BRITISH COLUMBIA

Ministry of
Water, Land and
Resource Stewardship

# Implementation Plan for the Recovery of Spotted Owl in British Columbia

March 2026

## PREFACE

The federal, provincial, and territorial government signatories under the Accord for the Protection of Species at Risk [1] agreed to establish complementary legislation and programs that provide for effective protection of species at risk throughout Canada. In the spirit of cooperation of the Accord, the Government of British Columbia (B.C.) has developed this implementation plan to support the requirements of an action plan per Section 49 of the Species at Risk Act (SARA [2]).

Implementation plans detail the measures to achieve the species' population and distribution objectives, address threats, and protect recovery and survival habitat. The plan is part of a linked series, including Committee on the Status of Endangered Wildlife in Canada (COSEWIC) status reports, recovery strategies/plans, and one or more implementation plans.

An implementation plan outlines the provincial government's response to supporting the recovery of a species at risk. These responses consider ecological, economic, cultural, and community interests on the landscape. Management of our natural resources is being transformed in B.C. to prioritize ecosystem health and biodiversity in partnership with First Nations in ways that support communities. This approach is expected to improve overall outcomes for species at risk, increase resilience to climate change and ensure the ecosystem services on which we rely are available for future generations.

The success of recovery depends on cooperation across constituencies. All people living in B.C. are encouraged to support and implement recovery actions. The implementation of this plan is subject to budget constraints and priorities of the participating jurisdictions. It may also be necessary to modify these actions while respecting their intent.

To learn more about species at risk recovery in B.C., please visit the B.C. Recovery Planning webpage at: https://www2.gov.bc.ca/gov/content/environment/plants-animals-ecosystems/species-ecosystems-at-risk/recovery-planning.

## Recommended citation

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## ACKNOWLEDGMENTS

This implementation plan was prepared by the B.C. Ministry of Water, Land and Resource Stewardship (WLRS). It builds on the 2006 B.C. Spotted Owl Recovery Action Plan and Sections 1 through 6 of the 2025 Amended Recovery Strategy for the Spotted Owl *caurina* subspecies (*Strix occidentalis caurina*) in Canada [3]. This plan was drafted by Nina Morrell (WLRS). Agnieszka Sztaba, Ian Blackburn, Joël Gillis, and Louise Waterhouse (WLRS) provided expert input that supported the development of this document. Rory MacMillan, Dianne McGuire, and Nargiz Rahimova (WLRS) provided the socio-economic cost and benefits analysis. Ana-Maria Bogdan (WLRS) provided ecosystem services analysis. Tara Haynes and Brian Mang (WLRS) provided geographical information system and analytical assistance, including geospatial modelling and mapping support.

Development of this implementation plan was coordinated by Leah Westereng, with Alana Phillips (WLRS) overseeing its posting to the B.C. Recovery Planning website. Kristina Lensky, Heather Wiebe, Matt LeRoy, David Muter, Jennifer Psyllakis and Brian Holmes (WLRS) provided guidance and oversight during plan development and review, as well as strategic leadership during plan development.

Cover photo by Felipe Fittipaldi (Government Communications and Public Engagement).

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# 1 SCOPE OF IMPLEMENTATION PLAN

This implementation plan aims to ensure the survival of Spotted Owl *caurina* subspecies (*Strix occidentalis caurina;* hereafter Spotted Owl) in British Columbia (B.C.) over the next five years (2025-2030) and to support ongoing recovery of Spotted Owl over the next 50 years. Spotted owls are known as Skelúle in the language of the Spô'zêm First Nation.

In fall 2023, WLRS began engaging First Nations whose lands coincide with Spotted Owl habitat. Learnings from this engagement and through direct relationships with rights-holding First Nations are reflected throughout the plan. This includes a series of specific actions that reaffirm B.C.'s commitment of working to achieve the long-term recovery of this species in partnership with First Nations, consistent with commitments to Spotted Owl in the Tripartite Framework Agreement on Nature Conservation between Canada, B.C., and the First Nations Leadership Council [4].

Historically, Spotted Owl thrived throughout the Pacific Northwest in large areas of mature and old coniferous forests [5]. It is believed as many as 1,000 owls once lived in the southwest corner of B.C., which is the northern extent of their range [6]. In 2003, Spotted Owls in Canada were listed as endangered under the Species at Risk Act (SARA). This designation was due to catastrophic population decline caused by habitat loss, habitat fragmentation and competition with Barred Owls (*Strix varia),* which has left the population severely depressed and vulnerable to ongoing threats. Today, there are 48 known Spotted Owls remaining in B.C.

This document builds upon the 2006 B.C. Spotted Owl Recovery Action Plan [7], focusing on three actions: protecting adequate habitat, rebuilding the population (including conservation breeding), and managing competitive species.

The population and distribution objective is to recover the Spotted Owl in Canada by restoring a stable population of at least 250 mature individuals distributed within a connected network of habitat representative of all three sub-regions within the species' historical Canadian range and linked to the larger population in the U.S.

This objective is also stated in the federal Amended Recovery Strategy for the Spotted Owl *caurina* subspecies (*Strix occidentalis caurina*) in Canada (Environment and Climate Change Canada [ECCC], 2025).

The composition of a recovered population may include both conservation bred and wild born individuals until such time as the population is fully self-sustaining. Meeting the population and distribution objective will take at least 50 years to achieve.

The following short-term recovery statements were developed toward meeting this objective within the five-year timeframe of this implementation plan:

1. Conserve and restore sufficient attributes and biophysical features of old-growth forests and mitigate human-caused threats that would cause loss of recovery and

survival habitat throughout the natural range of Spotted Owl in B.C. necessary to support recovery of a self-sustaining population.

2. By 2030, re-establish a wild Spotted Owl population in B.C. of four to six resident individuals, in at least two release areas, utilizing individuals bred from B.C.'s Spotted Owl Breeding Program.

3. Complete regular Barred Owl surveillance at sites occupied by Spotted Owl and/or where reintroductions are planned and remove all Barred Owls that are detected.

While there are significant uncertainties regarding the biological and technical feasibility of recovering Spotted Owl (Appendix A), the five-year actions outlined in this plan aim to aid in the survival of Spotted Owl and offer the best chance of achieving Spotted Owl population and distribution objective for recovery in the long term. Conservation measures are presented in the following sections: Recovery and Survival Habitat (2.4), Conservation Breeding (3.1), Conservation Translocation (3.2), Recovery Support Strategies (3.3), Research (3.4) and Monitoring Recovery (3.5).

The implementation schedules outline the anticipated benefits of each conservation action including how threats to the Spotted Owl can be managed and its relative impact [8]. The plan also identifies the co-benefits of ecosystem services within Spotted Owl habitat. The collaborative efforts outlined in this plan involve various parties committed to the conservation of Spotted Owl, ensuring a strategic and cooperative approach to the species' survival.

## 1.1 Recovery Context

Efforts to recover Spotted Owl in Canada began in the late 1980s. This section provides a timeline of recovery actions and supporting guidance that have informed the recovery measures included in this Spotted Owl Implementation Plan. Additional context is provided in Section 3.

- **1990:** The Province established the first Canadian Spotted Owl Recovery Team (CSORT; 1990-1995), tasked with developing a recovery plan for the species.
- **1994:** CSORT produced a report entitled Management Options for the Northern Spotted Owl in British Columbia, which presented a range of protection strategies [9].
- **1997:** Based on the CSORT 1994 report, the Province developed and implemented the 1997 Spotted Owl [habitat] Management Plan (SOMP 1).
- **1997-2002:** Within five years of implementing SOMP 1, Spotted Owl populations in B.C. and the U.S., experienced an unexpected precipitous decline in numbers. In response, a new CSORT (2002-2007) was established to identify additional recovery actions to prevent extirpation of the species.

- **2004:** CSORT completed the Recovery Strategy for the Northern Spotted Owl, which was accepted as advice by the Provincial Government [5] in 2006, and subsequently adopted by the Federal Minister of Environment.
- **2006:** The Province announced a Five-year Spotted Owl Recovery Action Plan, which included measures to re-build the Spotted Owl population, revise SOMP1 to ensure better habitat protection, and protect known Spotted Owl sites.
- **2007:** The Spotted Owl Population Enhancement Team (SOPET), an independent team of scientists established by the Province, provided advice and recommendations on population augmentation. Conservation breeding was identified as the best option (with the caveat that adequate habitat be protected). As a result, the Province launched a conservation breeding program in summer 2007. In fall 2007, an Interagency Northern Spotted Owl Steering Committee (INSOSC) was established to oversee the implementation of all recovery efforts for Spotted Owls in B.C.
- **2009:** INSOSC approved two documents: a revised Spotted Owl [habitat] Management Plan (SOMP2) to ensure the protection of adequate habitat, informed by new strategic modelling and independently reviewed [10][11], and a population management strategy to mitigate competition with invasive Barred Owls [12].
- **2009-2013:** More than 285,000 ha of Spotted Owl habitat were protected within Wildlife Habitat Areas – Long Term Owl Habitat Areas (WHA-LTOHA) and other protected habitat, including provincial parks, Greater Vancouver watersheds, and other protected areas.

# 2 RECOVERY AND SURVIVAL HABITAT

## 2.1 Description of the Species' Recovery and Survival Habitat

Recovery and survival habitat for Spotted Owl is the habitat that is necessary for its recovery or survival that would result in achieving the species' population and distribution objective within 50 years. This is the habitat in which the species naturally occurs or depends on directly or indirectly to carry out its life-cycle processes, or in which the species formerly occurred and there is potential for the species to be reintroduced.

Throughout their range, Spotted Owl are strongly associated with mature and old, late successional coniferous and mixed-coniferous forests. These forests are typically characterized by an uneven-aged cohort of trees; a multi-layered, relatively closed canopy; numerous large trees with broken tops, deformed limbs, and large cavities; and numerous large snags, accumulations of logs and downed woody debris; and canopies open enough to allow owls to fly within and beneath [5]. In moist parts of the range, these habitat characteristics are found naturally in late seral and old forests. In drier parts of their range (i.e., east of the Cascade Mountain Range), owls have been observed in younger forest stands where similar structural complexity was created by fire, wind events, selective logging, or disease factors such as root rot or mistletoe infections.

These biophysical features and attributes form the basis for understanding the operational approach to habitat protection needed to meet the recovery objectives for Spotted Owl. Table 1 provides the functions, biophysical features and attributes required for Spotted Owl recovery and survival habitat, including information on dispersal habitat and acoustic requirements during nesting.

In addition to biophysical features and attributes, the determination of recovery and survival habitat for Spotted Owls must include the configuration of suitable habitat needed to functionally support a territorial breeding pair. Spotted Owls require large, contiguous areas of nesting, foraging, and dispersal habitat to support breeding pairs. Depending on the sub-zone, the estimated size for a breeding territory ranges from 1,907 ha to 3,104 ha. Spotted Owl territories may overlap by up to 25% [13]. For this reason, an estimated 268,000 ha to 290,000 ha of recovery and survival habitat is needed to meet the population and distribution objective to restore a stable population of at least 250 mature individuals.

