Government of Canada Gouvernement du Canada

Species at Risk Act Implementation Guidance

-DRAFT-

Guidelines on Identifying and Mitigating Threats to Species at Risk

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- As drafted by Environment Canada -

Canada

Table of Contents

1. Background

1.1 Purpose

These guidelines aid in the identification and management of threats to species at risk by providing nationally consistent and evidence-based practices. They contribute to assessment of the conservation status of species as well as to recovery planning and implementation. Section 2 on diagnosing, categorizing, and classifying threats will be most useful during the preparation of status reports and recovery strategies, while the information on managing threats in Section 3 will be most useful for action planning.

Interactions among species, ecosystems, and society can lead to complex links among stresses, threats, and their underlying causes that are not always readily apparent. An accurate diagnosis of the causes of low population viability of a species is required in order to: 1) accurately assess the conservation status of the species; 2) understand the consultation requirements for both listing and recovering the species; 3) assess the socio-economic implications of listing and recovering the species; 4) target public and stakeholder outreach efforts; 5) meet other procedural and legislative requirements that require knowledge of threats (e.g., CEAA, permitting); and, most importantly, 6) determine effective protection and mitigation measures to recover the species.

These guidelines provide a general biological basis for identifying and mitigating population-level threats within SARA status reports, recovery strategies, and action plans. Threats identified in these documents are not automatically subject to prohibitions under SARA.

Action should not be delayed due to lack of full evidence. However, in cases where very little is known about a species or its threats, these guidelines provide a framework for improving and testing knowledge over time. Threat identification should be viewed as an on-going process throughout species assessment and recovery, rather than as a one-time diagnosis. Likewise, the management of threats does not occur in isolation, but is linked to recovery goals for the species, socio-economic influences (both positive and negative), as well as broader recovery actions and approaches that span both recovery strategies and action plans.

SARA provides an opportunity to improve species at risk conservation, and also brings greater scrutiny to decisions and actions. These guidelines will help to substantiate threats and the proposed actions to mitigate them. In addition, consistent methods will allow for better assessment of where it would be most beneficial to develop multi-species action plans, as well as a national analysis of threats with comparisons across species, time, and locations.

1.2 What are 'Threats'?

To provide clarity throughout this document on what is meant by the term 'threat' and other related terminology used in this document, some definitions and examples are provided below.

Stress: A species at risk is stressed when a key ecological or demographic attribute of a population, or a behavioural attribute of an individual, is impaired or reduced resulting in a reduction of its viability (Salafsky et al. 2003). Indicators of stress are not necessarily threats, in and of themselves, but rather conditions of the species at risk population (e.g., low reproductive success, high mortality, loss of genetic diversity). In some cases, indicators of population stress may be known but the threat causing the stress may be unknown. In this situation, the framework for identifying threats (Section 2) may help conceptualize the problem and build information over time. A stress often is a response to something such as a threat. There also may be cases where the stress is intrinsic to the population and is not caused by any threat – it is a naturally limiting factor of the species life history. In this situation it may still be helpful to identify these conditions (described under 'Limiting Factors' in the status report or recovery strategy) and work towards alleviating them to the extent that it is possible and appropriate.

Threat: A threat is any activity or process (both natural and anthropogenic) that has caused, is causing, or may cause harm, death, or behavioural changes to a species at risk, or the destruction, degradation, and/or impairment of its habitat, to the extent that population-level effects occur. In essence, it is any activity or process that imposes a *stress* on a species at risk population which contributes to, or perpetuates, its decline or limits its recovery. A threat is the stimulus creating the stress response. A threat could be a human activity (e.g., shooting, pollution, residential development), a human-induced change in a natural process or species dynamic (e.g., altered fire regime, introduced species, reduction in prey populations), or a natural process or disaster (e.g., erosion, browsing, hurricane). Naturally limiting factors such as aging, disease, and predation are not normally considered threats unless they are altered by human activity or pose a threat to a critically small or isolated population. Sections 2.2 and 2.3 provide detailed information on categorizing, naming, and classifying threats.

Underlying Cause: Most anthropogenic threats have an underlying cause, or even a chain of underlying causes, which are conditions or environments (usually social, economic, political, institutional, or cultural in nature) that enable, or otherwise contribute, to the occurrence and/or persistence of a threat (Salafsky et al. 2003). Examples might include land use policies, lack of effective protection mechanisms, lack of public awareness, etc. Threats due to natural processes or disasters do not usually have anthropogenic underlying causes, and thus are more often difficult to manage (see Section 3).

Although stresses, threats, and underlying causes are part of an inter-related chain of events (see examples in Figure 1), the guidelines for identifying and managing threats outlined below focus on the 'threats' link of the chain (emphasized by the bold box).

