Supplementary Material for:

Multiple impacts of invasive species on species at risk:
A case study in British Columbia, Canada

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Threat calculations

Two different tools are used to assess threats in Status Report and Recovery Strategy documents. Since 2012, COSEWIC has used the International Union for the Conservation of Nature (IUCN) Threat Calculator (detailed in Master et al. 2012) to assess threats in COSEWIC Status Reports (COSEWIC 2012, 2019). This same IUCN calculator is generally used in Recovery Strategies that are prepared by Environment and Climate Change Canada, though a few exceptions exist. Fisheries and Oceans Canada (DFO) uses a different threats calculator (herein referred to as the non-IUCN calculator) when preparing Recovery Strategies and Management Plans (DFO 2014). Though specific documentation was not found for it, the calculator used in Recovery Strategies prepared by Parks Canada Agency appears to be the same non-IUCN calculator that is used by DFO. Examples of recovery strategies using the IUCN Threat Calculator include those for Victoria's owl clover and the western rattlesnake, while examples of those using the non-IUCN Threat Calculator include those for foothill sedge and the Misty Lake sticklebacks.

Although terminology differs between the IUCN and non-IUCN threat calculators, definitions for the values in each calculator are detailed enough to allow the categories to be aligned in a manner that is sufficient for the purpose of summary analysis in this study (see Table 1). The non-IUCN Threat Calculator featured fewer possible values than the IUCN Threat Calculator, so in some cases we documented the conversion as a range. For example, if a species' non-IUCN **Extent** value was *High*, we recorded this as *Pervasive-Large* under the IUCN Threat Calculator's **Scope** values.

Table S1: Definitions and corresponding threat value categories of the non-IUCN and IUCN Threat Calculators used to document the magnitude of invasive species threats in species at risk assessments. For the purposes of this study, magnitude of impact values created using the non-IUCN Threat Calculator were converted to the closest corresponding magnitude of Impact value class under the IUCN Threat Calculator.

Non-IUCN	IUCN
Extent	**Scope**
Proportion of the species affected by the threat.	*Proportion of the species that can reasonably be expected to be affected by the threat within 10 years. Usually measured as a proportion of the species' population in the area of interest.*
High	**Pervasive** (71-100%)
	Large (31-70%)
Medium	**Restricted** (11-30%)
Low	**Small** (1-10%)
Severity	**Severity**
Magnitude of impact caused by the threat and level to which it affects species conservation. Reflects the population-level effect.	*Within the scope, the level of damage to the species from the threat that can reasonably be expected to be affected by the threat within a 10-year or three-generation timeframe. Usually measured as the degree of reduction of the species' population.*
High (Very large population-level effect)	**Extreme** (71-100%)
	Serious (31-70%)
Moderate	**Moderate** (11-30%)
Low	**Slight** (1-10%)
	Negligible (<=1%)
	Neutral or Potential Benefit (>=0%)
Occurrence	**Timing**
Timing of occurrence of the threat and describes whether a threat is historical, current, and/or anticipated.	
Current	**High** - Continuing
Anticipated	**Moderate** - Only in the future (could happen in the short term [<10 yrs or 3 generations) or now suspended (could come back in the short term)
	Low - Only in the future (could happen in the long term) or now suspended (could come back in the long term)
	Insignificant - Only in the past and unlikely to return, or no direct effect but limiting.

The IUCN threat calculator's **impact** value is based on the interaction between scope and severity values for present and future threats only. The IUCN Threat Calculator Template, available as part of the BC Government's online recovery planning guidance, was used to calculate **impact** after converting non-IUCN calculations of scope and severity. The template impact calculations generally follow the matrix shown in Table 2, however it allows input and output of ranges (e.g., *High – Low*).