Given the small population size, the availability and protection of existing recovery and survival habitat is not a limiting factor for Spotted Owl recovery over the next 5 years. Over the next 50 years, as the population increases, additional suitable habitat will become available, which is expected to exceed the amount needed to meet the population and distribution objective. Habitat protections will be adaptively managed with new learnings and/or to offset any potential impacts such as catastrophic wildfire, which could render existing protected habitat unsuitable.

The configuration of the area required to best support 125 territorial breeding pairs was informed by a series of strategic models [10], as follows:

- **Habitat supply models:** used a timber supply model, to project forest growth and structure, enabling projections of habitat supply over time under various management scenarios that can be evaluated, classified, and mapped.
- **Structural connectivity model:** assessed suitable habitat for individual owl movement or potential population movement through connected habitats. Spotted Owl dispersal between managed areas is essential to recover and sustain the population as dispersing individuals may re-occupy vacant habitats and/or rescue locally extirpated portions of the species' range. Specific pathways for dispersal were not established as further research is needed to better understand if the path of owls can be predicted.
- **Potential owl territory model:** identified and prioritized locations based on parameters such as habitat quantity and/or known nest sites.
- **Integrated habitat quality model:** assessed relative habitat quality between locations using outputs from the previous models, guiding the selection of current recovery and survival habitat as well as areas expected to become suitable in the future.
- **Final model:** determined the best locations of contiguous habitat capable of supporting 125 Spotted Owl territorial breeding pairs in 50 years.

This section and the next provide additional details on dispersal habitat and the habitat configuration needed to support territorial breeding pairs. Due to different modelling approaches, the amount and configuration of protected and potential recovery and survival habitat differ from those of federally identified Critical Habitat.

**Table 1**. Functions, biophysical features, and attributes of Spotted Owl recovery and survival habitat.

| **Function**[a] | **Biophysical features**[b] | **Attributes**[c] | | |
|---|---|---|---|---|
| | | **Maritime sub-region** | **Sub-maritime sub-region** | **Continental sub-region** |
| Nesting | Nest trees | Large (>50 cm dbh) snags or trees with deformities, e.g., large cavities, broken tops, dwarf mistletoe (*Arceuthobium* spp.) infections | Large (>30 cm dbh) snags or trees with deformities (e.g., large cavities, broken tops, dwarf mistletoe infections) | Large (>30 cm dbh) snags or trees with deformities (e.g., large cavities, broken tops, dwarf mistletoe infections) |
| | Stand age | ≥140 years | ≥110 years | |
| | Crown closure | ≥40% | | |
| | Stand height | ≥28 m | ≥23 m | |
| | Elevation | ≤900 m | ≤1100 m | |
| | Coarse woody debris (CWD) and understory | Abundant CWD and a diverse shrub layer | | |
| | Acoustic noise level | Anthropogenic noise level that does not interfere with life functions within nesting areas, resulting in loss of habitat availability or function. Noise level not exceeding 90 dB and/or not exceeding ambient conditions by >20 dB during the Spotted Owl nesting season (February—July) | | |
| Foraging[d] | Stand age | ≥140 years | ≥110 years | ≥110 years |
| | Crown closure | ≥40% | | |
| | Stand height | ≥28 m | ≥23 m | |
| | Elevation | ≤900 m | ≤1000 m | ≤1100 m |
| | CWD and understory | Abundant CWD and a diverse shrub layer | | |
| Nesting & Foraging | Area | 3,010 ha | 2,224 ha | 1,907 ha |
| Dispersal | Stand age | ≥120 years | ≥100 years | ≥80 years |
| | Crown closure | ≥10% | | |
| | Stand height | ≥19.5 m | | |

[a] **Function:** a life-cycle process of the species (e.g., include either animal or plant examples: spawning, breeding, denning, nursery, rearing, feeding/foraging and migration; flowering, fruiting, seed dispersing, germinating, seedling development).
[b] **Feature:** the essential structural components of the habitat required by the species.
[c] **Attribute:** the building blocks or *measurable* characteristics of a feature.
[d] Assumes leading species from Group A (Cw, Fdc, Fd, Fdi, Hw, and H) and CWH/IDF BEC zone. Stands with other leading species are associated with different stand attributes for foraging habitat as detailed by Sutherland et al. [10]

## 2.2 Protected Recovery and Survival Habitat

Spotted Owl habitat must be managed to ensure there is adequate habitat available to support the Spotted Owl population and distribution objective over the 50-year recovery timeframe. Four primary considerations informed the habitat management approach outlined in this implementation plan:

1. Forests that contain the functions, biophysical features and attributes of Spotted Owl habitat.
2. The amount and configuration of habitat that best supports recovery and survival (as described in Section 2.1).
3. The required measures to mitigate threats to the survival and recovery habitat. i.e., provide effective protection.
4. Adaptive management, including acknowledging uncertainty, knowledge gaps and assumptions that have thus far informed considerations #1-3 listed above.

Based on an updated and expanded habitat supply model it is estimated that there is 1,506,589 ha of Spotted Owl habitat in B.C., with 1,085,579 ha available for nesting, foraging, and dispersal habitat [14]. The remainder is recruitment habitat, which may currently support habitat functions (depending on its configuration) and/or will provide additional nesting, foraging and dispersal class habitat as it continues to regrow over the next 50 years.

The implementation of protections under SOMP2 resulted in 285,622 ha of recovery and survival habitat being protected specifically for Spotted Owl (Figure 1). This habitat is protected within WHAs including LTOHAs and Managed Future Habitat Areas (MFHAs), provincial parks, Greater Vancouver watersheds and other protected areas that combined protect 310,490 ha of the land base. The configuration of these habitats was informed by a series of strategic models to identify which habitat would best support recovery. This meets the estimated 268,000-290,000 ha of recovery and survival habitat that is expected to be needed to meet the longer-term population and distribution objective.

The amount of existing habitat protected under SOMP2 is expected to satisfy the population and distribution objective. The protected habitat is comprised of 200,868 ha of nesting and foraging habitat, 43,654 ha of dispersal habitat and 41,100 ha of recruitment habitat (Table 2). The recruitment habitat protected within SOMP2 is crucial in its current condition for preserving the configuration and integrity of functional Spotted Owl territories. As it further regenerates, it will provide additional functions and biophysical attributes for recovery and survival.

Given the uncertainty of climate change impacts on Spotted Owl habitat specifically, and recognizing the assumptions underlying the development of SOMP2, ongoing review of habitat needs is essential, particularly considering B.C.'s commitment to reconciliation. This includes commitments to adaptively manage habitat and to incorporate more ways of knowing into habitat planning processes and habitat management decisions. If additional protections are required, they will be incorporated where supported through engagement with First Nations.

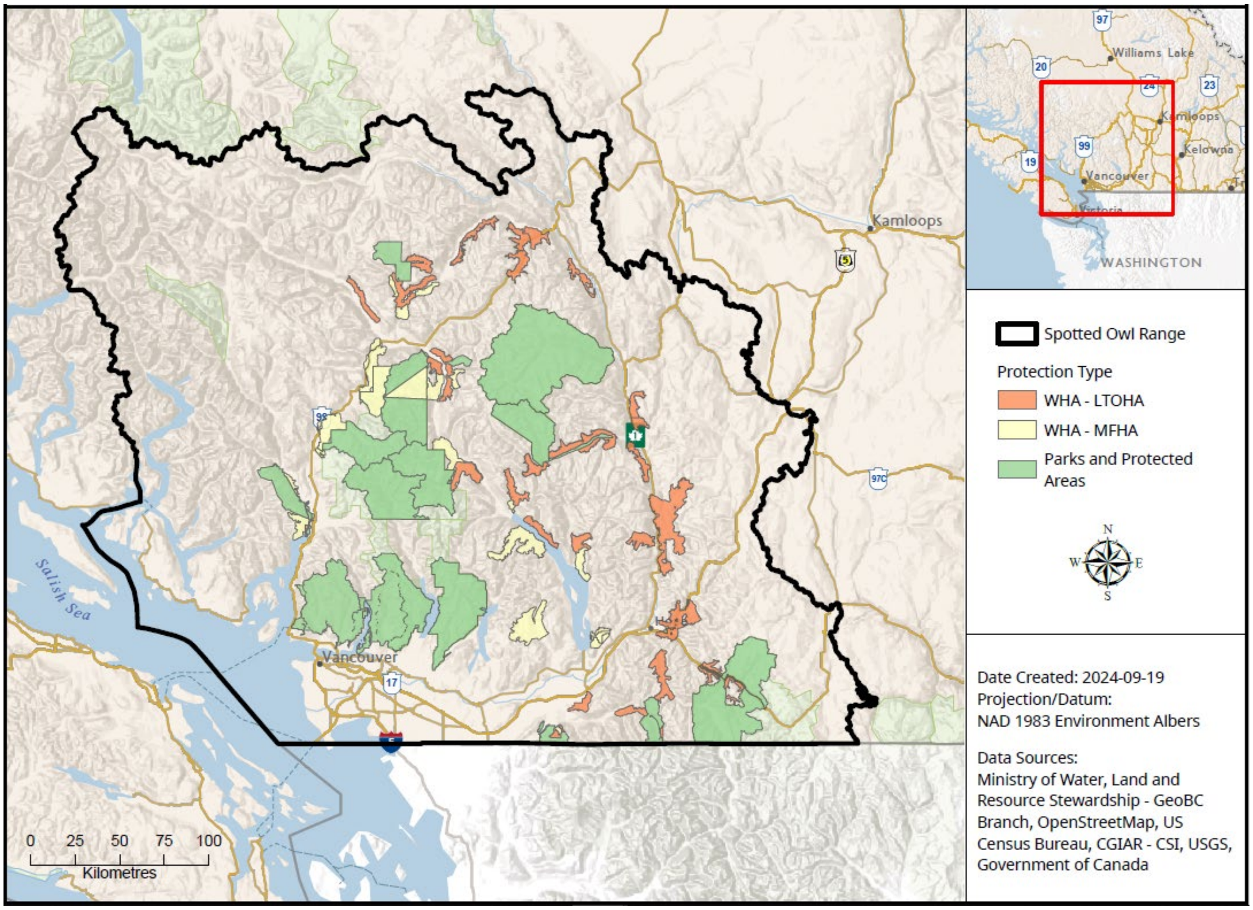


**Figure 1.** Protection of recovery and survival habitat and WHA-MFHA potential habitat for Spotted Owl as included in the revised Spotted Owl Management Plan (SOMP2).