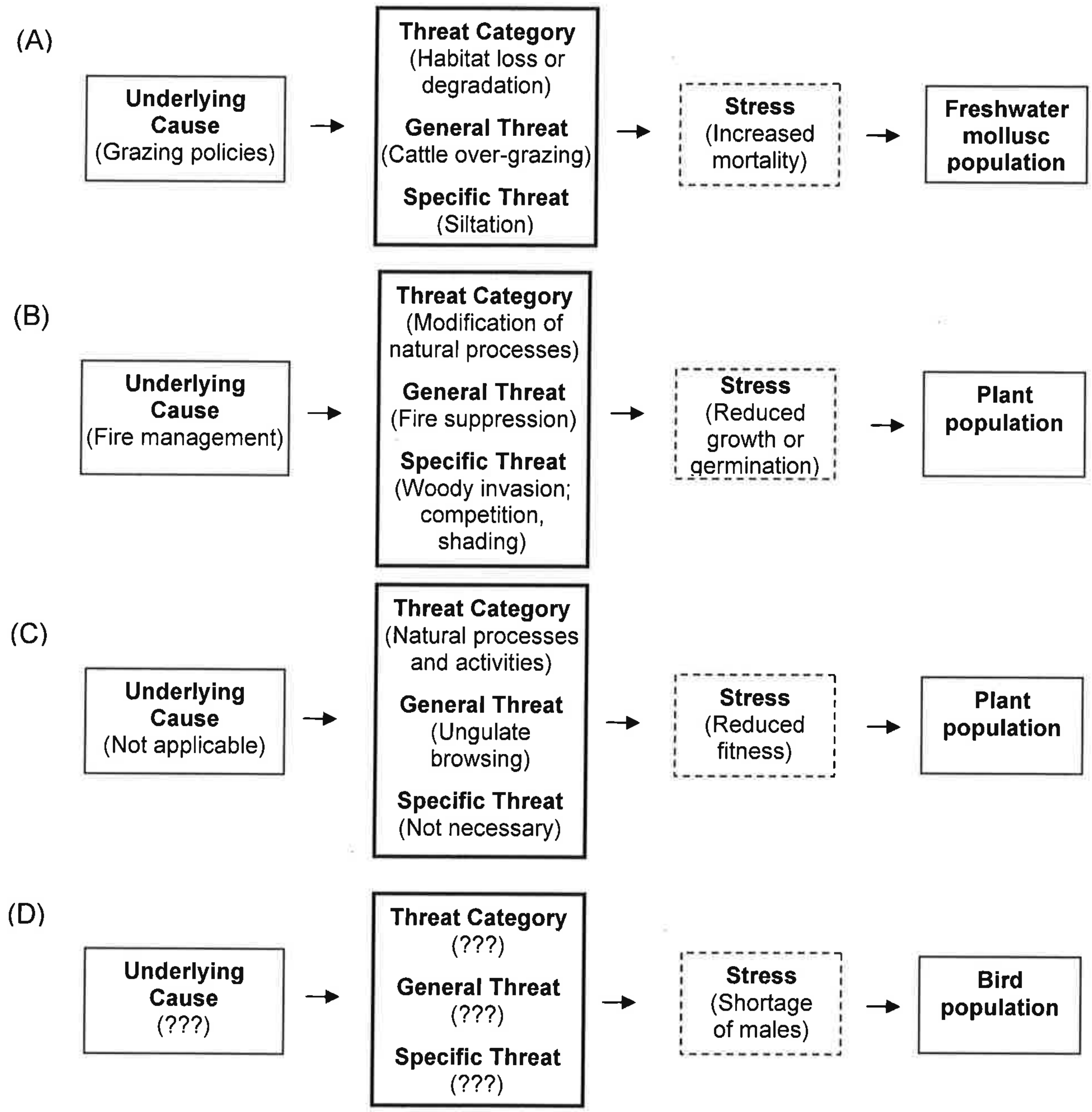

Figure 1. Examples of the relationship between stress, threat, and underlying cause for (A) a freshwater mollusc threatened by a human activity; (B) a plant threatened by modification of a natural process; (C) a plant threatened by a natural process; and (D) a bird with an unknown threat. Note in (C) that it may not always be appropriate to fill out all levels for the threat.

1.3 What does 'Evidence-based' Mean?

Evidence is commonly defined as *the available body of facts or information indicating whether a belief or proposition is true or valid.* Evidence-based practice implies that conclusions and decisions about the object of study are based on the best available evidence from a wide variety of sources, and that they are implemented as hypotheses that test whether the weight of evidence was indeed correct for each particular situation. An evidence-based approach does not exclude experience-based knowledge or Aboriginal Traditional Knowledge (ATK), but rather incorporates such knowledge into the body of information that constitutes evidence on a particular topic. Evidence-based practice does, however, discourage basing decisions solely on widespread beliefs because it is difficult to trace the source of such information (Sutherland et al. 2004).

An evidenced-based approach to identifying and mitigating threats is largely based on the concept of adaptive management and has three major components:

(A) **Diagnose threats.** Use the best available evidence to ensure threats are properly identified and linked to stresses on population viability (i.e., either causing or contributing to decline or preventing recovery). The goal here is to improve knowledge over time so that assumed or 'common knowledge' threats are evaluated and effects on the species at risk are understood. The end result would be greater confidence that a particular factor is actually causally-linked to the species' decline. To date, work on this aspect has been largely informed by Caughley's 1994 'declining population paradigm' and the methodology therein for determining the causes of population decline (Caughley 1994, Caughley and Gunn 1996, Norris 2004, Peery et al. 2004).

(B) **Manage threats.** Use the best available evidence to design and implement strategies to mitigate or alleviate threats. This step focuses on evaluating the body of evidence indicating whether certain actions or approaches are actually effective in reducing the threat. All threats will likely not have an equivalent impact upon a species and these impacts may be altered by interactions among threats as well as by the effects from the cumulative nature of some threats. Discussions on this topic can be found in conservation literature (Pullin and Knight 2001, Sutherland 2003, Fazey *et al.* 2004, Pullin *et al.* 2004a, Sutherland *et al.* 2004), plus due largely to work from the newly established Centre for Evidence Based Conservation (http://www.cebc.bham.ac.uk/).

(C) **Monitor and track species, threats, and actions.** Create a body of information (i.e., evidence) that can be drawn upon in the above two components. This involves critically reviewing existing information on a particular species, factor, approach (e.g., a meta-analysis) as well as collecting and adding new information. It also involves storing information in a commonly accessible and searchable venue. If tools and strategies used to address threats are implemented as hypotheses with well-designed monitoring protocols, the effectiveness of the approach (either good or bad) can be documented and used to help guide other practitioners facing similar circumstances. When evidence does not exist, any actions taken should be implemented and monitored in a way that would build information over time. The principles of adaptive management promote the importance of testing, monitoring, evaluating, and learning-by-doing, which in itself provides a framework for reducing over time many of the uncertainties inherent in diagnosing and managing threats (Holling 1978, Walters 1997, Salafsky et al. 2001). The U.S. experience with the *Endangered Species Act* has documented the importance of monitoring species throughout the recovery process for providing information necessary to determine if recovery goals have been met and delisting warranted (Norris 2002). Lastly, the need to make accessible both the successes and failures of various management actions so that practitioners are informed by what has been shown to work, or not work, for other similar threat diagnoses (Pullin *et al.* 2004b, Sutherland *et al.* 2004).

A commonly implemented set of guidelines will help make the process of identifying and mitigating threats:

- **Clear** – the relationships and linkages between population stresses, direct threats and their underlying causes, and tools or strategies to mitigate each threat are apparent.

- **Consistent** – common use of terminology and methods enables comparison across time, locations, and species; this also will facilitate multi-species planning and adaptive learning.

- **Causal** – result is greater certainty that threats are indeed linked to population decline and the tools or strategies to mitigate those threats are effective.

2. Guidelines for Identifying Threats

An important role of an evidence-based approach to identifying threats is to legitimize taking action to manage the threats and, in some cases, through SARA prohibitions and the environmental assessment process, prevent activities that may compound existing threats or cause new threats. The framework below may be most useful to status report authors and recovery planners/practitioners at the recovery strategy stage. Although following and documenting this process is recommended, only a brief summary of the results of the process are required in the status report or recovery strategy (see Appendices 1 & 2).

2.1 Diagnose Threats

2.1.1. Review and/or collect information on the species

Knowledge of the species' life history, ecology, population demography, historical role and status, and current status is important for identifying stresses and realistic hypotheses about plausible factors that might be causing the stresses. Some sources for these types of data include:

- Conservation Data Centres or Natural History Information Centres
- Environmental assessment reports
- Monitoring programs
- University research programs

2.1.2. Identify plausible threats

The first step in identifying threats is to determine which factors may be causing stress to the species. The review of the species' natural history should help identify only those threats that are plausible. If the status of the species has already been assessed, both of these first two steps should be well informed by the COSEWIC status report(s).

