

Endangered species laws and the inclusion of Indigenous knowledges and sciences in risk assessments

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Abstract

Indigenous Peoples actively manage or have tenure rights over lands where many rare and valued species occur. To meet national and global conservation targets, it is important to meaningfully consider Indigenous knowledges and rights in endangered species laws. We examined whether the Canadian *Species at Risk Act* (SARA) has upheld its commitment to consider Indigenous knowledges in decisions pertaining to endangered species assessment. Using data from 823 species status assessments published from 1998 to 2023, we constructed indicators and derived a composite score for 5 tenets of Indigenous models of conservation: those that center Indigenous sovereignty, incorporate place-based knowledges, emphasize interconnectedness, draw from Indigenous knowledge sources, and recognize the cultural importance of species. Over the last quarter century, we found no evidence of improved consideration or inclusion of Indigenous knowledges and science in species status assessments. Although status assessments in northern jurisdictions tended to be better aligned with Indigenous frameworks of conservation, mean composite scores remained low across status assessments (mean = 0.9/5 in 2023). To advance the meaningful consideration of Indigenous Peoples and their knowledges in conservation practices and policies, we recommend honoring endangered species laws' specifications to consider Indigenous knowledges at every step of the process, from species assessment, to increasing capacity, to meaningfully engaging Indigenous Peoples.

KEYWORDS

Aboriginal traditional knowledges, ATK, consultation, endangered species laws, Indigenous knowledges, Indigenous science, SARA, Species at Risk Act

Jaime Grimm, Bruno E. Soares, and Leila Vaziri Zanjani contributed equally to this work.

INTRODUCTION

Indigenous Peoples and their knowledges (including Indigenous science) are increasingly being called on to halt and reverse trends in biodiversity losses (Artelle et al., 2019). This recognition stems from the fact that many Indigenous practices, values, and place-based governance systems foster coexistence between people and the environments they rely on (Latulippe & Klenk, 2020; Leiper et al., 2018). Yet, the relationship between Indigenous Peoples' knowledges and the formation and enactment of endangered species laws, such as Canada's *Species at Risk Act* (SARA), United States' *Endangered Species Act*, Australia's *Environment Protection and Biodiversity Conservation Act*, and New Zealand's *Threatened Species Act*, remains contentious (Artelle et al., 2019; Lamb et al., 2023). Recognizing Indigenous knowledges within those legal frameworks is essential to achieve global conservation targets, particularly given that Indigenous Peoples manage or have tenure rights over a quarter of the world's land surface, including 40% of the areas free of industrial-scale anthropogenic impacts (Garnett et al., 2018; Lamb et al., 2022; Zurba et al., 2019). As a result, their lands support many endemic and rare species (Leiper et al., 2018; Schuster et al., 2019).

Although the intent of endangered species laws (e.g., to identify, protect, and recover biodiversity) may align with the goals of some Indigenous governance and stewardship approaches, their enactment often neglects the importance of biodiversity to Indigenous health, cultural practices, and ways of life (Hessami et al., 2021; Reyes-García et al., 2023; Schmidt & Peterson, 2009). The continued exclusion of Indigenous Peoples from endangered species laws has had wide-ranging repercussions around the world including infringing of Treaties. In Canada, historic Treaties are legally binding agreements between Indigenous Nations and the Crown guaranteeing Indigenous rights to hunt, fish, and live on their traditional territories. Provincial restrictions on harvest can violate Indigenous rights to sustain a culturally meaningful way of life (including through forceful removal from their lands) and impede the effectiveness of Indigenous-led conservation efforts (Lamb et al., 2023). In addition, efforts to conserve species are often ineffective or harmful when Indigenous Peoples are not meaningfully included. Such efforts often underestimate the scale needed for successful recovery and overlook the knowledges Indigenous communities hold on the critical habitat and ecology of endangered species (Artelle et al., 2019; Lamb et al., 2023).

We focused on the impact of policy reforms intended to support the meaningful participation of Indigenous Peoples and their knowledges in the conservation of endangered species in Canada. On paper, SARA, a key federal legislative tool supporting Canada's commitment to global conservation targets under the Convention on Biological Diversity (CBD), aims to confront the biodiversity crisis with consideration for the Indigenous Peoples who live there. Canada's Indigenous Peoples include more than 50 self-governed First Nations, Inuit, and Métis whose territories span the landscape and overlap with lands and waters of conservation interest (Artelle et al., 2019), including hotspots for national endemic species (Kraus et al., 2023).