**Table 2.** Summary of existing protected recovery and survival habitat for Spotted Owl (Section 2.2), and co-location between potential recovery and survival habitat and existing conservation measures (Section 2.3).

| Protection Type | Total area (ha) | Habitat Type | Area (ha) |
|---|---|---|---|
| **Existing recovery and survival habitat** | | | |
| Legal - Fully Protected (SOMP2) | **285,622** | Nesting | 101,558 |
| | | Foraging | 99,310 |
| | | Dispersal | 43,654 |
| | | Recruitment | 41,100 |
| **Total – Existing recovery and survival habitat** | **285,622** | | |
| **Potential recovery and survival habitat** | | | |
| Legal – Fully Protected (20%) | 247,373 | Nesting | 50,590 |
| | | Foraging | 82,312 |
| | | Dispersal | 61,557 |
| | | Recruitment | 52,913 |
| Legal – Partially Protected (37%) (includes WHA-MFHAs) | 452,433 | Nesting | 67,470 |
| | | Foraging | 122,112 |
| | | Dispersal | 127,913 |
| | | Recruitment | 134,937 |
| Non-Legal (12%) | 142,912 | Nesting | 30,327 |
| | | Foraging | 62,476 |
| | | Dispersal | 23,565 |
| | | Recruitment | 26,545 |
| Unprotected (31%) | 378,249 | Nesting | 30,100 |
| | | Foraging | 67,690 |
| | | Dispersal | 114,945 |
| | | Recruitment | 165,514 |
| **Total – Potential recovery and survival habitat** | **1,220,967** | | |
| **Grand Total (All habitat)** | **1,506,589** | | |

## 2.3 Potential Recovery and Survival Habitat

There is uncertainty around dispersal behaviour, forest maturation timelines, and the impact natural disturbances such as wildfires will have on Spotted Owl recovery and survival habitat. To mitigate these risks, additional habitat is managed specifically as a contingency for Spotted Owl. There is also further habitat that is protected for conservation of species other than Spotted Owl. Suitable habitat with the necessary functions, biophysical features, and attributes to support Spotted Owls exist beyond the areas protected under SOMP2. An updated and expanded habitat supply model identifies an additional 841,058 ha of nesting, foraging and dispersal habitat [14].

There is also 52,913 ha of protected and 326,996 ha of unprotected recruitment habitat that is expected to mature into having the biophysical features and attributes of suitable habitat within the 50-year recovery timeline. Together, the suitable habitat and the recruitment habitat bring the total potential recovery and survival habitat to 1,220,967 ha (Table 2).

A portion of the partially legally protected areas is designated as WHA-MFHAs. These areas are managed as a Spotted Owl-specific contingency and may be utilized, if necessary, to replace lost habitat or to support adaptive management (Figure 1). The approach to habitat management within WHA-MFHAs allows tree harvesting, but with the retention of stand structural attributes (e.g., large diameter trees) important for Spotted Owl. Currently, 53,174 ha of forest are managed within WHA-MFHAs with 27,470 ha of it being nesting and foraging habitat.

A co-location approach is being taken to prioritize areas for additional reserve designation to ensure that protection efforts maximize conservation through opportunities to overlap high value habitats for different species, meet objectives of land use plans and consider other values the land provides. This means maximizing the likelihood that a habitat patch forms part of a viable breeding territory for Spotted Owl (i.e., one that contributes to the population and distribution objective), keeping the many ecosystem services that old-growth forests provide intact and continuing to provide opportunities for sustainable resource use on the land base.

Table 2 details the extent of co-location between the potential recovery and survival habitat and other existing complementary conservation measures. The result is 69% of the potential recovery and survival habitat is at least partially protected by existing conservation measures.

- 20% are fully and legally protected. This includes areas designated for other species, such as WHAs, Old Growth Management Areas (OGMAs), Ungulate Winter Ranges (UWRs), etc.
- 37% are partially legally protected. This includes Visual Quality Objectives (VQOs), WHAs with conditional tree harvest allowances (i.e., MFHAs), community watersheds, etc.
- 12% are encompassed by non-legal protections. This includes Technical Advisory Panel (TAP) old growth deferrals, areas that are operationally or commercially infeasible for forestry operations, etc.

Additional details on these protection categories and methodology are provided in Appendix B.

These areas provide a contingency to the 285,622 ha already protected for Spotted Owl, ensuring sufficient recovery and survival habitat remains available to adaptively manage where needed. This cumulative area of protected Spotted Owl habitat in B.C. suggests that habitat is unlikely to be a limiting factor in the recovery of Spotted Owl even if faced with habitat loss due to natural disasters.

There are further protections under First Nations land use plans (i.e., S'ólh Téméxw Land Use Plan) and Strategic Land and Resource Management Plans (i.e., Sea to Sky LRMP and Lillooet LRMP). These may be observed by land practitioners and licensees; however, were not included within the scope of this analysis.

The Province is committed to collaboratively identifying areas of potential additional Spotted Owl recovery and survival habitat with First Nations, and proposing these areas for additional legal protection as determined to be needed through adaptive management processes (Action A2 in Table 3). This could include areas in which some natural resource extraction is currently temporarily deferred or areas with co-benefits for other strategic nature priorities (e.g., Canada's 2030 Nature Strategy [15]), especially where they overlap with Spotted Owl habitat.

Until further research and First Nations engagement supports a provincial decision on additional Spotted Owl-specific protections, the Province is exploring opportunities to protect additional habitat using existing measures and land management forums. The implementation of other habitat conservation measures are important complementary approaches to conserve the Spotted Owl and the habitat on which it relies.

## 2.4 Recovery and Survival Habitat Implementation Schedule

Table 3 provides details on the minimum actions necessary to ensure the success of the habitat management program in the five-year time frame of this Implementation Plan. Without the continued protection of Spotted Owl recovery and survival habitat, it will not be possible to achieve the population and distribution objective for Spotted Owl.

Work will be approached through co-management of habitat in partnership with First Nations to align with emerging land use visions, enhance old-growth protection, and prioritize ecosystem health. This includes adaptive management of existing protected recovery and survival habitat (A1) and potential incremental protection of suitable habitat (A2), supported by First Nations engagement (A5) and/or to meet recovery objectives (A7 & B2).

**Table 3.** Implementation schedule for management and protection of Spotted Owl recovery and survival habitat in B.C. All actions are currently underway (in progress). Timeline is continuous and expected to extend beyond the next 5 years.

| Action ID | CMP Action Category[a] | Description of Action | Impact[b] | Threat[c] or Limitation or Knowledge Gap | Output Indicators[d] |
|---|---|---|---|---|---|
| **1: Land/Water Management** | | | | | |
| **A1** | 1.1.11 Implementation of Better Management Practices or Land Use Guidelines | Adaptively manage recovery and survival habitat, including ensuring no net loss of habitat under the Spotted Owl Management Plan (SOMP2). | • Direct<br>• Delayed | 5.3 Logging & Wood Harvesting, 4.1 Roads & Railroads, 4.2 Utility & Service Lines, 7.1 Fire & Fire Suppression | • Area managed in fiscal year (ha)<br>• Number of new hectares managed (ha) |
| **B1** | 1.1.5 Restoring Targets or Mitigating Stresses via Mechanical Actions | Pursue partnership with existing projects undertaking wildfire risk-reduction efforts to explore options for enhancement measures that align with Spotted Owl habitat requirements. | • Direct<br>• Delayed | 7.1 Fire & Fire Suppression | • Number of treatments<br>• Area improved this fiscal year<br>• Number of new hectares improved (ha) |
| **6: Conservation Designation Planning** | | | | | |
| **A2** | 6.1.1 Establishing or Demarcating Government Protected Areas | Adaptively manage existing protected habitat with incremental protection of suitable habitat. | • Direct<br>• Delayed | 5.3 Logging & Wood Harvesting, 4.1 Roads & Railroads, 4.2 Utility & Service Lines, 7.1 Fire & Fire Suppression | • Number of hectares managed (ha) is stable or increased |
| **10: Institutional Development** | | | | | |
| **A5** | 10.3.2 Maintaining or Strengthening Relationships | Work collaboratively between governments (Indigenous, provincial, federal) in areas of suitable Spotted Owl habitat that correspond with | • Indirect<br>• Delayed | | • Number of partnerships developed and maintained |

| Action ID | CMP Action Category[a] | Description of Action | Impact[b] | Threat[c] or Limitation or Knowledge Gap | Output Indicators[d] |
|---|---|---|---|---|---|
| | | federal Critical Habitat outside of existing SOMP2 protections. | | | |
| **A6** | 10.3.2 Maintaining or Strengthening Relationships | Continue to promote habitat stewardship and an inclusive planning process with forest companies and other stakeholders that operate within the Canadian range of Spotted Owl. Promote awareness of, and compliance of, guidelines and regulations to reduce Spotted Owl habitat loss through ongoing leadership meetings with forest licensees and practitioners. | • Indirect<br>• Delayed | 5.3 Logging & Wood Harvesting | • Number of partnerships developed and maintained |
| **A7** | 10.3.4 Knowledge Sharing | Continuously improve understanding of Spotted Owl habitat. This includes incorporating knowledge structures and perspectives from Indigenous partners, with a focus on wildlife-risk reduction approaches, habitat enhancement and climate change resilience/mitigation. | • Indirect<br>• Delayed | Knowledge Gaps | |

[a] Action categories in this table are based on the International Union for Conservation of Nature-Conservation Measures Partnership (IUCN-CMP) unified Threats and Actions Classification systems (2.0). For a detailed description of these classification systems, see the Conservation Standards website [8].
[b] Impact reflects the degree to which an action: directly contributes to the recovery of the species, indirectly supports recovery as a necessary precursor to future actions, has either an immediate or delayed influence on recovery, or provides important contributions to the knowledge base about the species and the mitigation of threats.
[c] Threats correspond to those listed in the 2024 federal Amendment to the Recovery Strategy for Spotted Owl [3] and follow the IUCN-CMP classification system (version 2.0) [8].
[d] Indicators align with the output indicators used by ECCC's Priority Places Initiative.

# 3 RECOVERY ACTIONS

This implementation plan aims to aid in the survival of Spotted Owl and offer the best chance of achieving the population and distribution objective for recovery in the long term. This includes actions to be taken to address low population numbers, threats to the species, safeguard its habitat, and monitor its recovery and long-term viability. Actions and their relative priority may be revised as new information becomes available. Actions identified are intended to be undertaken collaboratively between the Province and its partners.

## 3.1 Conservation Breeding

The Northern Spotted Owl Breeding Program[1] was established by B.C. in 2007 based on advice from an independent-to-government Spotted Owl Population Enhancement Team (SOPET), which advised that Spotted Owls would become extinct in Canada without intervention to augment and enhance the wild population [16]. The goal of the program is to establish a genetically viable population at the breeding centre large enough to produce sufficient offspring for release annually.

The breeding program was built upon a founding population of five adult Spotted Owls captured from the wild, followed by capture of wild owlets from seven different breeding pairs. Owlets (<1 year old) exhibit low survivorship in the wild; therefore, it was deemed prudent to capture individuals of this age cohort to increase their chance of survival and ultimately contribute to species recovery. Given the small size of the founding population, genetic issues relating to founder effects, inbreeding depression, outbreeding depression, or genetic drift would be inevitable. As such, the breeding program also relies on importing individuals from the U.S. to supplement the founder population. To date, four Spotted Owls from the U.S. have been incorporated into the breeding program.

The known Spotted Owl population currently comprises 18 females and 27 males at the breeding centre, two released conservation-bred males last observed August 2025, and one wild-born female last observed in 2022, for a population total of 48. Since the inception of the breeding program in 2007, the number of Spotted Owls in B.C. has grown approximately 12% per year (Figure 2). Figure 2 also shows the population change from 2007 to 2024.