Note that lack of knowledge about a species may pose significant risk to its conservation, but is not a threat to the species in and of itself.

Things to keep in mind when listing plausible threats:

- Be as specific as possible (e.g., logging may pose a threat, but which specific activities related to logging and by whom?) Different types of the same activity may have separate societal drivers (underlying causes) or result in different symptoms or degrees of threat and thus may constitute separate threats.
- Include both natural threats (e.g., hurricane) and anthropogenic threats (e.g., urbanization).
- Consider separately threats responsible for historic decline, threats that currently limit recovery, and potential threats that are likely to be active in the future.
- Threats that occur outside of Canada (i.e., for migratory species) should be considered.
- Consider both threats that affect the species (e.g., disease, fishing, predation) and those that affect its habitat (e.g., urban expansion, resource use, altered habitat dynamics).
- Include threats that affect behaviour (e.g., noise pollution may affect mating or feeding patterns) in addition to threats that cause physical harm or death.
- Include internal threats (occur within the population or habitat – e.g., road kill or dredging of habitat) as well as external threats (occur outside the population or habitat – e.g., loss of pollinators, climate change).
- Keep in mind that threats may be cumulative. This often is displayed as a threshold (e.g., any particular small amount of habitat loss may not threaten a population, but the combination of many instances of habitat loss may become a threat; bycatch may not threaten a population when it is healthy, but in combination with other threats and stresses, bycatch also may become a threat).
- Use consistent, standardized terminology when both naming and classifying threats – see Sections 2.2 and 2.3.

2.1.3. Assembling evidence and testing predictions

Treat plausible threats as hypotheses. Develop predictions that help to differentiate among competing possibilities. Depending on the amount of information known about the species and its threats at the time of assessment, this step also may be informed by the COSEWIC status report. Where empirical evidence is not known, other types of knowledge, such as expert opinion, are of higher importance and studies may be planned to improve knowledge over time.

One useful approach to differentiating between several plausible threats is the **multiple competing hypotheses** approach, illustrated below (Caughley and Gunn 1996, Peery et al. 2004). This approach tests competing predictions as to the factors limiting a species with field data. This does not preclude the potential that more than one hypothesis may be valid or that the threats may have effects of differing severity or have interactions.

Hypotheses to explore the cause of the decline of caribou on Banks Island, Northwest Territories, Canada.

Hypotheses to account for the decline
Either **A**, food shortage, or **B**, increased predation

If **(A)** then mechanisms may be: **A1**, increase in weather events such as freezing rain, that affect availability of food; **A2**, competition for food with muskoxen, *Ovibos moschatus*, which are increasing; or **A3**, caribou themselves reducing the supply of food.

If **(B)** then mechanisms may be: **B1**, wolf predation, or **B2**, human predation.

The food-shortage hypotheses **(A)** may be tested against the predation hypotheses **(B)** by checking body condition. Hypotheses **A** predict poor body condition and low fecundity during a population decline; hypotheses **B** predict good condition and high fecundity during a decline.

If this test identifies the **A** hypotheses as the more likely, then **A1** is distinct from **A2** and **A3** by the prediction in **A1** of an increase of the population in some years. However, **A2** and **A3** predict a lower rate of increase or a reduction of the population in all years.

A2 (competition with another species) is distinct from **A3** (competition between caribou) and can be tested by determining whether there is a concomitant decline of caribou where muskoxen are not present in the same climatic zone.

(adapted from Caughley and Gunn 1996, p. 270.)

Other approaches that may be useful to determine which plausible threats are actually limiting the species are briefly outlined below. Any of these methods would help provide evidence for a particular threat being linked to a species' decline.

- **Experimentation** – candidate factors are manipulated and demographic responses measured. This approach provides a powerful means of disentangling the effects of multiple plausible threats, but many species at risk, as well as the factors that threaten them, are not amenable to manipulation (Peery et al. 2004).

- **Demographic models** –expected population response to the threat is modelled and compared to actual population data. This approach would be quite data-intensive.

In addition, care should be taken in interpreting results as the threat itself is not explicitly incorporated into the analysis (Norris 2004, Peery et al. 2004). Models such as population viability analysis also could be used to model the effects of different management actions, helping to elucidate the underlying threats.

- **Systems models** – general systems modeling may help to address circumstances where threats have delayed effects or to help identify the leverage point for improving the status of the species (Senge 1990).

- **Habitat models** – presence/absence of the species or rate of population change over time is modeled spatially and compared to environmental variables that describe the threat. When a population declines, there is often spatial variation in the rate of decline that can be used to help understand causes of the decline (Norris 2004). One potential concern includes interpreting correlation as causality, such as the fact that an off-site threat may first cause population decline in areas of marginal habitat even though the factors contributing to the habitat being marginal are not actually threatening the species (Norris 2004).

- **Population comparisons** – the demographics of populations in different environments, with different potential threats, are compared. Some caveats for this approach include the fact that different threats may limit different populations, and that species at risk often are restricted to one or a few populations, resulting in small samples sizes (Peery et al. 2004).

- **Time comparisons** – compare environmental variables and population data from before and after population decline. This approach could be used only if environmental and population data exist from when the species was more abundant. Care should be taken in interpreting correlation as causality (Peery et al. 2004).

- **Expert opinion, traditional knowledge, and field observations** – although these types of information do not generally constitute 'evidence' on their own, they can be extremely important sources of knowledge about species and their threats. This type of information is most valuable in very simple situations where the threats to the species are obvious and in situations where other types of information are lacking.

In addition, evidence from ecologically similar species or related species, or meta-analysis that supports the importance of the threat to many co-occurring species or species of the same taxon, could provide some inferences or be used to support other more direct evidence.

2.2 *Categorize Threats*

Consistent terminology help identify where common threats occur across species and landscapes and provide linkages between provincial, territorial, and national recovery strategies, thus helping to highlight opportunities for multi-jurisdictional and multi-species recovery planning and implementation. Standards enable threat analysis across species, time, and locations, which improve our understanding of recovery problems as well as reporting on recovery progress.

2.2.1. Proposed convention for naming threats

A hierarchical system for naming threats creates a logical way of grouping related threats and provides different levels for understanding problems – from broad threat categories to specific details.

Level 1 = **Threat Category** (Habitat Degradation)
Level 2 = **General Threat** (Removal of riparian vegetation through over-grazing)
Level 3 = **Specific Threat** (River siltation)

2.2.2. Threat definitions

Threat category – Broad category indicating the type of threat. Use fixed categories from Section 2.2.3.