Indigenous rights were recognized in a Royal Proclamation in the 18th century and established and defined in Canada's *Constitution Act* of 1982. Yet, it is only in the last couple of decades that Indigenous knowledges and rights have started being considered in biodiversity legislation. In the early 2000s, SARA was adapted to underscore the necessity of considering Indigenous knowledges and science (e.g., Sections 2, 3, 8, 10, 16, 18, 39, 66, 83, and 103) in decision-making. Other policy changes intended to promote the recognition of Indigenous knowledges and rights under SARA include the establishment of committees to ensure Indigenous participation in decision-making related to endangered species and the direction of funding to Indigenous organizations, such as the Aboriginal Fund for Species at Risk.

We specifically focused on species status assessments, which are risk assessments informing all decisions related to endangered species laws such as listing, delisting, designating critical habitat, and planning recovery. From 1977 to 2000, species' classifications were informed by Western knowledge of the ecology, critical habitat, and threats to a target species provided by an independent committee—the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) (Government of Canada, 2002). To comply with SARA's stated value and principle that Indigenous and Western knowledges must be considered on an equal footing in species assessments, COSEWIC created a subcommittee of experts in Indigenous knowledges. Members of the subcommittee began meeting in 2006 and were tasked with the responsibility to ensure that Indigenous knowledges and science (collectively referred to as ATK under SARA) are incorporated into species assessments. Although previous research showed that requirements for incorporation of Indigenous knowledges and science at all steps in the SARA process have not been adhered to (Beaulieu-Guay, 2022; Hill et al., 2019; Jeanson et al., 2025; Olive, 2012; Turcotte et al., 2021), these requirements have not been evaluated in the context of the initial status assessments.

We evaluated support for the hypothesis that, as a result of policy changes, Indigenous knowledges are increasingly braided rather than integrated into status assessments under SARA. Here, the term *integrated* describes the superficial inclusion of Indigenous knowledges in dominant Western frameworks (i.e., as an additional source of information, such as by using Indigenous observations of species decline in population trend analyses). In contrast, braiding recognizes Indigenous knowledge and Western science as equally valid systems that can guide the process together, shifting approaches to allow cultural significance, habitat relationships, and Indigenous stewardship to shape assessment priorities alongside Western frameworks. We also explored the hypothesis that policy changes have catalyzed a deeper transformation entailing the recognition of Indigenous stewardship, values, and knowledges in status assessments. Unlike integration within Western paradigms, Indigenous conservation models challenge the dominance of Western knowledge by holding the ways of knowing of different Nations as equally valid (e.g., *Etuaptmumk* or Two-Eyed Seeing) (Bartlett et al., 2012; Reid et al., 2021). They require rethink-

ing and correcting the relationships among peoples, the natural world, and other living beings by emphasizing their interrelatedness (M'sit No'kmaq et al., 2021; Young, 2018). Such models often view human relationships with nature as reciprocal, intertwined with cultural and spiritual values, rather than viewing nature as a commodity (McAllister et al., 2023). By prioritizing relationality, equity, and Indigenous governance, Indigenized models of conservation go beyond the inclusion of Indigenous Peoples into Western conservation frameworks to offer transformative pathways to planetary health.

Much of the literature focuses on evaluating the inclusion of Indigenous knowledges in conservation policy using qualitative methods. In contrast, we used quantitative metrics to measure and monitor alignment with 5 core tenets of Indigenized conservation frameworks: center Indigenous sovereignty; incorporate place-based knowledges; emphasize interconnectedness; draw from Indigenous knowledge sources; and recognize the cultural importance of species. Using data collected from species status assessment documents prepared under SARA, we explored how we could measure alignment among Indigenous knowledges, practices, and worldviews and species assessments in policy documents and assessed variation across taxonomic groups, jurisdictions, and over time. As many Canadian provinces and territories have unique legislation related to species at risk, which may overlap or complement SARA, we further predicted that trends may vary across Canadian jurisdictions and taxonomic groups. In doing so, we aimed to go beyond Indigenous inclusion into endangered species laws to assessing evidence for the deeper shift required to align with the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP, 2007) and to fulfill international commitments under the CBD. In particular, the Global Biodiversity Framework emphasizes the rights of Indigenous Peoples in several targets, including target 22 on recognizing the rights of Indigenous Peoples to self-determination and their governance systems as central to tackling biodiversity loss and global conservation, Target 3 on building equitable systems for managing protected areas, and Target 21 on ensuring just and effective participation in decision-making by Indigenous Peoples (CBD, 2024).

METHODS

Positionality

Anishinaabe scholars and S.C. and M.B. guided our analyses of the alignment of SARA with Indigenous knowledges, stewardship, and values. We learned much from the knowledge they shared with us, developed through decades of experience working with and for Indigenous communities on environmental projects in a settler-colonial context. J.G. is of mixed Manitoba Saulteaux and western European heritage. B.E.S. and L.V.Z. are lead authors and settlers of, respectively, Brazilian and Iranian heritage. They were supported by A.D. of Chippewas of Nawash Unceded First Nation and R.A., who contributed from Brazil. The lead authors were also guided by settler learners and colleagues D.J.F., N.E.M., and T.A.B. Collectively, we aim

to consider wildlife as interconnected with the land and water, including sociocultural landscapes, for the benefit of nature and people.