Based on the known and predicted number of breeders, egg fertility and hatching success, it was determined that two to five chicks could be produced annually to be eligible for release starting in 2022, for a total of 8 to 20 owls available for release between 2022-2025. This assumes that two young produced each year will be retained for the breeding program. As of 2025, twelve owls have been deemed eligible for release, confirming the program is on track with the predicted range. To meet the population and distribution objective, the conservation

[1] https://www.nsobreedingprogram.com/

breeding program needs continued scaled growth. Section 3.1 outlines the actions necessary to ensure the success of the conservation breeding program in the five-year time frame of this Implementation Plan.

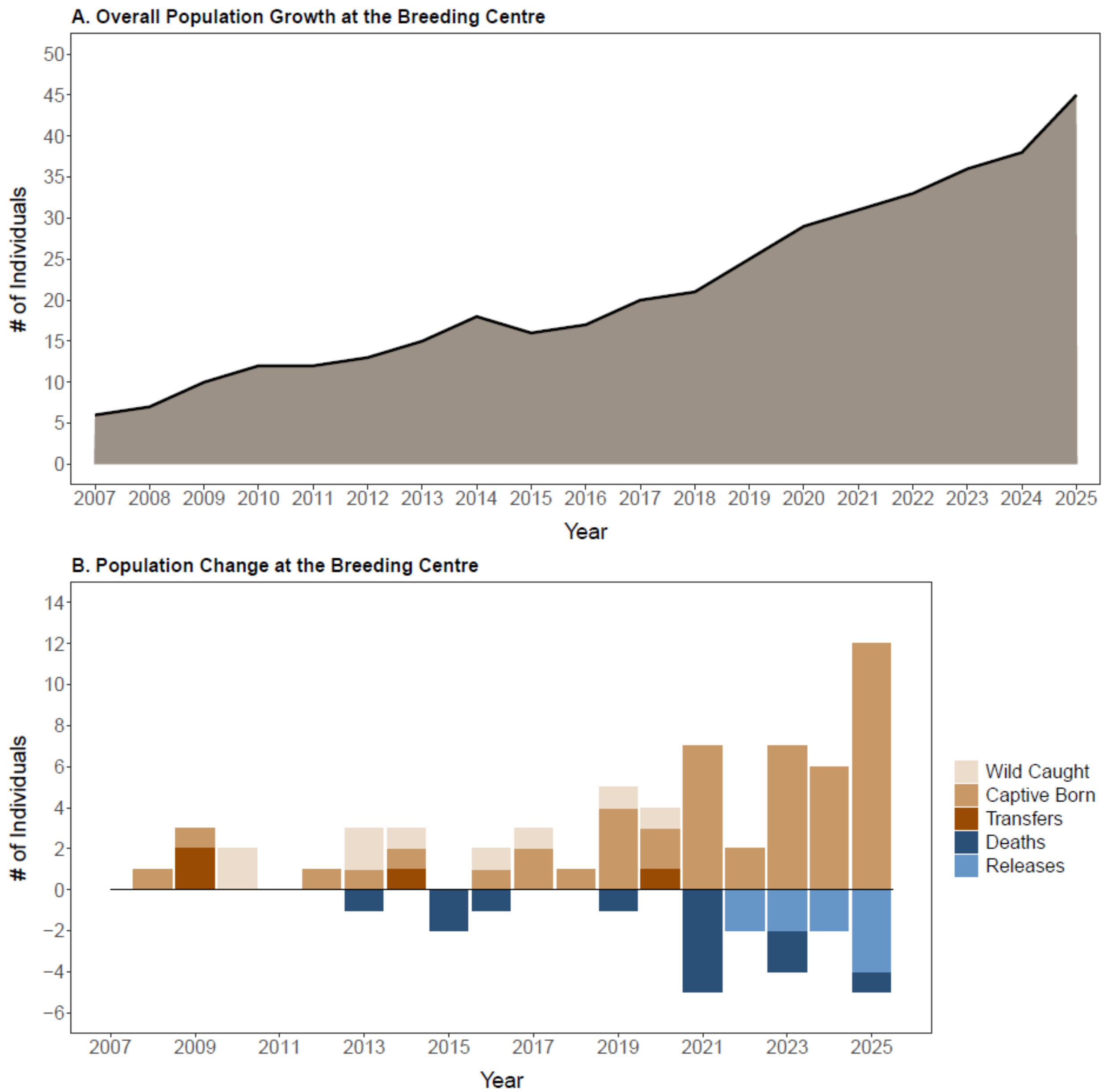


**Figure 2.** Population metrics for Spotted Owl at the Northern Spotted Owl Breeding Program from 2007-2025. Lambda[2] (λ) ≈ 1.116, indicating a population growth of approximately 12% per year.

[2] Lambda (λ) is the population growth rate per time period.

### 3.1.1 Conservation Breeding Implementation Schedule

Table 4 provides details on the minimum actions necessary to ensure the success of the conservation breeding program in the five-year time frame of this Implementation Plan. Without the contribution of owls raised at the breeding centre, it will not be possible to achieve the population and distribution objective for Spotted Owl.

**Table 4.** Implementation schedule for Spotted Owl conservation breeding in B.C. All actions are currently underway (in progress). Timeline is continuous and expected to extend beyond the next 5 years.

| Action ID | CMP Action Category[a] | Description of Action | Impact[b] | Threat[c] or Limitation | Output Indicators[d] |
|---|---|---|---|---|---|
| **2: Species Management** | | | | | |
| **C1** | 2.3.2 Support Conservation Breeding Over Generations | Continue the conservation breeding program, including scaled growth to support the breeding and release objectives. | Direct Immediate | Small population | • Number of individuals supported in captivity<br>• Survival rate<br>• Publish the Release Strategy for Spotted Owls in B.C. |
| **C2** | 2.3.2 Support Conservation Breeding Over Generations | Manage breeding program demographics and population dynamics, including continuous monitoring and documentation of births, deaths, parentage (DNA samples), source, and translocations. | Indirect Contributes | Knowledge Gaps | • Number of individuals in each age class<br>• Number of active territories<br>• Recruitment counts: births, deaths, parentage, source and translocations |
| **C3** | 2.3.2 Support Conservation Breeding Over Generations | Continuously adapt pre-release training protocols for eligible release candidates (e.g. live prey feeding protocols to ensure hunting competency). | Indirect Immediate | Knowledge Gaps | • Updates to live prey feeding protocols |
| **C4** | 2.3.2 Support Conservation Breeding Over Generations | Continuously adapt the Spotted Owl Husbandry & Breeding Procedures with operational learnings from the breeding and release program and/or transferrable learnings (e.g. Indigenous Knowledge systems, literature reviews, etc.). | Indirect Contributes | Knowledge Gaps | • Up to date Spotted Owl Husbandry & Breeding Procedures |

| Action ID | CMP Action Category[a] | Description of Action | Impact[b] | Threat[c] or Limitation | Output Indicators[d] |
|---|---|---|---|---|---|
| **C5** | 2.3.2 Support Conservation Breeding Over Generations | Supplement the Spotted Owl genetic pool with additional owls from the U.S. | Direct Immediate | Small Population | • Increased genetic diversity among captive and released owls |
| **9: Education & Training** | | | | | |
| **C6** | 9.2.1 Providing Hands-On Coaching and Technical Assistance | Increase opportunity for direct participation of First Nations in the conservation breeding program through Land Guardian Programs. This includes options for individualized projects that facilitate shared learnings and experience between communities and the program. | Indirect Contributes | N/A | • Number of individuals who participated in the breeding program<br>• Number of projects |
| **10: Institutional Development** | | | | | |
| **C7** | 10.3.2 Maintaining or Strengthening Relationships | Continue to work with government agencies in the US. to improve international coordination of Spotted Owl recovery efforts and increase the likelihood of cross-border immigration/gene flow. | Indirect Contributes | N/A | • Number of partnerships developed and/or maintained |

[a] Action categories in this table are based on the International Union for Conservation of Nature-Conservation Measures Partnership (IUCN-CMP) unified Threats and Actions Classification systems (2.0). For a detailed description of these classification systems, see the Conservation Standards website [8].
[b] Impact reflects the degree to which an action: directly contributes to the recovery of the species, indirectly supports recovery as a necessary precursor to future actions, has either an immediate or delayed influence on recovery, or provides important contributions to the knowledge base about the species and the mitigation of threats.
[c] Threats correspond to those listed in the 2024 federal Amendment to the Recovery Strategy for Spotted Owl [3] and follow the IUCN-CMP classification system (version 2.0) [8].
[d] Indicators align with the output indicators used by ECCC's Priority Places Initiative.

## 3.2 Conservation Translocation

### 3.2.1 Spotted Owl Releases

In 2022, the Province and Spô'zêm First Nation cooperatively initiated the release trials and have continued annually thereafter. Prior to initiating each release, the population of owls at the breeding centre was deemed stable and genetically diverse enough to support releases. The short-term plan for the release of Spotted Owls from the breeding centre has been to release "clusters" of two to four individuals[3] at each release area, which were selected to be located closest to the center of protected areas as possible.

There are currently five candidate release areas that meet the minimum criteria. The candidate release area within the Anderson LTOHA was selected as the top candidate for initial release efforts. It was chosen because of the size of its protected area (the largest Spotted Owl WHA in B.C.), a lack of adjacent private or Parks land (due to safety concerns related to removal of Barred Owls), the presence of the last known wild Spotted Owls in B.C, and the partnership with Spô'zêm First Nation. In 2023, six modular aviaries were constructed at the Anderson release site in partnership with Spô'zêm to support ongoing release operations. Future release areas will be determined and actioned with partnership of First Nations.

The goal of each release trial is to learn, informing protocols and procedures for raising 'releasable' owls and for monitoring and supporting them post release. Release protocols are experimental but designed based on best available science and Indigenous Knowledge. Since August 2022, twelve conservation-bred Spotted Owls[4] have been released into the wild within the Anderson LTOHA. All twelve of the released owls reached a milestone of self-reliance in the wild. Eight of the twelve releases owls did not survive, two were re-captured and returned to the breeding facility and two are currently in the wild. Trial releases in August 2022 and June 2023 did not result in overwintering success [16][17]. An over-winter intervention protocol is in development to improve over-winter survivability of owls. Trial releases in June 2024 and June 2025 did not result in dispersal success; however, continuous improvement of monitoring protocols allowed for earlier detection of mortality (within a week) and therefore opportunity for improved insights into cause of death. Based on the necropsy report and forensic evidence respectively, mortality of the two 2024 release owls are attributed to starvation and predation. The two owl mortalities in 2025 are attributed to failure to thrive for one individual and collision with a train for the other.

Despite the mortalities of release owls to date, the release trials continue to provide valuable learnings and continuous improvement of husbandry, translocation, and monitoring protocols.

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[3] A maximum of four releases in each cluster is planned, even though up to five may be available for release in any given year. This is because extra owls may be required to supplement RAs where releases have been initiated in previous years.

[4] Released owls were given the following names in the Spuzzum language: sítist ('night'), sinci ('younger brother'), qeck ('older brother'), wíkcn ('I see you'), c̓q̓áłp ('young Douglas-fir'), and skiʔkíyeʔ ('ancestor').

