a decision not to list (Findlay et al. 2009). The Standing Joint Committee on the Scrutiny of Regulations characterized this level of ministerial discretion as a "defect" of the act, concluding that a "failure to provide for the delivery to, and receipt of, an assessment by the Governor in Council reflects an unintended gap in the scheme established by the Act" (SJC 2008, section 9).

The two acts also share a constraining statutory similarity: Whereas it is widely recognized that ecosystem-level considerations are important for effective conservation (Noss 1990, Doremus 1991)—and in its stated purposes, the ESA emphasizes conserving the ecosystems necessary for listed species—both acts are nevertheless focused on the listing and recovery of individual species or populations. The individual-species, safety-net approach to conservation embodied by both the ESA and SARA would be more effective if it were coupled with a coarser-scale, ecosystem-based approach to ensure that fewer species slip through the cracks and need individual attention. This is the approach adopted by Australia, where the Environment Protection and Biodiversity Conservation Act (of 1999) allows for and has resulted in the listing of threatened ecological communities (*www.environment.gov.au/biodiversity/threatened/index.html*).

Discretionary differences. Two factors make it more difficult to produce objective, repeatable status assessments under the ESA than under SARA. First, neither the USFWS nor the NMFS has produced policy guidance to help their scientists (which include staff members with species, modeling, conservation biology, and ESA expertise) interpret the value-laden terms in the ESA definitions of *threatened* and *endangered* species. As a consequence, different scientists can readily come to different conclusions about risk, depending on how they interpret *in danger of*, *likely*, *foreseeable future*, and *significant portion*. This misguides the public into thinking decisions are strictly scientific, when, in fact, they involve many discretionary choices (Yaffee 1982, Doremus 1997, Robbins 2009, Cochrane et al. 2011). This conflation of science and policy also makes it difficult to ensure that listing determinations are repeatable by independent groups confronted with the same data—a benchmark for any rigorous scientific process.

A second factor is that Canada has adopted a rule-based approach to risk assessment; the United States has not. A standardized approach has several potential advantages, including simplicity, repeatability, and objectivity (Regan et al. 2005, Mace et al. 2008, Hutchings and Festa-Bianchet 2009a, 2009b). *Standardized*, here, means criteria and procedures that provide expert guidance in interpreting various indicators of extinction risk; such a system can be fairly simple; can constitute a more complex, multifactorial set of rules; or can be a computerized expert system (Andelman et al. 2004). A standardized approach can be designed to weigh all available evidence, as was prescribed by the ESA. In congressional testimony dating back to 1974 (Easter-Pilcher 1996), the primary argument against adopting standard criteria for the ESA listings has been that a standardized set of criteria could not capture all of the nuances of biological systems and should therefore not replace "best professional judgment" (Yaffee 1982, Doremus 1997, Ruhl 2004). The IUCN criteria, in particular, were designed simply to identify species warranting more complete diagnosis and possible conservation action (Mace et al. 2008); they were not developed to serve as surrogates for ESA classification. In recommending a system of objective criteria and rules to make ESA listing decisions more consistent, the National Research Council (NRC 1995) cautioned that

> Unfortunately, there is as yet no evidence that the criteria used in the IUCN system do represent… degrees of risk [comparable to the ESA threatened and endangered classification levels]. Any system of criteria developed for use with the ESA should be thoroughly tested [before it is adopted]. (p. 155)

In this regard, COSEWIC's approach is enhanced by its flexible application of the IUCN criteria, indicated by the observation that 15% of COSEWIC's species assessments have differed from what would have resulted from rigid application of those criteria. Whenever this occurs, the reasons are presented in the publicly available species status reports.

Who conducts scientific evaluations?

In Canada, COSEWIC prioritizes species for formal consideration, oversees status assessments, and communicates its final determinations to the federal government and posts it on its public Web site. Therefore, the whole process from selecting species for consideration to a final status assessment is conducted by independent scientists. This process is not immune to subjective factors that are embedded in all scientific enterprises, but the roles of those factors are generally clear and transparent, and the products of the procedure are peer reviewed and publicly available.