Study documents

Species status assessments provide decision makers with information to guide decisions regarding whether a species should be listed and receive legal protection or recovery actions. In Canada, the process involves several defined stages. In Stage 1, candidate species are prioritized for assessment by COSEWIC members, including one representative of the ATK subcommittee. In Stage 2, the ATK subcommittee further prioritizes a subset of species selected in Stage 1 for an independent assessment based on ATK. The selected species undergo assessment, followed by publication of a status report outlining the species' biology, distribution, threats, and conservation status (i.e., not at risk, special concern, threatened, endangered, extirpated, extinct, or data deficient). In April 2024, we downloaded all available status reports from SARA's public registry (<https://species-registry.canada.ca/>). For each report, we recorded publication year, taxonomic group, and geographic occurrence of the taxa assessed.

Development of indicator alignment with Indigenized frameworks of conservation

To develop our scoring rubric, we drew extensively from the Indigenized approach to Grizzly Bear stewardship practiced by the Haí'tzaq, Kitsoo/Xai'xais, Nuxalk, and Wuikinuxv First Nations in British Columbia. This model, articulated around 7 tenets, reflects values and worldviews commonly shared across Indigenous-led stewardship approaches in Canada and beyond, thereby offering an alternative to dominant, Western approaches to conservation (Artelle et al., 2021). For example, the tenets are evidenced in the stewardship practices focused on culturally important species like caribou (*Rangifer tarandus*) (Polfus et al., 2016) and white sturgeon (*Acipenser transmontanus*) (Oloriz et al., 2020) in Canada. More broadly, Indigenous-led stewardship of lands, waters, fisheries, and wildlife in North America and internationally (including Australia and New Zealand) demonstrated similar worldviews grounded in local values (Lyver et al., 2019; Woodward et al., 2020). As such, we intended our model to be generally applicable to efforts to decolonize and Indigenize conservation (Artelle et al., 2021)

Specifically, we developed 5 indicators aligned with our interpretation of the following principles: resource stewardship is inseparable from the rights, title, responsibilities, self-determination, and sovereignty of Indigenous Peoples (stewardship); connections between species, peoples, and the environment are considered (connections); diverse knowledge sources are included and respected (knowledges); stewardship is place-based (centered on communities), with collaborations with other governments as appropriate (place); and the cultural importance of species is recognized and addressed (cul-

TABLE 1 Rubric for scoring metrics of stewardship, connections, knowledges, place, and culture in reference to Indigenous Peoples in status report outlining Canadian species' biology, distribution, threats, and conservation status, adapted from Artelle et al. (2019).

Indicator	Score	Description
Stewardship	0	No mention at all
	1	Vague statement recognizing Indigenous communities as right holders regarding resource use (e.g., "Aboriginal peoples hold first rights to the use of migratory caribou for subsistence and other traditional uses."); if a report specifies that a given population or species occurs on Indigenous land without being more explicit about the rights, responsibilities, and self-determination of the Indigenous Peoples, it is not enough to warrant a score of 1 (report needs to be more explicit) in the stewardship indicator, but it may warrant a 1 in the place indicator
	2	Recognizes Indigenous communities as rights holders to the environment and as decision makers by recognizing treaties where they exist; recognizes sovereignty of Indigenous Nations in the area (e.g., "In Quebec, the majority of the 35 territories where migratory Caribou exist are governed under the James Bay and Northern Quebec Agreement, and the Northeastern Quebec Agreement."); or mentions Indigenous-led stewardship initiative
Connections	0	No mention
	1	Recognizes importance of relationships with a generic statement: "important to Indigenous Peoples who recognize the interrelationships of all species within the ecosystem"
	2	Anything else (make a note of it)
Knowledges	0	No mention
	1	Generic statement: "There is no species-specific ATK [Aboriginal Traditional Knowledge] in this report" or some indication that the authors searched but could not find it (e.g., "In terms of sources of Aboriginal Traditional Knowledge relating to the Rusty Blackbird, a study of the available sources did not find any in Canada.")
	2	Includes some species-specific ATK (e.g., "According to Aboriginal users, especially Inuit and Cree hunters, the Leaf River subpopulation has decreased since 2011.")
	3	Considers ATK a reason for designation (e.g., "Aboriginal Traditional Knowledge also indicates a decline.")
Place	0	Does not mention specific Indigenous communities or Indigenous Nations
	1	Mentions specific nations, cites, knowledges, or literature from the community but does not attempt to engage for the Committee on the Status of Endangered Wildlife in Canada assessment
	2	Mentions attempts to collaborate or include Indigenous communities or Nations (e.g., "South Nation Authority was contacted with no response.") or mentions gray literature specific to communities
	3	Collaborates with specific communities or Indigenous Nations in the assessment (e.g., "assessed by Allan Penter [Cree Nation] and Natalie D'Astous [Naskapi Nation of Kawawachikamach].")
	4	Indigenous Groups or Peoples listed as author or as coauthors
Culture	0	No mention
	1	Includes some information on cultural significance