Section 3.2.3 outlines the actions necessary to ensure the success of Spotted Owl release component of the conservation translocation program in the five-year time frame of this Implementation Plan.

### 3.2.2 Barred Owl Management

Barred Owls share overlapping ecological niches and similar adaptations with Spotted Owls, making them formidable competitors. Controlling Barred Owls is necessary to reduce their negative impact prior to augmentation of wild Spotted Owl populations with individuals born at the breeding centre. In 2007, the provincial government initiated a Barred Owl removal program, with target sites including active Spotted Owl territories and proposed release areas. Removals were a combination of relocation and lethal removal.

To effectively monitor for Barred Owls, the project has employed additional methods using Acoustic Recording Units (ARUs) in conjunction with traditional call playback surveys. Since 2021, two ARU grids and a total of 195 units have been deployed in the highest priority release areas, with each grid covering a ~15,000 ha area. The ARUs are spaced to optimally detect Barred Owls within their home ranges and within appropriate Spotted Owl habitat. The boxes are assigned to record one hour at dusk through the peak active season (February 15 – October 31) and the recordings are analyzed for all owl species. The results provide essential information on the distribution of breeding pairs of Barred Owls and their territories.

Between 2007-2021, 108 Barred Owls were captured and translocated away from proposed release sites and 80 were removed from active Spotted Owl sites using lethal methods. With the start of release trials in 2022, the focus of the Barred Owl management program shifted to the area immediately around the proposed release areas. Between 2022-2023, 28 Barred Owls were removed from the active release area using lethal methods.

Detailed methods for Barred Owl removal and safety protocols are part of standard operating procedures and safety plans for the Spotted Owl field program. Section 3.2.3 outlines the actions necessary to ensure the success of the Barred Owl management component of the conservation translocation program in the five-year time frame of this Implementation Plan.

### 3.2.3 Conservation Translocation Implementation Schedule

Table 5 provides details on the minimum actions necessary to ensure the success of the Barred Owl management program and Spotted Owl conservation translocation in the five-year time frame of this Implementation Plan. Without successful releases, it will not be possible to achieve the population and distribution objective for Spotted Owl.

**Table 5. Implementation schedule for conservation translocation and Barred Owl management for Spotted Owls.**

| Action ID | CMP Action Category[a] | Description of Action | Impact[b] | Threat[c] or Limitation or Knowledge Gap | Output Indicators[d] |
|---|---|---|---|---|---|
| **2: Species Management** | | | | | |
| **D1** | 2.1.6 Assisting Specific Taxa In-Situ via Interspecific Interaction Management | Manage Barred Owl populations as required to support Spotted Owl recovery objectives, including lethal removal in prioritized areas. | Direct Immediate | 8.2 Problematic Native Plants & Animals | Number of individuals removed |
| **D2** | 2.1.6 Assisting Specific Taxa In-Situ via Interspecific Interaction Management | Trial new monitoring technologies such as Autonomous Recording Units, Survey123, and Field Maps to improve monitoring/detection efficiency for both Barred Owls and Spotted Owls. | Indirect Contributes | 8.2 Problematic Native Plants & Animals | New monitoring technologies being used |
| **D3** | 2.1.6 Assisting Specific Taxa In-Situ via Interspecific Interaction Management | Adaptively manage the Barred Owl Control Program based on learnings from the provincial program, the US Fish & Wildlife Barred Owl Management Strategy and/or transferrable learnings (e.g. Indigenous Knowledge systems, literature reviews, etc.). | Indirect Influences | 8.2 Problematic Native Plants & Animals | Number of individuals removed |
| **E1** | 2.2.1 Reintroduction of Species | Implement the Spotted Owl Release Strategy to achieve the short-term recovery statement of 4-6 resident owls in at least two release areas, interim (20 year) objective of 20 breeding pairs in each ecological subregion. | Direct Immediate | 8.2 Problematic Native Plants & Animals, 5.3 Logging & Wood Harvesting, 4.1 Roads & Railroads, 4.2 Utility & Service Lines, 7.1 Fire & Fire Suppression, 3.2 Mining & Quarrying | Number of individuals released<br><br>Survival rate |
| **E2** | 2.2.1 Reintroduction of Species | Develop and implement over-winter intervention protocol for Spotted Owls based on the overwinter habitat quality index at the site level to evaluate | Direct Immediate | | Over-winter intervention protocols |

| Action ID | CMP Action Category[a] | Description of Action | Impact[b] | Threat[c] or Limitation or Knowledge Gap | Output Indicators[d] |
|---|---|---|---|---|---|
| | | expected survivability (includes supplemental feeding and satellite tracking of released individuals). | | | |
| **6: Conservation Designation & Planning** | | | | | |
| **E3** | 6.4.2 Species Specific Planning | Adapt delivery of the Spotted Owl release strategy and operating protocols based on new learning and annual reporting. | Direct Immediate | 8.2 Problematic Native Plants & Animals, 5.3 Logging & Wood Harvesting, 4.1 Roads & Railroads, 4.2 Utility & Service Lines, 7.1 Fire & Fire Suppression, 3.2 Mining & Quarrying | |
| **10: Institutional Development** | | | | | |
| **E5** | 10.3.4 Knowledge Sharing | Work collaboratively between governments (Indigenous, provincial, federal) on release planning, including regularly sharing updates on location, status, and fate of release owls. This includes building relationships around additional potential release sites. | Indirect Contributes | Knowledge gap | |

[a] Action categories in this table are based on the International Union for Conservation of Nature-Conservation Measures Partnership (IUCN-CMP) unified Threats and Actions Classification systems (2.0). For a detailed description of these classification systems, see the Conservation Standards website [8].
[b] Impact reflects the degree to which an action directly contributes to the recovery of the species, indirectly supports recovery as a necessary precursor to future actions, has either an immediate or delayed influence on recovery, or provides important contributions to the knowledge base about the species and the mitigation of threats.

[c] Threats correspond to those listed in the 2024 federal Amendment to the Recovery Strategy for Spotted Owl [3] and follow the IUCN-CMP classification system (version 2.0) [8].
[d] Indicators align with the output indicators used by ECCC's Priority Places Initiative.

## 3.3 Recovery Support Strategies

Table 6 provides the implementation schedule and description of the recovery actions that are essential to the recovery program for Spotted Owl. This includes actions related to securing funding, engagement, outreach, and communications. Communicating the intent and results of the recovery program is critical to the success of this Implementation Plan and to ensure public confidence in recovery efforts.

**Table 6.** Implementation schedule for recovery support strategies for Spotted Owls in B.C. All actions are underway (in progress).

| Action ID | CMP Action Category[a] | Description of Action |
|---|---|---|
| **3. Awareness Raising** | | |
| **F1** | 3.1 Outreach & Communications | Improve public awareness and understanding of Spotted Owl recovery activities, including translocations and ongoing habitat management. |
| **9. Education & Training** | | |
| **G1** | 9.2.1 Providing Hands-On Coaching and Technical Assistance | Increase opportunity for direct participation of First Nations in the Spotted Owl recovery program (linked to C6). This includes options for individualized projects that facilitate shared learnings and experience between communities and the program. |
| **10. Institutional Development** | | |
| **H1** | 10.3.1 Forming Relationships | Pursue new partnerships that support and promote Spotted Owl recovery, with a focus in delivery models for conservation breeding (reproduction and genetics) and veterinary health & medicine. |
| **I1** | 10.3.4 Knowledge Sharing | Engage with First Nations regarding the respectful inclusion of Indigenous Knowledge into the recovery program (linked to A5, A7). |
| **J1** | 10.4.1 Securing/Raising Funds | Identify and secure sources of funding to implement recovery actions |

[a] Action categories in this table are based on the International Union for Conservation of Nature-Conservation Measures Partnership (IUCN-CMP) unified Threats and Actions Classification systems (2.0). For a detailed description of these classification systems, see the Conservation Standards website [8].

## 3.4 Research

This section provides the implementation schedule and description of the research studies that are essential to the recovery program for Spotted Owl.

The schedule for research in Table 7 has been developed to provide the information necessary for successful implementation of the three program areas: habitat management, conservation breeding and conservation translocation including Barred Owl management. There is emerging evidence from experimental work completed in the U.S. [17] and work in B.C. [18] that collectively these recovery actions will allow the Province to meet both the short-term recovery statements and the long-term population and distribution objective. However, there is considerable uncertainty regarding the application of these actions to effectively and efficiently recover the species. The studies proposed in Table 7 are intended to address these uncertainties.

**Table 7.** Implementation schedule for research to support the recovery of Spotted Owl.

| Action ID | CMP Action Category[a] (Research & Monitoring) | Description of Action | Research Priority[b] | Threat | Timeline |
|---|---|---|---|---|---|
| **A3** | 8.1.1 Conducting Field Research/ Monitoring | Pursue additional research on impacts of acoustic disturbance on Spotted Owls, including impacts outside of the breeding season. | Beneficial | Knowledge Gaps | Anytime when feasible |
| **B2** | 8.1.2 Conducting Desktop/ Benchtop Research and Analysis | Pursue research on climate change impacts for Spotted Owls, including modelling fire impacts, fire refugia, and identifying areas to prioritize for wildfire risk reduction in LTOHAs and MFHAs. | Necessary | Knowledge Gaps | Start within 2-5 years |
| **B3** | 8.1.2 Conducting Desktop/ Benchtop Research and Analysis | Pursue research on alternative habitat enhancement approaches, including field trials if practicable. For example, tree-thinning, post-fire salvage logging. | Necessary | Knowledge Gaps | Start within 2-5 years |
| **D4-6** | 8.1.1 Conducting Field Research/ Monitoring | Pursue research on Barred Owl individuality & movement to identify summer breeding range using GPS (Argos) tags. Replicate study using ARUs to assess | Essential | Knowledge Gaps | Start Immediately |

| Action ID | CMP Action Category[a] (Research & Monitoring) | Description of Action | Research Priority[b] | Threat | Timeline |
|---|---|---|---|---|---|
| | | the effectiveness of using ARUs to determine home range. | | | |
| **E4-5** | 8.1.1 Conducting Field Research/ Monitoring | Pursue research on using the ARU grid to determine home range and confirm territory establishment of released owls. | Necessary | Knowledge Gaps | Start within 2-5 years |

[a] Action categories in this table are based on the International Union for Conservation of Nature-Conservation Measures Partnership (IUCN-CMP) unified Threats and Actions Classification systems (2.0). For a detailed description of these classification systems, see the Conservation Standards website [8].

[b] Essential = urgent and important, needs to start immediately; Necessary = important but not urgent, action can start in two to five years; Beneficial = action is beneficial and could start at any time that was feasible.