The United States has nothing comparable to COSEWIC; ESA responsibility is split between two agencies, neither of which has a single national review team or process. Although the US system provides ample opportunity for interested parties to provide relevant information for consideration, most status assessments are conducted by agency biologists, with varying degrees of experience, training, and oversight by higher-level staff. In some cases, US status-review teams produce a stand-alone technical document (roughly comparable to a COSEWIC status report) that summarizes the scientific conclusions about the risk of extinction, independent from judgments about classification status. In other cases, however (and as a rule in the USFWS), these two steps are combined into a single document, in which case it can be difficult to separate scientific information from policy overlays. In addition, neither service has a systematic national process for identifying unlisted species that warrant a full ESA status review.

Transparency in delineating the roles for science and policy

COSEWIC makes scientific determinations about status, but the federal government can decline (and has declined) to list species for nonscientific reasons. Although the basis for not listing species that COSEWIC concludes are at risk is subjective and not standardized, at least the science and policy roles are clearly separated. Importantly, even if a COSEWIC-recommended species is not listed by the federal government, it remains on the COSEWIC list of at-risk species.

The roles of science and policy are less clearly separated in the United States, even though the USFWS and the NMFS are explicitly prohibited from considering socioeconomic factors in making listing determinations. Even in the cases in which a stand-alone scientific report is produced, the role that professional judgment played in interpreting the ambiguous, normative terms in the ESA generally will not be clear.

Conclusions

SARA and the ESA are two of the most powerful pieces of environmental legislation in the world. Our comparative analysis of the different approaches that they use to achieve broadly overlapping goals suggests that each act could benefit from mimicking the strengths of the other. We have the following specific recommendations for changes that could strengthen each act.

Resolve ambiguous terminology in the ESA. We agree with the NRC (1995), DeMaster and colleagues (2004), Cochrane and colleagues (2011), and others, who have called for clear legal or policy guidance regarding the interpretation of the ambiguous ESA definitions of *threatened* and *endangered* species. For example, the USFWS and the NMFS could adopt a policy stipulating that, for the purposes of the ESA, an *endangered* species is one that has a certain probability of extinction within a certain number of years, and a *threatened* species has a certain probability of becoming *endangered* within a certain number years; alternatively, more sophisticated permutations could be framed in decision-analytic terms (DeMaster et al. 2004, Regan et al. 2013). Providing specific thresholds that define the degree of risk equating to *threatened* and *endangered* status would promote consistency, transparency, and scientific rigor in classification decisions, even for the large fraction of species for which quantitative estimates of extinction risk are not feasible.

Increase the consistency and transparency of risk analysis and ESA listing determinations. The state of the science for assessing the degree of risk that a species faces is to integrate all potential threat and viability information in order to estimate the likelihood of the species' persistence over time. Whether this analysis comes from quantitative modeling, qualitative professional judgment according to fundamental principles of conservation biology, application of classification rules, or a combination of methods, it should be explained transparently and succinctly in listing decisions (NRC 1995). Although the USFWS and the NMFS provide some explanation or justification for all listing determinations, there is little consistency in how this is done. Specifically, we recommend that all status reports conclude with a section in which the method of assessment for the degree of extinction risk is summarized in a consistent and logical manner. These summaries should cover a standardized set of risk factors, which might include, for example, the four viable salmonid population criteria (abundance, productivity, spatial structure, and diversity) or redundancy, resiliency, and representation. (After this article went to press, the NMFS released guidance that recommends the use of the four viable salmonid population criteria in all ESA status reviews; see *www.nmfs.noaa.gov/pr/listing/*.) Each status report should also apply the IUCN criteria to the species or populations being assessed. Finally, a weight-of-evidence approach should then be used to integrate all this information into a listing determination.