tural significance). In our rubric (Table 1), a score of zero indicated no evidence of alignment, whereas a score of 5 represented the highest level of alignment. The development of the rubric benefited from the perspectives of all authors, which include Indigenous members of the ATK subcommittee and COSEWIC and non-Indigenous members of COSEWIC.

We identified consensus-based scoring (Legree et al., 2005) as a powerful approach for the evaluation of the status reports based on preliminary analyses. This approach was ideal because the reports are unstandardized as they are prepared by contracted writers with varying interpretations of COSEWIC guidelines. At least 2 of the 6 members of the literature review team (J.G., B.S., L.V., R.A., A.D., T.B.) evaluated each report independently in its entirety and scored the 5 indicators. Each report was searched for keywords adapted from Hill et al. (2019): *aboriginal, nation, band, Metis, Indigenous, Inuit, tribe, tribal,*

council, people, community, treaty, unceded, relation, and native. The context of keyword hits was then evaluated for evidence of alignment with the Indigenous framework of conservation. Many status assessments assess multiple taxa within one report. We assigned rubric scores at the level of the full report, meaning that each taxon (e.g., subspecies, designatable unit) within the report was assigned the same score. We excluded from the analysis reports focused entirely on data-deficient, extirpated, or extinct taxa. The final score was then obtained by a consensus among the evaluators during group meetings held weekly from April 2024 to June 2026. This consensus-scoring approach gave our team an opportunity to identify and resolve the possible causes of disagreement, which often stemmed from different interpretations of a particular context, overlooked elements of a report, or biases due to the evaluator's background or knowledges.

Braiding and consideration of Indigenous knowledges and sciences

To evaluate support for the improved braiding and consideration of Indigenous knowledges and science in species assessments due to policy changes, we used Fisher's exact tests to evaluate whether the indicator focused on knowledges was associated with reports published within 2 periods. Specifically, we expected significant differences between reports published prior to the inaugural meeting of the ATK subcommittee in February 2006 ($n = 217$) and reports published since 2015 ($n = 200$). The latter period was chosen to ensure relatively equal sample sizes between the 2 periods, which can maximize statistical power. We then examined the deviation between observed and theoretically expected distribution to evaluate where scoring deviations have the strongest impact. Based on our scoring rubric, we expected that a greater proportion of 2 among recent reports would suggest integration of Indigenous knowledges and science into risk assessments, whereas a greater proportion of 3 may provide some support for greater consideration of Indigenous knowledges into the recommendation issued by the report.

Alignment with Indigenized frameworks of conservation

To provide a comprehensive overview of alignment with Indigenized frameworks of conservation, we generated a composite metric derived from the indicators (place, connections, stewardship, cultures, knowledges). To do so, we first normalized each individual indicator to a scale of 0–1 so that none of the specific indicators would dominate the composite metric. We then summed the normalized scores between the indicators to obtain a composite score on a scale of 0–5 describing alignment with some of the tenets of Indigenized models of conservation.

We evaluated differences in composite scores across taxonomic groups with a generalized linear mixed model (GLMM). We used the taxonomic group as a fixed effect and specified a negative binomial distribution because the response variable (mean composite score) was bounded between 0 and 5, positively right skewed, and zero inflated. We also included species as a random effect to account for repeated status reports over time for the same species. We used the R package *emmeans* 1.8.5 (Lenth, 2023) to calculate the mean value for each taxonomic group while accounting for the model structure. To assess whether differences between taxonomic groups were significant, we assessed overlap between asymptotic confidence intervals around the taxa. Additionally, we assessed whether there were spatial differences in mean composite scores by comparing 95% confidence intervals across jurisdictions.

We tested whether reports' alignment with an Indigenous framework of conservation improved over time using GLMMs with a negative binomial family. Using the composite score as a response variable, we conducted the analysis using 2 datasets: a full dataset including all reports ($n = 826$) and a reduced dataset including reports for taxa that had been assessed more than

once since 1998 ($n = 288$). To evaluate changes in the degree of alignment with Indigenized models of conservation and potential variation among taxonomic groups across all reports published from 1998 to 2023 (i.e., the full dataset), we ran a first model that included an interaction between the centered and scaled year of publication of each report and taxonomic group as a fixed effect. Species common name was included as a random effect to account for multiple evaluations of the same taxa. We further examined variation between and within taxonomic groups in a second model focused on the reduced dataset, in which we included the centered and scaled year of publication as a fixed effect and species common name nested within taxonomic groups as a random effect. The significance of the fixed effect was determined using likelihood ratio tests and backward model selection, removing the interaction term (full model) first.