## 3.5 Monitoring Recovery

Monitoring recovery of Spotted Owl will focus on tracking population trends and other key indicators directly related to achieving the Population and Distribution Objective outline. Proposed monitoring activities included in the implementation tables are repeated here for ease of reference:

- **Action A4, Table 2.** Conduct iterative habitat modelling to understand the current state of habitat in the Spotted Owl range and if recovery and survival habitat is recruiting at the rate predicted by initial models at the establishment of the Spotted Owl Management Plan. This will provide information to determine if sufficient attributes and biophysical features are being conserved for the Spotted Owl (Recovery Statement #1).
- **Action C2, Table 3.** Continuous monitoring and documentation of births, deaths, parentage, source, and translocations to track population trends in both the breeding facility and in the wild. This will provide evidence of whether we are re-establishing a wild Spotted Owl population and meeting our 2030 target (Recovery Statement #2).
- **Action D2, Table 4**. Monitor and detect Barred Owls and Spotted Owls at occupied Spotted Owl sites. This will determine if Barred owl removal efforts have been successful and/or alert to where to put efforts (Recovery Statement #3).

The effectiveness of specific actions implemented to address threats and support recovery will be monitored and evaluated as part of the implementation process, as detailed in the implementation tables (Tables 3-5). The data gathered through the monitoring activities outlined above will inform future COSEWIC reassessments and adaptive management.

# 4 ECOSYSTEM SERVICES: CO-BENEFITS OF IMPLEMENTATION

This section outlines the expected co-benefits of the proposed actions for Spotted Owl, highlighting their contributions to key ecosystem services.

Ecosystem services are the many and varied benefits to humans provided by the natural environment and healthy ecosystems. These services are typically grouped into four main types: provisioning, regulating, cultural, and supporting services [19]. The actions outlined in this implementation plan are likely to contribute to multiple co-benefits, especially those associated with the conservation and restoration of old growth forests, which are essential to supporting the owl's habitat.

These co-benefits extend beyond species conservation, offering nature-based solutions like enhanced carbon sequestration, improved water quality, and biodiversity maintenance. Protecting these forests supports both the owl's habitat and broader environmental goals, making it a cost-effective strategy for carbon storage and overall ecosystem health [20].

## 4.1 Provisioning Services

A provisioning service is the supply or extraction of any materials or energy from an ecosystem such as food, forage, fibre, fresh water and other resources. The actions in the implementation plan will result in an increase in the availability of non-timber forest products (NTFP), and a decrease in potential timber harvesting, hydroelectric power production and mineral extraction.

**Diversity of Non-Timber Forest Products**

The protection of species and their habitats can have significant effects on the availability and sustainability of resources such as medicinal plants, fruits, nuts, mushrooms and other products gathered from forests [21]. By conserving forests for species protection, particularly in biodiversity-rich areas, the ecological conditions necessary for the sustainable harvesting of NTFPs are maintained or even enhanced.

**Provision of Medicine**

The actions listed in this plan contribute to the conservation of old growth forests, which are important for both Indigenous and Western medicine. These forests are home to a rich diversity of plants and fungi, which have been used for centuries for traditional healing practices and ceremonies. In addition to the importance of these natural resources to Indigenous communities' medicinal knowledge and culture, these forests also contribute to western pharmaceutical discoveries and medical advancements. For example, the Pacific yew tree, found in old-growth ecosystems, is the source of paclitaxel, a life-saving drug used in certain cancer treatments [22]. Similarly, unique fungi from these forests are currently being studied for their potential to treat diseases like COVID-19 [23].

### Preservation of Genetic Resources

The conservation actions for Spotted Owls are also important for preserving the genetic diversity found in old growth forests. This diversity is not only important for the species currently recognized but also for those that may become significant in the future.

Protecting genetic resources is crucial for the adaptability and resilience of ecosystems, allowing them to withstand environmental changes, diseases, and other stresses. This aligns with global commitments, such as the Kunming-Montreal Global Biodiversity Framework (GBF) of the Convention on Biological Diversity (CBD) [24], which emphasizes the importance of safeguarding genetic diversity. By conserving these genetic materials, the plan contributes to global efforts to minimize loss of biodiversity, ensuring that ecosystems can continue to provide essential services, including the potential discovery of new medicines.

### Potential Timber Harvesting

Protection of Spotted Owl habitat may impact future timber provisioning services. Spotted Owl range includes several forest districts, including Chilliwack, Squamish, Lillooet, and Merrit. As large areas of old forests have been designated as recovery and survival habitat, limiting logging activities may result in increased competition for timber from second-growth forests [25]. There will likely be an effect on timber harvest and associated revenues, income, and employment. However, the plan encourages the development of collaborative relationships and innovative land-use strategies, which could help regions transition towards more sustainable and diversified economic models, including non-extractive uses of forests and increasingly sustainable harvesting of timber and NTFPs.

### Potential Hydro-electric Power and Mineral Extraction

Protection of Spotted Owl habitat may limit the provision of hydro-electric power and minerals within designated areas [26]. Most of the Spotted Owl range has moderate or high potential for small hydro projects. Such projects may not be allowed to proceed in protected habitat. Road construction, mining (blasting), rock quarry activities and low flight of jets or helicopters are likely to be limited, particularly where acoustic disturbance may have a significant impact on Spotted Owls.

## Regulating Services

Regulating services maintain environmental conditions that are favourable to life. The importance of regulating services is most apparent when they are not functioning properly.

The implementation plan, specifically actions A1 to A7 and B1 to B3, enhances several regulating ecosystem services, including carbon storage, water flow regulation, water purification, wildfire reduction, and increased ecosystem resilience.

**Carbon Storage**

Protecting Spotted Owl habitat will have carbon storage co-benefits. B.C.'s old coastal forests store large amounts of carbon (up to 1,300 Mg $ha^{-1}$), which is higher than in tropical or boreal areas [27]. Intact old forests are estimated to store twice as much carbon as mature forests and six or more times as much as clearcuts. Productive coastal old forests can store up to six times more carbon than old forests in drier climatic areas. Studies have shown that unmanaged, old-growth forests continue to sequester atmospheric carbon (C) at a rate of 2.4 ± 0.8 Mg C ha–1 yr–1 for stand ages exceeding 200 years [28]. Increased carbon storage can also be linked to the reduction of the forest edge effect. Globally, locations up to 500 m from a forest edge average 25% less biomass carbon than locations further from forest edges, and even locations up to 5 km from an edge can have >10% less biomass carbon [29].

**Water Flow Regulation**

Protecting Spotted Owl habitat has co-benefits in the form of water regulation, such as preventing floods and droughts. Intact forests have a direct influence on water availability through the redistribution of runoff, evapotranspiration, water table levels and soil moisture by altering soil permeability. According to a European Environmental Agency report (Water-Retention Potential of Europe's Forests; [30]), water retention potential tends to increase along with the extent of forest cover in a water basin. Compared to basins with a forest cover of 10%, total water retention is 25% and 50% higher in water basins where the forest cover is more than 30% and 70%, respectively. Recent research in B.C. has found that logging increases flood risk and has a particularly large impact on spring flooding caused by snow melt [31][32].

**Water Purification**

Protection of Spotted Owl habitat has co-benefits in the form of improved water quality. Forestry service roads and larger areas of bare soil led to increased levels of erosion and nutrient runoff that can negatively impact water quality in adjacent watersheds. Spotted Owl habitat conservation will be beneficial for reducing disturbances affecting water quality.

A study in Costa Rica analyzed the impact of forest cover on the quality of raw water and the extent of water treatment required at the water treatment plants in Costa Rica between 2008 and 2014. Forest cover change during the study period statistically significantly affected the chemical use of water treatment plants. Avoiding 1% of the catchment's forest loss reduced chemicals use by 0.026%. The estimated value of water purification service provided by forests is USD 9.5 per hectare per year. Depending on the discount rate, this results in a net present value of water purification service ranging between USD 315.4 and USD 113.9 per hectare [33].

**Wildfire Reduction and Forest Ecosystem Resilience**

Recent research [34] found that forest restoration may support Spotted Owl recovery by reducing the owl's exposure to severe wildfire. Forest structure restoration, where large, old trees are maintained, may mitigate severe fire activity and support old growth forest species and forest ecosystem resilience under climate change. Strategies incorporate the dynamic natural disturbance regimes in a manner that provides for long-term ecological sustainability

[35]. It is thought that natural disturbance-based management provides a comprehensive ecosystem-based framework for managing forests for human needs of commodity production and immaterial values, while maintaining forest health in the rapidly changing global environment [36][37].

## 4.2 Supporting Services

Supporting services are services that maintain fundamental ecosystem processes, such as habitat for plants and wildlife, or genetic and biological diversity.

The implementation plan, particularly actions A1 to A7, B1 to B3 and D1 to D4, enhances several supporting ecosystem services such as protection of habitat and increase in Spotted Owl prey and other species.

**Protection of Habitat for Co-located Species**

Spotted Owl is considered an umbrella species. If sufficient habitat for this species can be conserved, then habitat for a multitude of other species, including species at risk, with smaller home ranges and similar habitat requirements can also be achieved [38]. Old growth represents 15% of habitat required by old growth-dependent species at risk, with 52.9% of this unprotected, including almost half (49.2%) classified as priority unprotected old growth [37]. Over 400 species of plants and animals that rely on old growth forests in B.C. would benefit from conserving habitat for Spotted Owl habitat. An example is Marbled Murrelet as nearly 50% of its habitat overlaps with unprotected habitat suitable for Spotted Owl. Other SARA-listed species at risk that would benefit include Grizzly Bear (*Ursus arctos*), Northern Goshawk (*Accipiter gentilis*), Westslope Cutthroat Trout (*Oncorhynchus clarkii lewisi*), and Smoker's Lung Lichen (*Lobaria retigeria*), as well as B.C. Red-listed species like Fisher (*Pekania pennanti*) [39].

**Increase in Prey for Spotted Owls and Other Species**

Barred Owls are apex predators and fierce territorial invaders that exert pressure on species not adapted to this source of predation, leading to negative effects on potential prey species and competitors for the prey. At high densities they have the potential to affect a variety of native wildlife. Barred Owl removal in the Spotted Owl range would have a beneficial effect on potential prey species by reducing this novel source of predation and on potential competitors by reducing competitive pressure [38]. Barred Owl prey species include rodents, birds, insects, worms, fish, reptiles, crayfish, frogs, and flying squirrels. Some of these species are threatened, including Coastal Giant Salamander (*Dicamptodon tenebrosus*) and Coastal Tailed Frog (*Ascaphus truei*).

## 4.3 Cultural Services

The Millennium Ecosystem Assessment defines cultural ecosystem services as the nonmaterial benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation, and aesthetic experiences [40].

All of the actions in the implementation plan support the provision of cultural services through Habitat Management and Enhancement (actions A1 to A7 and B1 to B3), Conservation Breeding (actions C1 to C7), Barred Owl management (actions D1 to D4), Spotted Owl releases (E1 to E5), engagement and information sharing particularly with First Nations (actions F1, G1, and I1), and through program planning, (action H1 and J1).

Spotted Owls and their habitat provide important cultural ecosystem services, including existence values (the well-being derived from knowing the species currently exists), bequest values (the worth of preserving something for future generations), and a wide range of cultural heritage, aesthetic, recreational, spiritual, and educational and knowledge values**.** This Implementation Plan supports these ecosystem services through actions aimed at protecting and restoring Spotted Owl habitat in collaboration with Indigenous partners, integrating Traditional Knowledge into conservation strategies, and ensuring the preservation of these cultural connections for future generations through research and monitoring.