General threat – Typically the general activity causing the specific threat. To be determined by status report author or recovery team/planner.

Specific threat – The specific factor or stimulus causing stress to the population. To be determined by status report author or recovery team/planner. Note that not every threat can be specified to all three levels in this classification hierarchy. Thus, in these situations, specify either a general or specific threat.

Stress – Indicated by an impairment of a demographic attribute of a population, or a physiological or behavioural attribute of an individual, in response to an identified or unidentified threat that results in a reduction of its viability (see Section 1.2). To be determined by status report author or recovery team/planner.

2.2.3. Threat categories

The threat categories are:
- Habitat Loss or Degradation
- Exotic, Invasive, or Introduced Species/Genome
- Changes in Ecological Dynamics or Natural Processes
- Pollution
- Accidental Mortality
- Biological Resource Use
- Disturbance or Harm
- Climate and Natural Disasters
- Natural Processes or Activities

These categories are listed below with some examples of general and specific threats. Categories were derived from a number of sources, including: IUCN-CMP Unified

Classification of Direct Threats (June 2006), IUCN Authority File for Major Threats (unspecified date), Salafsky et al. 2003, recent COSEWIC status reports, RENEW recovery plans, and draft SARA recovery strategies.

When identifying threats in status reports and recovery strategies, and completing the threat classification table (see Section 2.3.2), please group general and specific threats under these threat categories unless the threat cannot fit into any of the categories.

Note that these examples do not comprise an exhaustive list of possible general and specific threats – they are meant to provide greater understanding of what is meant by each threat category. Also note that a particular threat can appear in more than one threat category (e.g., siltation could be considered under Habitat Loss or Degradation or under Pollution, depending on the particular situation). While the threat categories are fixed, status report authors and recovery practitioners should determine the general and specific threats appropriate to the species in question. The examples of general and specific threats under each threat category are intended to provide guidance, not to represent fixed selections.

Habitat Loss or Degradation

General Threat	Specific Threat
Garbage dumping	habitat conversion; alteration of habitat characteristics (name); nuisance species (name); reduced resource availability
Oil extraction; seismic exploration	Habitat fragmentation; habitat conversion; behavioural disruption
Crop production; tilling	Habitat conversion; habitat fragmentation; isolation ; reduced resource availability
Road construction	Habitat fragmentation; road kill
Utilities corridors	Collision with power lines; habitat fragmentation
Over-grazing	Alteration of habitat characteristics (name); reduced resource availability
Dam construction	Alteration of habitat characteristics (name), habitat fragmentation
Housing development	Habitat conversion; habitat fragmentation; isolation
Irrigation activities	Loss of wetlands; alteration of habitat characteristics (name), and/or resource availability
River channel alteration; dredging	Erosion; reduced microhabitat; substrate instability
Loss of riparian vegetation; stream impoundments	Higher water temperature; sedimentation; siltation
Sand and gravel extraction	Disturbance and removal of substrate
Forestry	Clear cutting; terraforming/scarification; habitat fragmentation; alteration of habitat characteristics (name)
Aquaculture (farming of fish/seafood in natural environment	Habitat conversion; alteration of habitat characteristics (name)

Exotic, Invasive, or Introduced Species/Genome

General Threat	Specific Threat
Name species	Resource competition; alteration of habitat characteristics (name); loss of dependent species (name)
Hatchery/game farm (release into the wild)	Resource competition; alteration of habitat characteristics (name); altered gene pool
Varietal introductions	Hybridization; resource competition; alteration of habitat characteristics (name); altered gene pool
Genetically modified organisms (e.g., herbicide resistant crops, genetically engineered animals)	Hybridization; resource competition; alteration of habitat characteristics (name); altered gene pool

Changes in Ecological Dynamics or Natural Processes

General Threat	Specific Threat
Pest suppression	Altered predator-prey dynamics (name)
Alteration or suppression of grazing, fire, or water regime	Plant competition; changes in species community (name); dune stabilization

Pollution

General Threat	Specific Threat
Waste water treatment	Increased siltation, turbidity, and nutrient loading (name)
Crop or animal production (e.g., pesticide, herbicide, or fertilizer application)	Altered predator-prey dynamics (name), consuming poisoned prey, direct exposure, alteration of habitat characteristics (name)
Oil spill or gas leak	Altered predator-prey dynamics (name), consuming contaminated prey, direct exposure, alteration of habitat characteristics (name)
Acid rain	Alteration of water chemistry (name)
Industrial effluent	Alteration of growth or habitat characteristics (name); hormonal imbalance; altered physiology or morphology
Garbage/waste	Entanglement; behavioural disruption; toxins/leaching

Accidental Mortality

General Threat	Specific Threat
Hunting/trapping	Misidentification of target; over-harvest
Fishing	Entanglement in fishing gear; bycatch
Pest control	Direct exposure to pesticide; consuming poisoned prey
Trapping	Non-target species captured
Shipping/boating/flying	Collision with ships, boats, or planes
Military activities	Non-targeted bombing or shooting

Biological Resource Use

General Threat	Specific Threat
Hunting/trapping	Cultural use
Gathering	Collection of fruit, seed, or plant parts
Pet trade	Collection of animals
Horticultural trade	Collection of plants or plant parts
Whaling	Harvesting of animals
Tree harvesting	Removal of SAR (individually or as part of clear cut)
Fishing (over-harvest)	Selective harvest of SAR

Disturbance or Harm

General Threat	Specific Threat
Recreational, industrial, military activities: incidental harm/harass (e.g., whale/bird watching, ATV's, oil and gas activity, military manoeuvres, aquatic vessel sonar/noise)	Behavioural or life cycle disruption; damage or injury to individuals
Aircraft (low-flying/noise)	Behavioural or life cycle disruption
Intentional harm/harassement	Behavioural or life cycle disruption; damage or injury to individuals
Discriminate killing	poisoning, trapping, shooting, clubbing

Climate and Natural Disasters

General Threat	Specific Threat
Storms	Mortality; alteration of habitat characteristics (name); reduced resource availability
Drought	Mortality; alteration of habitat characteristics (name); reduced resource availability
Avalanche/landslide	Mortality; alteration of habitat characteristics (name); reduced resource availability
Climate change	Change in weather patterns
Temperature extremes	Physiological tolerance (edge of range)

Natural Processes or Activities

These are often natural limiting factors, but could be a threat for small, isolated, or suppressed populations. It is important to consider that in some cases these threats may be a result of an anthropogenic activity, thus the actions taken to address the threat may be more appropriately targeted at the human activity than the perceived threat (e.g., controlling the human activity rather than controlling a predator that has benefited or taken advantage of the human activity)

General Threat	Specific Threat
Red tide	Alteration to water chemistry; toxins
Nest predation	Predation by jays and squirrels
Interspecific competition	Seed-eating finches
Grazing by deer	Loss of flowers, seeds, or floral primordial

2.2.4. Indicators of stress

Indicators that a species at risk population is stressed might include (but are not limited to):

- Reduced population size or reduced population viability
- Small population size
- Local extinctions
- Increased mortality (adult, juvenile, *etc*)
- Increased dormancy
- Increased incidence of disease or parasitism
- Dilution or contamination of gene pool
- Shortage of breeding males
- Reduced productivity
- Reduced fitness
- Poor reproductive success
- Reduced growth
- Reduced germination/establishment
- Reduced immigration or emigration
- Reduced ability to migrate
- Behavioural changes
- Physiological or neurological changes

2.3 Classify Threats

2.3.1. Threat Attributes

The attributes of each threat are important for understanding how the threat acts upon the species and provides an indication of where measures may be used to manage or mitigate the threat.