RESULTS

Species status assessments

In total, we analyzed 823 reports published from 1998 to 2023 for alignment with Indigenized frameworks of conservation. These reports focused on vascular plants (18.6% of the taxa), freshwater fishes (15.3%), birds (12.7%), marine fishes (11.6%), arthropods (8.8%), reptiles (7.0%), marine mammals (6.4%), terrestrial mammals (6.20%), mollusks (4.8%), amphibians (3.6%), lichens (2.6%), and mosses (2.3%). Many species (38.7%) had geographic ranges extending over multiple Canadian jurisdictions (i.e., provinces, territories, oceans), including Indigenous homelands and waters, of which the most frequently cited were British Columbia (34.7%), Ontario (31.5%), Québec (18.7%), Alberta (15.1%), Manitoba (14.7%), Saskatchewan (13.8%), Nova Scotia (11.1%), New Brunswick (10.5%), Atlantic Ocean (10.3%), Newfoundland (8.7%), Labrador (8.4%), Pacific Ocean (7.5%), Northwest Territories (6.9%), Nunavut (5.6%), Yukon (5.7%), Prince Edward Island (5.1%), and Arctic Ocean (3.9%).

Trends for braiding and consideration of Indigenous knowledges and science

There was no evidence for increased braiding nor consideration of Indigenous knowledges and science in recent reports relative to those published prior to the inaugural meeting of the committee tasked to promote the meaningful engagement of Indigenous Peoples and their knowledges in risk assessments. Specifically, we found a significant association between periods and the knowledges indicator ($p < 0.01$, Fisher's exact test). However, most of the difference between observed and theoretically expected counts (70%) was due the inclusion of generic statements (report score = 1) in recent reports. Values near 0 indicated that the difference related to the integration (report score = 2) and consideration (report score = 4) of Indigenous knowledges and science between the 2 periods was

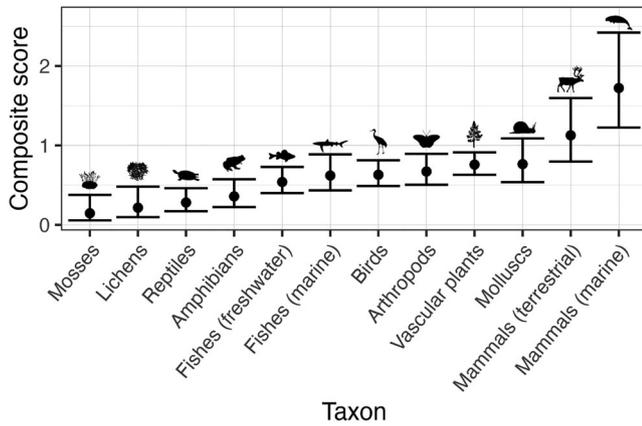


FIGURE 1 Mean and asymptotic confidence intervals in composite score combining metrics of stewardship, connections, knowledges, place, and culture in reference to Indigenous Peoples in status reports assessing the biology, distribution, threats, and conservation status of Canadian species assessed based on a generalized linear mixed model.

very small. We found evidence for the inclusion of Indigenous knowledges and science in 6% of the reports published prior to 2006 and 6.5% of the reports published after 2015. Only one of the former and 6 of the latter explicitly considered Indigenous knowledges and science as a reason for designation.

Trends in composite metric of alignment with Indigenized frameworks of conservation

We found that composite scores remained on average low (average = 0.92 of 5). Many species status assessments (40.2%) had a composite score of zero, meaning that no evidence of alignment with Indigenized frameworks of conservation was found for any of the scored indicators (i.e., stewardship, connections, knowledges, place, and cultures). When accounting for model structure, mean composite scores did not differ significantly among taxonomic groups, with the exception of terrestrial mammals (Figure 1). Specifically, reports assessing marine mammals had significantly higher composite scores than all other taxa with the exception of terrestrial mammals. Despite this significant difference, the range of mean composite scores among taxonomic groups was limited, ranging from 0.145 to 1.722 (Figure 1). In addition, composite scores differed significantly among areas of occurrence (Figure 2): reports for taxa occurring in northernmost territories and provinces (e.g., Nunavut, Arctic Ocean, Northwest Territories, Yukon) tended to score higher. Species occurring in Nunavut and the Arctic Ocean had the highest composite score, whereas those overlapping with Saskatchewan and Alberta had the lowest composite score.