**Indigenous Values**

The plan proposes to work closely with First Nation governments to confirm protection in areas required for Spotted Owl recovery or survival (A5), co-manage these habitats to align with Indigenous land stewardship practices (A6), and continuously adapt conservation strategies by integrating Indigenous Knowledge systems (E5). These actions:

- ensure that the cultural heritage tied to Spotted Owl and its habitat is preserved for future generations;
- support the revitalization of Indigenous Knowledge systems;
- ensure that the cultural significance of Spotted Owls is upheld;
- recognize the importance of Indigenous Knowledge and practices; and
- contribute to the ecological resilience of the forests, vital for the Spotted Owl's survival.

Old-growth forests are integral to Indigenous cultural heritage, serving as sources and sites for traditional activities such as canoe building, medicine collection, and artistic expression inspired by Spotted Owls [41]. Spotted Owls have been symbolic to Indigenous traditions since time immemorial, in connection with customs and oral traditions of storytelling, songs, dances and folklore [42]. Spotted Owls have inspired Indigenous artwork across North America, such as through paintings and mask-making to pay homage to Spotted Owls. Cedar, Douglas fir and western hemlock are used for building, carving, crafting, clothing, cleaning, or blessing for traditional healing [43]. Trees in old-growth forests that are home to Spotted Owls provide food or shelter to other species important for Indigenous communities.

Indigenous forest stewardship practices, including cultural burns, have shaped the landscapes of old-growth forests for millennia, promoting the health of these ecosystems and ensuring the availability of resources such as berries and medicinal plants [44]. Their use of fire to steward the land has been both a part of their culture and survival as it has helped promote the regrowth of non-timber products used for food (e.g., berries and mushrooms), medicine and browsing for ungulates typically harvested [45]. Indigenous culture encapsulates a sense of responsibility and cultural obligation to steward their lands and nurture resilience as well as foster intergenerational access to natural resources.

Spotted Owls serve as an indicator of ecosystem health. Spotted Owls hold great cultural and spiritual significance for Indigenous Peoples, particularly those whose ancestral lands overlap with the owl's habitat in old-growth forests. The Spô’zêm Nation, among others, regards Spotted Owls as "messengers" between this world and the spirit world, symbolizing both guardianship and deep spiritual connection [46]. The owl is symbolic with many meanings to Indigenous Peoples. It has symbolized both guardianship and an omen of death; it has been both a blessing and a curse. Owls also have significant representation in Indigenous stories, ceremonies, as well as song and dance [42].

The owl and “owl landscapes” breathe new life into ancestral knowledge and relationalities. Indigenous cultures have drawn from “owl embodied teachings” through their movement and sensory perspective. Indigenous Nations sometimes listen to owls at night. Owl landscapes and their stories, movements, and kinships have been an integral part of ancestral landscapes and transmissions of their teachings [47].

**Social Values**

The conservation of old-growth forests and Spotted Owl aligns with broader societal values, particularly those concerning environmental ethics, human well-being, and the advancement of scientific knowledge. The obligation to protect old-growth forests and the species that depend on them, such as Spotted Owl, is a core component of the plan. It reflects the broader public’s concern for preserving this irreplaceable habitat and the moral responsibility to sustain ecological systems for future generations [48].

**Recreation and Tourism**

Even though most recreational activities are likely not a threat, some restrictions might become necessary to avoid disturbance and limit activities near the active nests. For example, in southern Utah, Mexican Spotted Owls (*Strix occidentalis lucida*) were unlikely to flush at distances of 24 m or more from hikers [49].

Recreational uses of forests have altered the public’s perception and interest in old-growth forests. Recreational activities for human enjoyment include hiking, camping, snowshoeing, painting, sketching, and meditating. This may also include enjoyment of hunting and gathering berries, greens, and fallen bark, and firewood [50].

### Moral and Ethical Values

Public discourse and collective moral claims associated with questions on how humans ought to coexist with wildlife are ongoing. Socio-cultural values also relate to the ethics associated with the conservation of old growth forests. Old growth forests are irreplaceable habitats and thus, there is a moral obligation for protecting the species whose habitat depends on the protection of these ecosystems [23]. The ethical values for protecting the species also have pertinence to ongoing concerns about the competition with expanding Barred Owl as a threat second to habitat loss [48]. Ethical values are also closely tied to the legal obligation to protect under the Species at Risk Act which mandates protection of Critical Habitat and the need to sustain ecological systems for future generations.

### Scientific and Artistic Inspiration

Spotted Owls and their habitats have inspired human expression, from art and literature to scientific inquiry [42]. Inspiration from ancient forests can be seen in features of modern literature, art, and cinematography, appearing consistently across many generations. The owl has also been an iconic symbol in folk, fine art and has been used as a visual representation promoting the advancement of scientific understanding. The aesthetic and symbolic value of Spotted Owls, reflected in cultural and artistic works, underscores the importance of conserving these species and their habitats [42].

### Spirituality and Tranquility

Old-growth forests, often described as "cathedral forests" due to their majestic and serene qualities, offer significant spiritual and therapeutic benefits to society. Ancient, old-growth forests and sounds of the presence of a Spotted Owl offer a place of tranquility, in which its natural complexities and the beauty of its wholeness offer spiritual values and therapeutic benefits for humans. Old growth forests provide spaces for recreation, reflection, and connection with nature, contributing to overall human well-being [51].

### Research Value

Research has enhanced Canadian expertise on old growth forests to define and understand its biological complexities and ecological roles. The ability to observe and map long term changes in carbon as global carbon sinks, both in soils and above ground carbon storage and sequestration, is needed to explore implications for climate change mitigation and ecosystem resilience to climate change impacts [52]. The relationships between old growth habitat, demographic performance, and nesting habitat of Spotted Owl have also brought forth major contributions to avian population ecology, conservation biology and management planning across the species' natural range [53]. The substantial depth of research on Spotted Owls over a quarter of a century has also had a great effect on land use policy and has uncovered new approaches and methods for conservation planning [54].

## 4.4 Relationships Between Actions and Ecosystem Services

Figure 3 uses a Sankey diagram[5] to illustrate the relationships between the individual conservation actions in the Spotted Owl Implementation Plan and ecosystem services. For example, the diagram shows that action A1 (Continue No Net Loss Policy) affects almost all ecosystem services through the conservation of old-growth forests, while action B1 (Pursue wildfire risk reduction and climate change mitigation) affects timber production, wildfire risk, carbon sequestration, and non-timber forest product ecosystem services. The size of the right-hand side bar corresponds with the number of management actions an ecosystem service has a connection with; it does not represent the impact of all management actions on an ecosystem service.

[5] Sankey diagrams are a data visualization technique that emphasize the major transfers or flows in a system, in which the width of the arrows is proportional to the contribution of the factors.

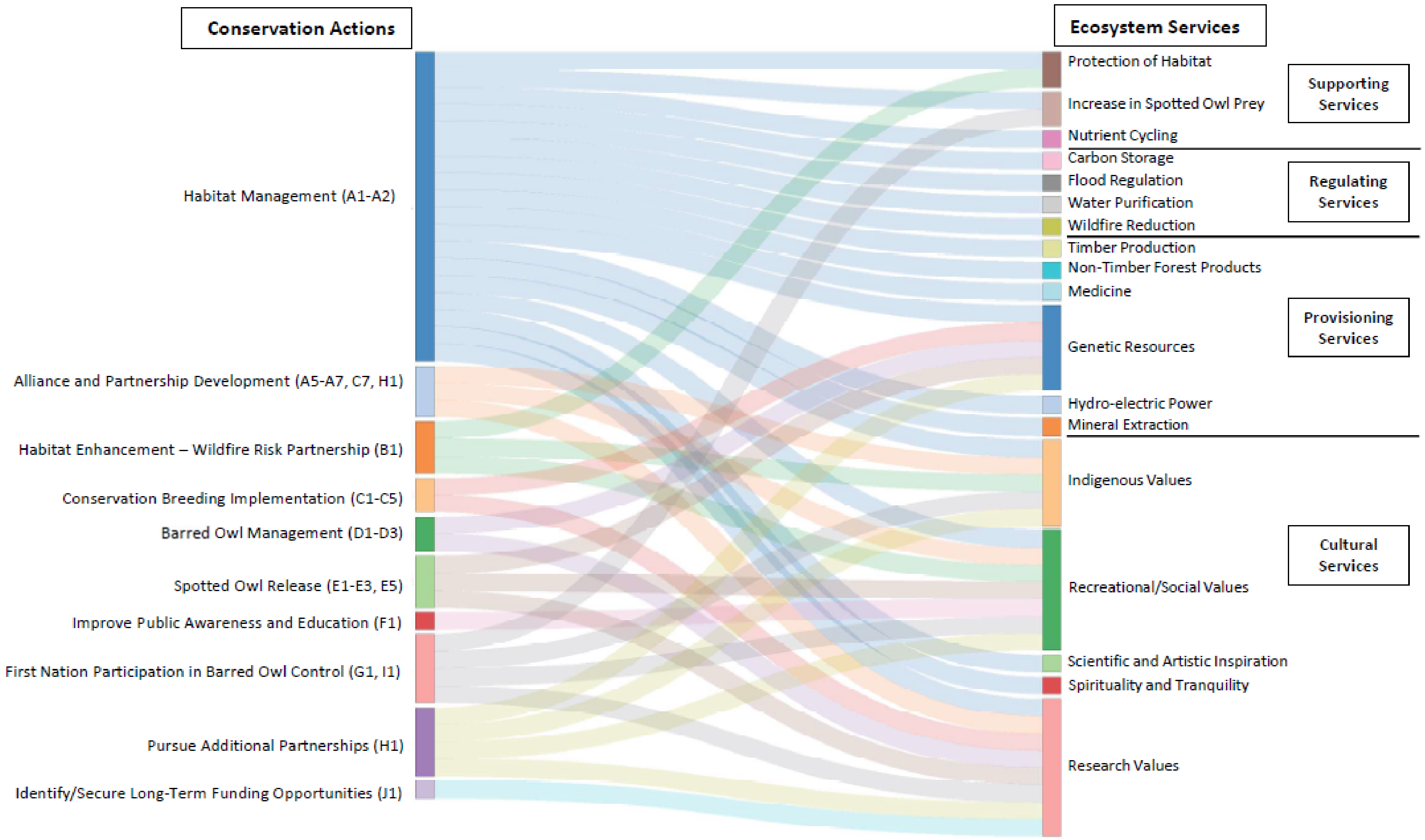


**Figure 3.** Sankey diagram illustrating the co-benefits between conservation actions for Spotted Owl recovery and ecosystem services in B.C.

# 5 EVALUATION OF BENEFITS, COSTS, AND COST-EFFECTIVENESS OF THE IMPLEMENTATION PLAN

This section assesses the costs and benefits associated with implementing this plan, with the goal of identifying recovery actions that will deliver the greatest conservation impact. The analysis compares ongoing and proposed actions against a baseline scenario that includes:

1) Existing protections - all current and underway laws, regulations, and polices to protect the species and its habitat, e.g., established legal habitat protection.
2) Completed actions – all previously completed recovery efforts, as summarized in Section 1.1: Recovery Context and the program area introductions found under Section 3: Recovery Actions of this implementation plan.