Extent – Indicate whether the threat is widespread, localized, or unknown across the species range.

Occurrence – Indicate whether the threat is historic (contributed to decline but no longer affecting the species), current (affecting the species now), imminent (is expected to affect the species very soon), anticipated (may affect the species in the future), or unknown. If applicable, also indicate whether the occurrence differs between 'local' populations, or smaller areas of the range, and the full 'range-wide' distribution.

Frequency – Indicate whether the threat is a one-time occurrence, seasonal (either because the species is migratory or the threat only occurs at certain times of the year – indicate which season), continuous (on-going), recurrent (reoccurs from time to time but not on an annual or seasonal basis), or unknown. If applicable, also indicate whether the frequency differs between 'local' populations, or smaller areas of the range, and the full 'range-wide' distribution.

Severity – Indicate whether the level of severity of the threat is high (very large population-level effect), medium, low, or unknown. If applicable, also indicate whether the severity differs between 'local' populations, or smaller areas of the range, and the full 'range-wide' distribution.

Causal certainty – Indicate whether the best available knowledge about the threat and its impact on population viability is high (evidence causally links the threat to stresses on population viability), medium (correlation between the threat and population viability, expert opinion, etc), or low (assumed or plausible threat only). This should be a general reflection of the degree of evidence that is known for the threat, which in turn provides information on the risk that the threat has been misdiagnosed. If applicable, also indicate whether the level of knowledge differs between 'local' populations, or smaller areas of the range, and the full 'range-wide' distribution.

Level of concern – Indicate whether managing the threat is an overall high, medium, or low concern for recovery of the species, taking into account all of the above factors. This may take into account the ability to mitigate or eliminate the threat.

Local – indicates threat information relates to a specific site or narrow portion of the range of the species.

Range-wide – indicates threat information relates to the whole distribution or large portion of the range of the species.

2.3.2. Threat Classification Table

A threat classification table will help to organize information on each threat and set the stage for taking action to manage threats. This information also will be valuable for other processes requiring knowledge of threats, such as environmental assessment and permitting. If not all the information is known, indicate this in the table. A brief definition and explanation of each field in the table is given below.

Procedure for completing Threat Classification Table:

- Fill in the name of the threat – this is usually the common name used to describe the threat and is often the activity causing the threat.
- Fill in the general and specific threats – both may not be necessary and the general threat is often the same as the name used in the top left corner of the table (see Section 2.2.2 for definitions).

- Determine the threat category from the list provided in 2.2.3 by linking the general and specific threats to the appropriate category.
- Identify the species' stress response to the threat, if at all possible (see Section 2.2.2 for definition and 2.2.4 for examples).
- Specify whether the extent of the threat is localized to a specific site or narrow portion of the range or if it is widespread throughout much or all of the range of the species (see 2.3.1 for definition).
- Indicate whether the attributes for occurrence, frequency, causal certainty, and severity are local or range-wide by filling in one column or the other. If the information is relevant and the same for both local and range-wide, the row can be merged and the selection chosen once and centered in that field (see Section 2.3.1 for definitions).
- Provide the overall level of concern for the threat on the species (see Section 2.3.1 for definition).

Table 1. Examples of a Threat Classification Table for (A) a freshwater mussel and (B) a migratory bird. Note that if there is more than one threat identified, each should be entered in the table separately (B provides an example with two threats). See the Recovery Strategy template for a template of this table.

(A)

1	**Nutrient loading (N,P) from agricultural runoff**	**Threat Attributes**		
Threat Category	Pollution	**Extent**	Widespread	
			Local	***Range-wide***
General Threat	Agricultural runoff	**Occurrence**	Current	
		Frequency	Seasonal	
Specific Threat	Nutrient loading (N,P)	**Severity**	High	
		Causal Certainty	Medium	Low
Stress	Toxic effects (reduced productivity, increased mortality	**Level of Concern**	Medium	

(B)

1	**Low-flying aircraft**	**Threat Attributes**		
Threat Category	Disturbance or harm	**Extent**	Localized	
			Local	***Range-wide***
General Threat	Low-flying aircraft	**Occurrence**	Current	
		Frequency	Re-current	
Specific Threat	Behavioural and social disruption	**Severity**	Moderate	
		Causal Certainty	High	
Stress	Reduced productivity	**Level of Concern**	Low	
2	**Sand and gravel extraction**	**Threat Attributes**		
Threat Category	Habitat loss or degradation	**Extent**	Localized	
			Local	***Range-wide***
General Threat	Mining: sand and gravel extraction	**Occurrence**	Current	Anticipated
		Frequency	One-time	Seasonal
Specific Threat	Removal of substrate and individuals	**Severity**	Moderate	Low
		Causal Certainty	High	High
Stress	Reduced population size	**Level of Concern**	Low – Medium	

Table 2. Examples of an alternate Threat Classification Table for a migratory bird.

Threat[a]	Stress	Extent	Threat Attributes									
			Occurrence		Frequency		Severity		Causal certainty		Level of concern	
			Local	*Range-wide*	*Local*	*Range-wide*	*Local*	*Range-wide*	*Local*	*Range-wide*	*Local*	*Range-wide*
C: Habitat loss or degradation **G:** Forestry **S:** Commercial harvest	Reduced population	Widespread	Historic/ current		Continuous		High	Unknown	High	Low	High	Medium
C: Exotic species **G:** Food competition **S:** Red squirrels	Reduced productivity	Widespread	Current		Recurrent	Continuous	Unknown	Unknown	Medium	Medium	Medium	
C: Habitat loss or degradation **G:** Agricultural expansion **S:** Loss of forest cover	Reduced population	Localized	Current/ anticipated	-	One-time	-	Medium	Low	Medium	Low	Low	
C: Habitat loss or degradation **G:** Fire **S:** Loss of habitat and food	Reduced reproductive success	Localized	Historic/ anticipated	Historic/ current	One-time	Recurrent	High	Low	High	Low	Low	
C: Natural processes **G:** Nest predation **S:** Interspecific nest predation (jays and squirrels)	Increased mortality	Widespread	Current		Seasonal		Unknown	Unknown	Low	Low	Low	

[a] **C** = threat category; **G** = general threat; **S** = specific threat.