Composite scores increased over time across all reports (full dataset) and for the subset of reports focused on species with multiple assessments (reduced dataset) (Figure 3). In both analyses, the interaction term between time and taxonomic group was not significant, implying that the relationship between time and composite score did not vary by taxonomic groups. The

final models included time and taxonomic group and depicted comparable trends, as demonstrated by overlapping confidence intervals around both the intercept and the slope of the full and reduced GLMMs. Despite the increase, the predicted mean composite scores remained low with a maximum predicted composite score of 0.92 (95% CI 0.76–1.11) for the full model and 0.65 (95% CI 0.44–0.95) for the reduced model.

DISCUSSION

Our research showed how alignment between conservation policy documents and Indigenized frameworks of conservation can be evaluated using quantitative metrics. Specifically, we extended previous research by employing quantitative methods to document that, despite policy changes intended to enhance the inclusion and engagement of Indigenous Peoples and their knowledges under SARA (e.g., recognizing the need to consider Indigenous and Western knowledges on equal footing, funding projects, and promoting engagement), Indigenous knowledges continue to be excluded from most species status assessments. As a result, we found little evidence for improved alignment between status assessments and a cumulative metric representing alignment with 5 core tenets of Indigenized frameworks of conservation (i.e., centering Indigenous sovereignty, incorporating place-based knowledges, emphasizing interconnectedness, drawing from Indigenous knowledge sources, and recognizing the cultural importance of species) from 1998 to 2023. Overall, these findings suggest that Indigenous knowledges, stewardship, and values are generally not reflected in species status assessments under SARA.

Our results have important ramifications for decision makers and policy makers aiming to improve the consideration of Indigenous knowledges and rights under endangered species laws. First, they point to the value of understanding and tracking progress toward alignment between Indigenized frameworks of conservation and conservation policies. In our study, monitoring progress toward considering Indigenous knowledges, stewardship, and values in status assessments revealed important gaps between the intent of endangered species laws (i.e., to meaningfully include Indigenous Peoples in the conservation of rare and valued species) and how they are enacted, which is likely to manifest as a lack of alignment between policy objectives and their practical outcome. Second, our analysis of the cumulative metric confirms that decision makers and policy makers need to ensure that the legal requirements to consider Indigenous knowledges and science at all steps of the SARA process are adhered to (Hill et al., 2019; Olive, 2012; Turcotte et al., 2021). Lack of consideration in the first stage of the act is particularly problematic as it is likely to carry forward to all decisions pertaining to endangered species informed by species status assessments, which include listing and delisting species, designating critical habitat, and planning recovery.

Many others have provided detailed specific advice and recommended changes to improve the consideration of Indigenous knowledges, practices, and worldviews under SARA, including the Indigenous Circle of Experts (Government of Canada,