The first recommendation would foster more consistency in status assessments across the two agencies and would make it easier for the public to understand the rationale for different conclusions for different species. In addition to contributing to the overall conclusions about extinction risk, the second recommendation would provide a basis for a direct comparison with many other such evaluations around the world—something that is presently problematic and that inhibits our ability to improve the science of species classification (Alvo and Oldham 2000, Hutchings and Festa-Bianchet 2009b). Over time, including IUCN analyses (and perhaps other ranking schemes) in new status assessments, combined with retrospective analysis of past ESA listing determinations (see Regan et al. 2009), would provide empirical data to demonstrate the likely consequences of adopting a rule-based system for risk assessment for the ESA.

Form a national status-assessment team with diverse qualifications. Some factors could make it difficult for the United States to simply adopt the COSEWIC model of external control of status assessments. For example, the Federal Advisory Committee Act (passed in 1972) places constraints on the membership of committees that provide advice to the federal government. Nevertheless, the United States could benefit from moving at least part way toward the Canadian model of using groups of scientists to conduct multiple species status assessments. The USFWS and the NMFS have many dedicated and experienced scientists involved in listing determinations, but most status assessments are conducted regionally, with varying degrees of national coordination. A team of diversely qualified staff could be responsible for all status reviews over an extended period of time, incorporating localized expertise of field staff as appropriate. This model was followed, albeit on a smaller scale, by NMFS scientists involved with ESA status reviews for Pacific salmon, which were conducted over a period of a decade beginning in the early 1990s. During that period, a core group of scientists participated in most or all biological review teams, while composition of the rest of the team varied depending on expertise. Regardless of how teams are assembled, each status review should produce a stand-alone scientific document that presents the scientific findings, analytical methods, and conclusions of the team, which becomes a central part of the final listing determination.

Similarly, the USFWS and the NMFS could form a national team that periodically reviews information about unlisted species and recommends those that should receive priority for full assessments. Logically, this screening process should follow the same systematic approach and criteria used to determine risk for ESA listing, thus increasing the efficiency of subsequent status reviews and directing efforts toward species most likely to warrant listing sooner rather than later.

Improve the transparency of ministerial discretion under SARA. Although SARA generally does a good job of clarifying and separating the roles of science and policy in listing determinations, the Canadian government could adopt measures to increase transparency in two ways: by making the post-COSEWIC listing recommendations provided by federal scientists to their respective ministers publicly available and by submitting socioeconomic cost–benefit analyses of the potential outcomes of listing decisions to external peer review and making the results public. In contrast to the multiple and lengthy reviews to which COSEWIC species status reports are subjected, governmental cost–benefit analyses in support of decisions to not list are undertaken internally, are not always publicly available, and do not undergo external peer review. The government could also adopt standardized rules or guidelines for conducting these analyses.

Close the listing loophole. The ESA prescribes maximum time lines for completing all of the key steps in the listing process, whereas SARA leaves one crucial gap: No deadline is specified for when the minister must pass the COSEWIC assessment on to the governor in council (figure 1). Given the importance of time lines to actions pertaining to endangered species recovery and protection, we view this as a significant deficiency of the Canadian legislation (Vanderzwaag and Hutchings 2005, Mooers et al. 2007, Findlay et al. 2009). Ideally, this gap would be addressed through legislation. Failing that, the government could adopt a policy that specifies a maximum duration for this step.

In closing, we would like to emphasize that we have not attempted to evaluate which statute (the ESA or SARA) is better from the perspective of biodiversity conservation. Such an evaluation would be very complex and would involve consideration of a host of technical and normative issues that are well beyond the scope of this article. Instead, we have compared the two acts through a lens that focuses on how the roles of science and policy are partitioned in the process of deciding which species merit legal protection. We believe that clarity and transparency regarding these roles will promote sound public policy toward the conservation of biodiversity.

Acknowledgments

The manuscript benefited from discussions within the Red Flags and Extinction Risk Workgroup sponsored by the National Center for Ecological Analysis and Synthesis, in Santa Barbara, California. We thank Resit Akçakaya, Steve Chambers, John Fay, Mike Ford, Doug Keinath, Mike Schwartz, and three anonymous reviewers for valuable comments on an earlier draft. The views and opinions presented here are solely those of the authors and do not necessarily represent those of their employers.

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