2.4 Describe Threats

To better describe threats, be certain to address the following questions and considerations:

- What is the activity, action, factor, or alteration that is causing the threat? (see General or Specific threat in section 2.2.2).
- Does the threat affect the species directly at the population level (e.g., important predation or disease, loss of prey base, loss or degradation of habitat) or affect the species' habitat, indirectly affecting the population level (e.g., urban or agricultural development, forestry, invasive species, resource extraction)?
- How does this threat express itself on the species or individuals and populations? (see Indicators of stress in section 2.2.4).
- How extensive is the threat? Is it localized to a small proportion of the species range or populations? Or is the threat present across much or all of the species range? Which areas or populations are affected?
- What is the time-frame of the threat? Is the occurrence of the threat in the past, present, or future? (see Occurrence in section 2.3.1).
- How frequent does the threat occur? Will it occur only once, during a specific season, all the time, or re-occur at some interval? (see Frequency in section 2.3.1).
- How certain are you that the threat is actually affecting the species or causing the negative effects? Is the evidence causal, correlated, or just plausible? (see Causal Certainty in section 2.3.1)
- How severe is the threat and how extensive is the severity? Is the effect minor or does it have very large population-level effects? Does this severity differ across the range of the species or from site to site? (see Severity in section 2.3.1).
- Is the underlying cause of the threat(s) known? This would help guide the actions required to abate or mitigate those threats.
- Is there evidence or an indication of interactions between threats or the cumulative effects of the known threats?
- Are there any significant known potential threats (e.g., an introduced disease agent that is spreading through a population of a species or a likely project or activity that would have a significant affect on the habitat of the species)?

See Appendix 4 for some examples of threat descriptions.

3. Guidelines for Managing Threats

Using the best available evidence, design and implement strategies to mitigate or alleviate threats. This section will be most useful to recovery planners and practitioners at the action planning stage, although the information also will be useful for developing broad strategies to address threats within the recovery strategy. Environmental assessment practitioners may particularly benefit from sound threat management strategies, as both SARA and CEAA require measures to be taken to mitigate and monitor adverse effects of recovery measures.

3.1 Manage Threats

3.1.1. Determine the underlying cause(s) behind each threat

This holistic view will be integral to developing a broad strategy to address the threats. Strategies aimed at underlying causes may be more effective at mitigating threats in the long run, but may require more time. Strategies aimed at threats will likely produce more immediate results, but if the underlying causes are not addressed, the threat will likely persist or reoccur in the future. A broad strategy that targets both areas often will be most effective.

For example, consider the previous example of a freshwater mollusc species that experiences an increase in mortality (stress) from siltation (specific threat) in agricultural areas because of agricultural and grazing practices/regulations, policies on the use of riparian buffer strips, land use zoning, etc (underlying causes). Strategies aimed at treating the siltation problem in isolation of its causes will ultimately be less successful.

There will be instances where the underlying cause can not be addressed either because it is too large, too complicated, or may take too long. In these cases, it may still be useful to address and/or mitigate the proximate threat.

Furthermore, complicated and costly strategies such as genetic studies or captive breeding to reintroduce or augment populations should not be implemented in advance of addressing the threats responsible for reducing the populations in the first place, such as habitat loss or pollution. However, to avoid delays in such studies or re-introductions, the necessary information should be gathered and techniques developed concurrent to threat abatement.

Keep in mind that some threats on a species are cumulative in nature. The cumulative impact of the threats may reach a threshold level that triggers population stress indicators, sometimes quite abruptly. Determining the relative impact of the individual threats may be quite difficult.

3.1.2. Develop strategies to mitigate or alleviate threats

The *mitigation sequence* used in the environmental assessment process provides useful 'rules of thumb' for conceptualizing threat management. The preference is to first avoid occurrence of the threat, then to minimize its impact, and lastly to compensate for the threat (e.g., through habitat re-creation once the threat has been removed). This is most intuitive in terms of future threats, but also can be useful for assessing cumulative effects.

If the threat has already occurred or cannot be prevented, the type of action taken to manage threats will depend on the particular situation. In general, threats can be categorized in terms of the type of management actions that should be taken (Salzer and Salafsky 2003):

- **Immediate action** – Threats for which effective management strategies are known and feasible. Take immediate action to manage the threat and monitor results to assess effectiveness of action.

- **Experimentation** – Threats for which effective management strategies are unknown. Experiment with different threat management actions and carefully monitor and assess results to measure effectiveness, build knowledge over time, and modify strategies and actions accordingly. This should only be considered if the experimentation does not adversely affect the species at risk.

- **Minimal on-site action or contribute to global action** – Threats which are beyond the scope of the recovery practitioner to manage (e.g., climate change). No or minimal on-site threat management action is taken, but the species is monitored to assess status. Threat management may include contributions to global reduction of the threat for very broad issues such as climate change. Species that are listed due to very small or restricted populations without immediate threats also may fall into this category.

Consider all the available tools, approaches, and strategies for mitigating each threat. Use evidence-based tools to the extent possible (i.e., tools that are known to be effective in addressing the threat). Implement management actions as hypotheses to be tested and document results (successful or not) so that they can contribute to the collective knowledge for that particular action.

There are many actions that can be taken to manage threats, but in general, these can be grouped into three categories (Table 2, adapted from Salafsky et al. 2002).

While not a strategy for managing threats *per se*, an often important precursor to managing threats is gathering further information through inventories, monitoring, surveys, mapping, and other research (such as on threats, demographics, genetics, life history, *etc.*).

Although these guidelines have been developed specifically for managing threats, it is important to note that threat management strategies and actions are developed most often within the larger context of recovery implementation, including other strategies to affect recovery and reach goals and objectives set for the species.

Table 2. Examples of strategies for threat management with examples of approaches under three broad categories. The majority of actions taken to address threats will likely fall under Protection and Management.