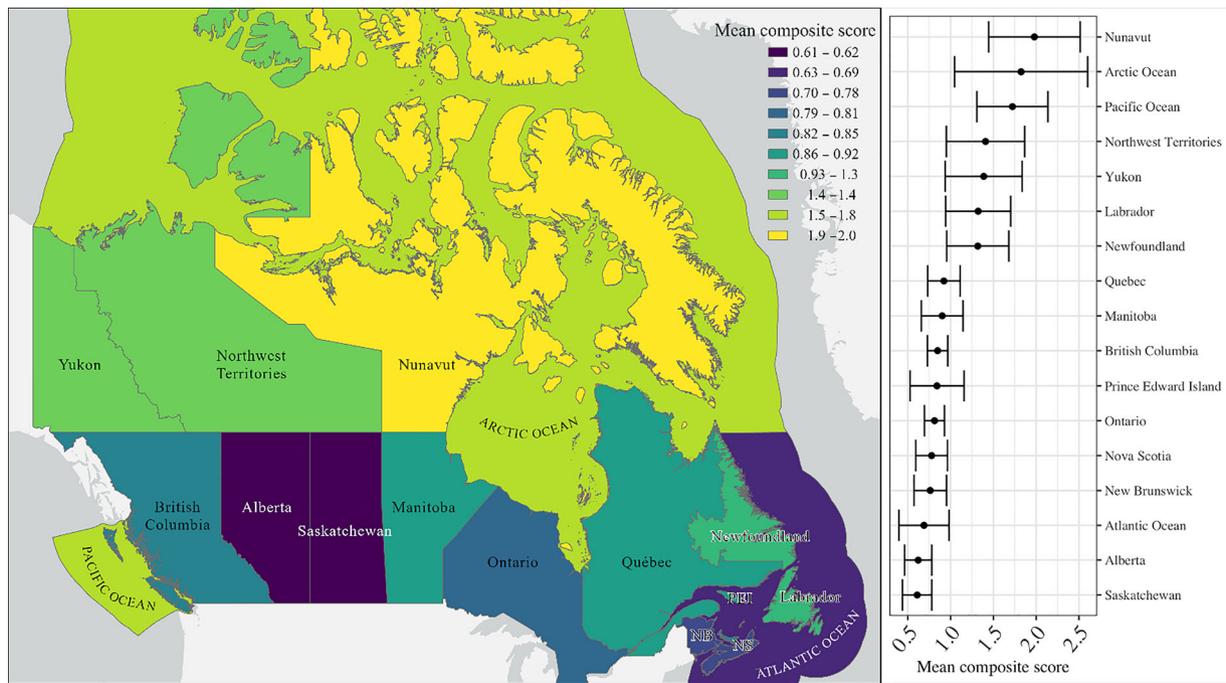


FIGURE 2 (a) Mean composite score, which combines metrics of stewardship, connections, knowledges, place, and culture, in reference to Indigenous Peoples in status reports on the biology, distribution, threats, and conservation status of Canadian species for each Canadian region where the species occurs (95% confidence intervals on the right).

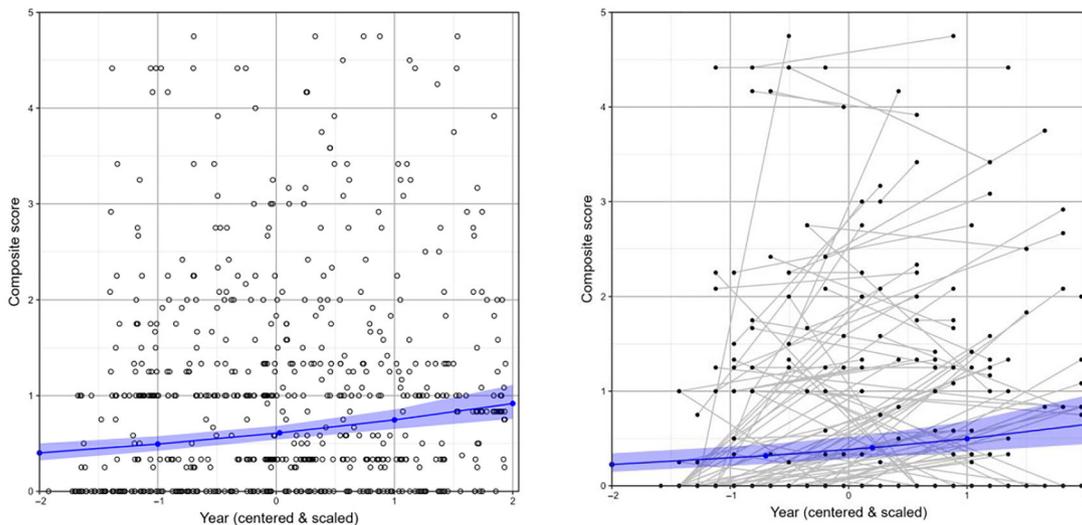


FIGURE 3 Temporal trend in composite scores, which combine metrics of stewardship, connections, knowledges, place, and culture, in reference to Indigenous Peoples in status reports on the biology, distribution, threats, and conservation status of Canadian species for all species assessed (left) and for a subset of species assessed multiple times (right) (points, a single status assessment report; blue, 95% confidence intervals around the trend line [center line] inferred from generalized linear mixed-effect model; gray lines, connect reports on the same species).

2018), the Truth and Reconciliation Commission of Canada (2015), the Assembly of First Nations, the National Aboriginal Council on Species at Risk (2014), and Indigenous scholars and allies (Binham et al., 2021; Hill et al., 2019; McGregor, 2014; Reid et al., 2021, 2024; Turcotte et al., 2021). A representative set of options that could be implemented to improve the meaningful inclusion of Indigenous Peoples and their knowledges,

by no means exclusive, includes complying with SARA’s obligations to consider Indigenous knowledges at all stages of the process, increasing Indigenous representation, and increasing capacity and funding to meaningfully engage and gain knowledge from Indigenous knowledge holders. The slow progress of Indigenous endangered species laws, such as SARA, can also be attributed to these laws being fundamentally non-Indigenous

because they are often negotiated and adopted outside methodologies developed and recommended by Indigenous elders and experts, such as *Etuaptmuk* (Two-Eyed Seeing) and ethical space (Indigenous Circle of Experts, 2018). As a result, many Indigenous leaders and researchers have advocated for representation that goes beyond a seat at the table to a shift facilitating deeper involvement in the decision-making process (Artelle et al., 2019; Gazing Wolf et al., 2024; Zurba et al., 2024).