Table S2: *A matrix showing the resulting IUCN impact value based on the interaction of scope and severity values for present and future threats. Adapted from the BC Government's IUCN Threat Calculator Template (available* here*).*

		Scope			
		Pervasive	**Large**	**Restricted**	**Small**
Severity	**Extreme**	Very High	High	Medium	Low
	Serious	High	High	Medium	Low
	Moderate	Medium	Medium	Low	Low
	Slight	Low	Low	Low	Low

Other threats associated with species at risk under threat by invasive species

On average, the focal SAR were impacted by three other threat categories in addition to invasive and problematic species. Other notable threats impacting the focal SAR span all of the IUCN threat calculator's categories, however development and human intrusions or disturbances are the other threat categories most often faced by the focal SAR (Figure S1).
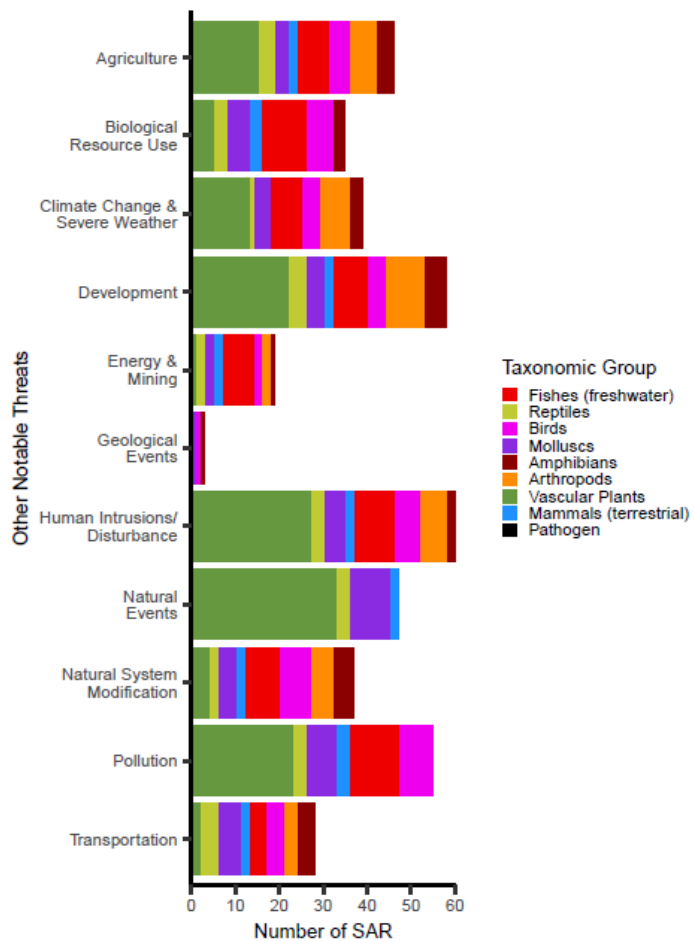
Project analysis R code

The R code used for this project is available to download from the following figshare data repository link:

Figure S1. *Other notable threats impacting SAR, as documented by Woo-Durand et al. (2020) and McCune et al. (2013) and broken down by taxonomic group of the SAR.*

Tracking spreadsheet

The complete project dataset is available as an Excel spreadsheet download from the following figshare data repository link: https://doi.org/10.6084/m9.figshare.21508062

This dataset is a valuable product of this work in and of itself and will be most useful to managers and researchers interested in better understanding and mitigating impacts or of on specific species. The following list describes the contents of each sheet in this file (also in the file itself):

- **TrackingTable:** This sheet contains the primary data on impacts to each SAR (rows) impacted by at least one IS on the BC Priority List of Invasive Species (core columns). Additional columns in this spreadsheet track other categorical variables describing the interactions between each IS-SAR pair, including vector of introduction, mechanism of impact, etc.
- **Invasive Species:** This sheet consolidates information for each of the IS presented on the first sheet, and provides a place to store IS-specific information (e.g., BC Priority List designation, taxonomic group, vectors of introduction and spread) not specific to a given SAR interaction.
- **Other Notable Threats:** This sheet contains raw data extracted from two prior studies on impacts to SAR in Canada (McCune et al. 2013, Woo-Durand et al. 2020) and merged here for an analysis of other types of threats commonly affecting SAR that are impacted by IS.
- **Variable Overview:** This sheet provides definitions and rationale for some of the variables (columns) in the TrackingTable sheet.
- References: This sheet provides all the references cited in short form on other sheets.
- **Dropdown Lists:** This sheet provides the drop-down lists used for data validation on the TrackingTable sheet.

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