Protection and Management	**Law and Policy**	**Education and Awareness**
Protected Areas • Parks, reserves, conservation areas • Critical habitat • Stewardship agreements • Conservation agreements/ easements Species and Habitat Management • Habitat management/ restoration • Control of invasive species • Signage/fencing • Disease prevention/ treatment • Population reintroduction • Stewardship agreements Industry Codes of Practice • BC Forest Practices Code *Ex situ* Protection • Captive breeding • Gene banking	Legislation and Treaties • SARA • Provincial/Territorial legislation • Migratory Birds Convention Act • Wildlife Act • Fisheries Act • Parks Canada Act • Canadian Environmental Assessment Act Litigation • Criminal prosecution • Civil suits Enforcement • Compliance with laws, policies, regulations, agreements Policy	Public Education and Outreach • Outreach via museums, etc. • Public lectures/talks Informal Education • Media campaigns • Community awareness • Stakeholder awareness • Community participation Formal Education Institutions • Education curriculum • University courses

3.1.3. Prioritize and implement actions

To make the most of limited resources, prioritize actions to get the best return for the investment. When making decisions, it should be made clear which factors were considered. Criteria for prioritizing actions may include:

- **Level of concern** – refer to the threat classification table in the status report or recovery strategy (see Section 2.2.2 in this guidance).
- **Certainty/effectiveness of action** – has this action been proven to mitigate or remove the threat or would it be implemented on more of a trial-and-error basis.
- **Risk** – associated with not implementing recovery actions.
- **Feasibility and scope of action** – some threats may be less feasible to mitigate, or require actions larger than the scope of recovery planning. For example, there may be limited threat management opportunities if the threat is naturally low reproductive

success due to climate (perhaps because the species is at the northern edge of its range), whereas management is more feasible when the threat is low reproductive success due to increased predation related to land use changes. Likewise, management of threats such as habitat loss due to climate change is less feasible than habitat loss due to residential development.

- **Cost** – some actions simply may be too costly (in terms of resources or effects on ecosystems and/or other species) to implement, relative to the benefits for the species or society as a whole.

Note that SARA specifically includes a precautionary principle which states: "*if there are threats of serious or irreversible damage to the listed wildlife species, cost-effective measures to prevent the reduction or loss of the species should not be postponed for a lack of full scientific certainty.*" (SARA section 38).

3.2 Monitor and Track Species, Threats, and Actions

When thinking about monitoring the effectiveness of threat management actions, keep in mind that it should be part of the overall monitoring and inventory strategy for the species.

3.2.1. Develop a protocol to monitor results and effectiveness of actions

To assess whether actions are effective in recovering the species, both threat reduction assessment and population monitoring should be considered together. This will enable evaluation of whether the action has helped (1) mitigate or reduce the threat and (2) recover the species. This is, in essence, the best evidence that threats have been correctly identified and managed.

Threat reduction assessment (Salafsky and Margoluis 1999) should focus on evaluating changes in the occurrence, frequency, and severity of the threat (see Section 2.3). Population monitoring should be based on taxa-specific protocols and fine-tuned with species-specific details.

Some important factors to keep in mind regarding monitoring protocols include:

- Select appropriate indicators suitable for detecting changes over time.
- Carry out monitoring for an appropriate timeframe over which it will be possible to observe changes. In general, population-level indicators will be slower to respond to management actions than threat reduction indicators.
- Develop a consistent protocol that is followed over time and across the species range.
- Be aware of existing monitoring protocols used in the environmental assessment process and others.
- Consider a power analysis to determine the likelihood of detecting an effect.

3.2.2. Analyze and disseminate results

Assess the effectiveness of threat management strategies and actions – Is the strategy working? Are the ecological and/or demographic indicators of population stress showing improvement? Are recovery goals and population and distribution objectives being met? Are threats being mitigated or reduced? Make the results of this analysis available to the conservation community, including not only successful and positive outcomes, but also those which were negative or unsuccessful.

3.2.3. Adapt strategy and tools based on degree of success or failure

Implement the principles of adaptive management by building on what has been learned and adjusting management strategies as necessary. Report results (good and bad) so that evidence on that approach or tool can be used to assess whether it is appropriate to put into practice. An investment in developing and tracking a repository of evidence will make testing predictions about threats and management actions easier in the future.

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Appendix 1: Threat identification in COSEWIC status reports

- would need to be informed by COSEWIC

Appendix 2: Requirements for threat identification and broad strategy to address threats in SARA recovery strategies

An identification of the threats to the survival of the species and threats to its habitat that is consistent with information provided by COSEWIC and a description of the broad strategy to be taken to address those threats. [SARA, S.41(1)(b)]

Identification of threats

Threat classification table

See Section 1.5.1 in the Guidelines for Completing Recovery Strategy Templates.

Description of threats

See Section 1.5.2 in the Guidelines for Completing Recovery Strategy Templates. See Appendix 4 for examples of threat descriptions.

Broad strategy to address threats

Recovery planning table

See Section 2.5.1 in the Guidelines for Completing Recovery Strategy Templates.

Narrative

See Section 2.5.2 in the Guidelines for Completing Recovery Strategy Templates.

Appendix 3: Requirements for threat management actions in SARA action plans

Measures to be taken to address threats

Measures to be taken to address threats should be considered within the broader context of measures to implement the recovery strategy.

A statement of the measures that are to be taken to implement the recovery strategy, including those that address the threats to the species..., as well as an indication as to when these measures are to take place. [SARA S. 49(1)(d)]

Narrative

Address the threats to achieving population and distribution objectives. There should be a logic flow with direct linkages from threats through to goals, objectives, and approaches in the recovery strategy and recommended actions in the action plan. Include any narrative detail that will clarify the proposed actions, including which populations it applies to and why, and which threats it addresses (this may be done in the implementation schedule if there is space), but avoid repeating information that appears in other sections of the action plan. Make reference, as necessary, to information contained in the recovery strategy and status report for the species, to avoid overlap with those documents as well. The implementation schedule table supports this section. Although the table does not replace the need for descriptive or explanatory text, the narrative should be kept to a minimum without over-duplication.

Implementation Schedule

See Section 2.7 of the Action Plan template and companion guidance for examples of implementation schedules and information for completing them.

Monitoring the effectiveness of threat actions

Threat monitoring should take place within the broader context of monitoring the recovery of the species and its long term viability.

Describe the methods to be used to monitor the recovery of the species and its long-term viability. [SARA S.49(1)(d.1)]

How will you determine if the recovery objectives are being met, and if the situation of the species is improving? Identify what variables and which populations will be monitored, at what frequency, and with what methods. Include monitoring actions in Section 2.5 Actions and Performance Measures and Section 2.7 Implementation Schedule and explain the methods to be used in Section 2.6 Monitoring .

Appendix 4: Examples of threat descriptions

Note that these descriptions should accompany a threat table. Details found in the threat table do not need to be re-iterated in the descriptions unless they provide additional information or clarity.