Variation across jurisdictions and taxonomic groups

We provide promising evidence that Indigenous resurgence might drive policy changes by Indigenous conservation. Notably, reports most aligned with the core tenets, especially knowledges and culture, focused on species in northern jurisdictions such as Nunavut, Northwest Territories, Yukon, and coastal British Columbia. These jurisdictions are characterized by strong Indigenous resilience and resurgence within their political and institutional context, where organizations have revised regional laws, policies, and governance structure to ensure meaningful Indigenous participation and the consideration of Indigenous knowledges into decision-making (Armitage et al., 2011; Peacock et al., 2020; Singer et al., 2023). Indigenous groups in these regions also negotiated comprehensive land-claim agreements with the Canadian and territorial governments (e.g., Nunavut Land Claims Agreement, Inuvialuit Final Agreement, Sahtu Dene and Métis Comprehensive Land Claim Agreement, Yukon Land Claims) in which co-managed institutions are mandated to advance Indigenous aspirations. Building on these legal developments, the Northwest Territories recently developed 2 complementary sets of criteria to assess species status, which independently reflect Indigenous and Western knowledge to gain a more holistic understanding of species status (Singer et al., 2023). For meaningful inclusion of Indigenous knowledges under SARA, similar structural changes will likely be necessary at the federal level.

Our results demonstrate that alignment with Indigenous frameworks has been, to date, most strongly associated with the conservation of endangered mammals. This finding might reflect the influence of Indigenous-led research and management for culturally significant species. Notably, species that scored high in our study (e.g., the 10 most highly scored species were, in order, caribou, ringed seal, grizzly bear, polar bear, beluga, narwhal, bowhead whale, bison, sea otter, and Atlantic walrus) are deeply embedded with Indigenous identity and relationships with the land due to their role as a food source and their profound cultural significance (COSEWIC, 2011; Polfus et al., 2016). Many of these mammals are also geographically restricted to northern regions, further underscoring the importance of Indigenous resurgence as a necessary condition for improved alignment with Indigenous models of conservation. Finally, because these species also capture the attention of the public, researchers, funders, and authorities alike (Davies et al., 2018; Kim et al., 2014; Mammola et al., 2020), they might be more likely to receive financial investments to encompass all

sources of information toward improved conservation. However, these sentiments may not be universally applied to taxa that are less charismatic but similarly important to Indigenous Peoples (e.g., lake whitefish for the Anishinaabek), resulting in fewer political and financial incentives to Indigenousize conservation efforts for these taxa. Given the conservation and cultural implications, there is an urgent need to promote local inventories of culturally significant species. Aside from funding, compiling these data will require ethical collaborations with Indigenous Nations throughout Canada (Reid et al., 2021, 2024).

We recognize some limitations of this work. First, applicability to other settings might be limited as our study focuses on a single context: the species assessment process in Canada. Yet, despite nuances among countries (e.g., Canada, United States, Australia), the Western knowledge criteria applied for species assessments have many similarities as well, often being adopted from International Union for Conservation of Nature criteria (COSEWIC, 2011). Therefore, countries that have ratified the CBD and committed to underscoring the rights and upholding the knowledges, stewardship, and values of Indigenous Peoples to manage wildlife species for global well-being could benefit from lessons learned in Canada. Second, we caution here that the primary aim of SARA is to conserve biodiversity, rather than Indigenousize conservation. As a result, there might be a disconnect between our quantitative metrics and actions taken by report writers or COSEWIC members to align with Indigenous frameworks of conservation. Writers may not acknowledge Indigenous knowledge holders with whom they spoke as they are not instructed to do so, and acknowledgments of Indigenous stewardship may have been removed from the assessments if they were not deemed essential to the assessment by COSEWIC. Future studies could improve on the approach taken here by refining the indicators and focusing on a broader sample of policy documents.

Indigenous knowledges must be considered and meaningfully included in legal frameworks to improve the effectiveness of conservation efforts for endangered species. Our study demonstrates that from 1998 to 2023 in Canada, there were no major increases in the inclusion and consideration of Indigenous knowledges nor 4 other core tenets of Indigenous frameworks of conservation, including centering Indigenous sovereignty, incorporating place-based knowledges, emphasizing interconnectedness, and recognizing the cultural importance of species. To further discussions about the ways endangered species laws and, more broadly, conservation could be Indigenousized, we recommend honoring endangered species laws' specifications to consider Indigenous knowledges at every step of the process, from species assessment onward; increasing Indigenous representation within decision-making process; and increasing capacity to meaningfully engage Indigenous Peoples. As Indigenous territories span the continent and overlap with all lands, waters, and species of conservation interest, conservation and recovery strategies are not possible nor legal without consulting and building partnerships with Indigenous Peoples (Artelle et al., 2019). Greater attention to fostering the inclusion and consideration of Indigenous knowledges in status assessment reports may have benefits through centering Indigenous

sovereignty, incorporating place-based knowledges, emphasizing interconnectedness, and recognizing the cultural significance of species.

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