Example 1: Piping Plover melodus (adapted from draft recovery strategy)

Threat 1 - Habitat Loss or Degradation
Piping Plover habitat is threatened by increasing numbers of beach users and coastal development, including construction of wharves, jetties, erosion control structures, and cottages or homes in areas adjacent to nesting beaches. These developments may physically destroy or alter the function of a site to render them unsuitable for nesting. Beach cleaning removes important components of the Piping Plover's habitat such as wrack and natural debris that provide feeding areas and shelter from inclement weather. Other threats to habitat include oil or contaminant spills, vegetation encroachment onto nesting areas, and catastrophic weather events (hurricanes, flooding), which may cause localized erosion and thereby loss of habitat and potentially direct loss of adults and chicks. Conversely, severe weather events may create new habitat through accretion/deposition or maintain early successional stage habitat required for successful nesting. Activities such as illegal use of off-road vehicles in nesting habitat and various human recreational activities (e.g., kite flying, fireworks) may not always physically destroy available habitat, however habitat function is impaired since sites become unsuitable due to the level of disturbance that these activities cause.

Threat 2 - Predation
Predation has been identified as one of the most important limiting factors across the North American breeding range. The current predation rates appear to be higher than they have been in the past. A study conducted on 'site location' of 174 nests between 1937 and 1958 reported 91% hatching success. No predator control measures were taken during this study. Current eastern Canada estimates suggest that hatching success is less than 55% (Amirault, unpubl). There are many known or suspected predators of piping plover adults, chicks, and eggs, including American Crow, red fox, Common Raven, gulls, Merlin, raccoon, coyote, striped skunk, short-tailed weasel, American mink, domestic dogs, and feral cats. Human activities and land use practices have resulted in artificially high predator populations.

Threat 3 - Oil Spills
Oil spills and oil discharge from bilge water pose a risk to foraging adults and chicks. Oil impacts birds through physical contact and toxic contamination. Oiled birds may be impacted by the disruption in the natural water-repellency of feathers, affecting their thermo-regulatory capacity and may experience reduced hatching success if the oil is transferred to the eggs during incubation. Ingestion of toxic compounds while preening also commonly occurs. Ingested toxins can lead to severe internal damage and organ failure.

Example 2: Oregon Forestsnail (adapted from draft recovery strategy)

Threat 1 - Exotic Species

Exotic species of snails and slugs, and other foreign organisms, may pose a threat to the Oregon forestsnail through competition for food and shelter or through predation. Exotic gastropods of European origin are prevalent within urban and agricultural areas on southern Vancouver Island and in the Lower Fraser Valley and several species have penetrated forested habitats. These species continue to spread into new areas with inadvertent assistance from humans when nursery plants, garden ornamentals, or other materials with adhering soil are transported or when garden waste is discarded. Exotic species that might compete with the Oregon forestsnail include (*list of species*).

Example 3: Bluehearts (adapted from draft recovery strategy)

Threat 1 - Recreational Activities

Recreational activities are a demonstrated threat for the population at 'site location'. This population is found in a wet meadow that is surrounded by a popular campground. Trampling and direct destruction by bicycles, as well as the picking of the showy flowers continue to be observed at this site. It is also possible that road and infrastructure development in the campground has altered water levels and drainage patterns.

Threat 2 - Succession

Succession by woody plants is a possible threat to this species. The dominance of woody shrubs appears to be controlled in part by fluctuating water levels. In the last decade, lake levels on 'site locations' have remained consistently below the long-term average (Environment Canada 2005). Over time, this may reduce the frequency of seasonal flooding that appears to maintain open habitat.

Threat 3 - Deer Herbivory

White-tailed deer have not been documented as a major threat to bluehearts, although evidence of deer browsing has been observed during monitoring work. Deer have been abundant in this area in the past, particularly at 'site location'. It is possible that herbivory by deer has reduced the number of available host shrubs for this hemi-parasitic species. Recent efforts to reduce deer populations through park management plans have been successful and herbivory on herbaceous and shrubby plants has been reduced. It is possible that deer help to maintain the open conditions favoured by bluehearts.

<u>Example 4. Small White Lady's-slipper</u> (adapted from draft recovery strategy)

Habitat Loss or Degradation
Threat 1 - Development

Industrial, urban, and agricultural developments have reduced the amount of land available to small white lady's-slippers and continue to pose a significant threat on unprotected land. Development has drastically reduced the amount of natural prairie that remains intact and has resulted in the extirpation of several populations of small white lady's-slipper in Canada. At one site on 'site location', a large section of the prairie was lost when a light industrial building was built in 1987. Another site on 'site location' was potentially threatened by expansion of agriculture. In 1998, there were approximately 470 ha of tallgrass prairie on 'site location', this is 36% less than was on the island 25 years earlier.

Threat 2 - Overgrazing

Incompatible (livestock) grazing regimes can decrease the quality of habitats inhabited by or preferred by small white lady's-slippers. This is a potential threat on the 'site location' and on privately owned pastures in Manitoba.

Threat 3 - Altered Hydrology

Altering the hydrologic regime of an area can be detrimental to small white lady's-slippers because it can alter the moisture levels that the plants depend on. The population on 'site location', Ontario may be extirpated because of altered drainage patterns resulting from the construction of a residential driveway in 1986. A site on 'site location' is potentially threatened by altered water levels due to an adjacent drainage ditch. One small population in the 'site location' in Manitoba disappeared when the water table rose at the site.

Exclusion by Other Plants
Threat 4 – Altered Disturbance Regime

Populations can be threatened by the changes in habitat dynamics (e.g., shading) resulting from the encroachment of shrubs and trees or the accumulation of thatch (dead, but non-decomposed plant material). The population in 'site location' has been decimated by the encroachment of woody vegetation. In grassland habitats, woody vegetation can invade and thatch can build up as a result of fire suppression. Conversely, traditional burning activities on 'site location' have allowed lady's-slipper populations to thrive.

Threat 5 - Invasion of Non-Native Plants

Competition from non-woody, invasive plant species threaten to reduce or eliminate populations of small white lady's-slippers. In Manitoba, (*list of exotic species*) have been known to threaten sites with small white lady's-slippers. On 'site location', common reed threatens at least two populations.

Altered Reproductive Processes
Threat 6 - Hybridization

The genetic integrity of small white lady's-slipper populations is at risk from hybridization with yellow lady's-slippers. Hybrid plants have been found in all small white lady's-slipper populations in Manitoba. At the 'site location', only hybrid plants have been found in the past decade.

Threat 7 - Inbreeding

Most populations of small white lady's-slippers in Canada tend to be in small, isolated pockets and subject to inbreeding. Genetic variability has been found to be low in populations of only 12 to 3000 individuals. This implies that most Canadian populations may be at risk from low genetic diversity and inbreeding.

Consumptive Use
Threat 8 - Orchid Collectors

Small white lady's-slippers have been collected from many sites in Manitoba and 'site location'. In 1997 and 1998, orchid collectors reduced the population of small white lady's-slippers by 10% in two of Manitoba's populations.