The costs and benefits of the baseline are not included in the socio-economic assessment.

## 5.1 Benefits

The implementation of this plan should result in progress towards meeting the Spotted Owl's population and distribution objective (PDO). Tables 3-5, include a column to indicate whether an action has a direct or indirect impact on the PDO.

### 5.1.1 Benefit of Direct Actions

The implementation of this plan should result in progress towards meeting the species population and distribution objective. To contribute to the PDO, actions must have a direct impact on either the threats, habitat, or other special considerations of the species. Costs related to direct actions are in Table 8.

### 5.1.2 Benefit of Indirect Actions

Actions that do not have a direct impact on the PDO are necessary as they indirectly contribute to the species' progress towards recovery. These actions generally fall within the areas discussed below.

<u>Monitoring</u>
Monitoring is needed to assess progress toward meeting the PDO. See actions discussed in Section 3.5.

<u>Research</u>
Research increases our understanding of the species, its threats, or its habitat to improve action outcomes. This is essential to the recovery program for Spotted Owl (Table 7); however, the benefit they provide towards achieving the population and distribution objective is not known until the information gathered can be applied.

<u>Relationships, Community Engagement and Education</u>

Building and strengthening relationships are crucial to the success of the Spotted Owl program. These relationships can lead to increased support for Spotted Owl recovery, seen through greater public awareness, volunteer involvement and compliance, information sharing among institutions, funding, and government-to-government collaboration. While the contribution of these relationships to project success is difficult to quantify, they are invaluable and provide benefits that extend beyond any single project. Related actions include:

- Maintaining or strengthening relationships related to activities for habitat management (A2, A5, A6, A7), conservation breeding (C6) and conservation translocation (E5); general program activities (H1)
- Improving public communication of recovery activities (F1)
- Hands-on coaching and technical assistance (First Nations participation and engagement); knowledge sharing (G1 +I1)
- Securing/raising funds for conservation actions (J1)

### 5.1.3 Co-benefits of Actions

The implementation of this plan provides numerous co-benefits, i.e., benefits that are not specific to the species, but instead are beneficial to other species, ecosystems, or people. These various ecosystem services are detailed in Section 4. It is challenging to assess the economic value of these ecosystem services, as these services provide long-term benefits into the future, so as long as the habitat remains.

### 5.1.4 Other Benefits of Actions

Further advantages to taking recovery actions for the Spotted Owl, include fulfilling British Columbia's commitments as a signatory to the National Accord for the Protection of Species at Risk, honouring SARA while maintaining provincial jurisdiction and supporting industry certification. Assessing the economic value of these commitments/strategies are difficult, as they involve reducing the likelihood of potentially punitive actions. It is difficult to assign a value to something that doesn’t occur [5].

## 5.2 Costs

The costs provided in this section are estimated annual costs directly attributable to the proposed action. These do not include the costs associated with the initial implementation of ongoing actions. For example, the land acquisition costs for the breeding centre are not included in the annual costs for continuing activities at the breeding centre. Similarly, the cost data for action A1 (Continuation of the No-Net-Loss Policy) do not include costs associated with the initial implementation of the No-Net-Loss policy, such as establishing legal protection for habitat on public lands (Table 8).

The annual costs associated with the Spotted Owl Implementation Plan is approximately $2,181,030. This total includes around $500,000 worth of provincial staff time. On average a further $200,000 is provided by partners from external fundraising and charitable donations.

**Table 8.** Provincial annual costs and cost effectiveness of Spotted Owl recovery actions directly (indirectly) impacting the population and distribution objective.

| Action | Benefit | Feasiblity | Annual Cost to B.C. | Cost Effectiveness Score | Ranking |
|---|---|---|---|---|---|
| **B1:** Habitat Enhancement Partnerships on Wildfire Risk Reduction | 35% | 43% | $8,750 | 1.70 | 1 |
| **C5 + (C7)** Conservation Breeding - Collaboration with the U.S. | 35% | 85% | $35,000 | 0.85 | 2 |
| **A1 + A2:** Adaptive Habitat Management - Continue Implementation of No Net Loss policy | 70% | 85% | $175,000 | 0.34 | 3 |
| **D1 + (D2 + D3)**: Conservation Translocation - Barred Owl Management Actions | 70% | 50% | $331,100 | 0.11 | 4 |
| **C1 + (C2 + C3 + C4)**: Conservation Breeding-Implementation Actions | 85% | 75% | $1,030,980 | 0.06 | 5 |
| **E1 + E2 + E3:** Conservation Translocation - Spotted Owl Release Actions | 85% | 50% | $465,200 | 0.09 | 6 |
| **Relationship-building related activities** | | | $135,000 | | |
| | | **Annual Cost to B.C.** | **$2,181,030** | | |

## 5.3 Cost Effectiveness Analysis

A Cost Effectiveness Analysis (CEA) for Spotted Owl action sets was conducted to evaluate and compare the relative effectiveness of the proposed conservation action sets that directly support the population and distribution objectives (Table 8). CEA compares different sets of actions to understand how much conservation value each action set brings relative to its cost. This helps decision-makers decide how to pick the set of actions that result in the greatest conservation impact subject to their budget. An action set can be made up of one action or multiple actions.

To estimate the impact of proposed action sets on achieving the population and distribution objectives for the Spotted Owl, input was gathered from subject matter experts. These experts—provincial staff from WLRS with direct involvement or expertise in the recovery program—were asked to assess:

- The benefit of implementing an action set is based on the likelihood of meeting recovery objectives with and without each proposed action set.
- The feasibility of each action set, based on expected uptake and successful implementation.

The elicitation was conducted collaboratively using a shared file. Each subject matter expert could view and build upon the initial estimates, comments, and reviews provided by others. This iterative process allowed for transparent comparison and refinement of expert judgments. Final estimates were compiled based on input from six experts, incorporating both quantitative assessments and qualitative insights.

Cost-effectiveness depends on the feasibility of the action set, its benefit, and the estimated annual cost (see Appendix C for methodology). The costs included are the incremental costs directly attributable to the proposed action set. The analysis does not include sunk costs[6] or speculative costs[7].

The conservation action sets are evaluated solely by their effectiveness at meeting the population and distribution objective of Spotted Owl; however, conservation actions often provide benefits unrelated to Spotted Owl that can be considered when deciding which actions to pursue. For example, while Action A1 increases the probability of meeting the population and distribution objective of Spotted Owl by reducing the risk of wildfire, it also preserves habitat that provides many ecosystem services (Section 4).

The relative effectiveness of the action sets considered varies greatly; for example, actions such as B1 (Wildfire Risk Reduction) are ranked highest in cost effectiveness, while the conservation breeding program (C1-C4) and the translocation action sets (D1-D3) are ranked 2nd and 4th, respectively. In the absolute sense, all action sets are considered effective in contributing to the PDO as seen in the benefit percentages shown in Table 8. For Spotted Owl, all actions must be implemented for recovery to be possible; however, the ranking provides guidance on which activities could be paused or scaled down temporarily if needed.

There are several actions to which the concept of cost-effectiveness cannot be applied, as the benefits they provide towards meeting the population and distribution objective are not easily quantified (i.e., they provide indirect or co-benefits, Section 4). Approximately $135,000 annually is allocated to activities that help build and strengthen relationships. This amount does not include the value of the time and effort contributed by partners, such as the capacity provided by First Nations and non-government partners to the program.

[6] Sunk cost refers to expenses that have already been incurred and cannot be recovered. For example, if part of an action has already been conducted the cost of these completed components will not be accounted for in this analysis. Only future expected costs of continuing the action will be analyzed.
[7] Speculative cost refers to projections or assumptions of the future value of a business decision or investment.

# 6 ONGOING IMPLEMENTATION

Over the last several decades, targeted measures have been implemented to protect and restore Spotted Owl nesting and foraging habitat, monitor Spotted Owl populations and closely related competitors, and develop a successful Spotted Owl conservation-breeding program to supplement wild Spotted Owl populations. However, it must be acknowledged that while some actions have shown proven success, the recovery program is still learning and adapting. This implementation plan covers five years of actions in a 50-year recovery timeframe, designed to make continuing progress and set up the program for long-term success.

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## APPENDIX A: Recovery Feasibility Summary

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) and Environment and Climate Change Canada (ECCC) use the following criteria to establish recovery feasibility [54][55]. Based on these criteria, there are significant uncertainties associated with the biological and technical feasibility of recovering Spotted Owl in Canada [56]. However, uncertainty does not mean survival or recovery is impossible, and efforts to recover the Spotted Owl will continue with the expectation that certainty will improve over time.

**1. Survival characteristics:** Can survival characteristics be addressed to the extent that the species is no longer at significantly greater risk of extinction or extirpation as a result of human activity?

**UNKNOWN:** The Spotted Owl is currently assessed as Endangered on the basis of four key survival characteristics: (i) resilience (D1 COSEWIC quantitative criteria) – its wild population is estimated to be small (well below the 250-individual threshold for Endangered status) and is in decline; (ii) redundancy and connectivity (linked with COSEWIC B2ab indicators) – its habitat and associated distribution is in decline and fragmented (iii) stability (linked with COSEWIC A2ac, C1+2a, and E indicators) - there is an ongoing decline in the number of mature individuals and area/quality of habitat, and a quantitative analysis showing high probability of extirpation, and (iv) continuing impacts caused by ongoing human-caused threats.

<u>Resilience</u>: For recovery to be considered feasible, it must be biologically and technically possible to improve the resilience of the Spotted Owl so that its population exceeds the 250-individual threshold (criteria D1) associated with Endangered status, thereby restoring it to a status of Threatened.

In 2007, the Spotted Owl conservation breeding program was established to augment and enhance the wild population to prevent extinction. It began with five adult owls and owlets from seven different breeding pairs to increase genetic diversity. The current population includes 11 females and 25 males at the breeding centre, plus one wild-born female last seen in 2022, totaling 37 owls. While breeding has been successful, released owls have not survived through the winter. It remains unknown if resilience can be addressed to the extent that the species is no longer at significantly greater risk of extirpation due to human activity.

<u>Redundancy, connectivity and stability</u>: Prior to impacts from human activity (i.e., in its natural condition), Spotted Owl had a relatively restricted distribution, concentrated in southwestern B.C. Although its precise historical range is unknown, it would have included three ecologically distinct sub-regions (the wet ‘Maritime’, moist ‘Sub-maritime’, and dry ‘Continental’ sub-regions). Connectivity in habitat within these sub-regions and to the U.S. would support a stable and genetically diverse population. It is unlikely that any of the COSEWIC quantitative criteria for assessment as Endangered associated with redundancy, fragmentation, and/or stability would have been met for the species in its natural condition.

Through habitat protection, it is both biologically and technically feasible to prevent further habitat decline. Based on the configuration of regenerating and existing Spotted Owl habitat (Section 2), it is also possible to achieve a connected network of habitat sufficient to support ≥250 mature individuals within 50 years. Some connectivity to the U.S. still exists, and additional connectivity could be restored through long-term protection of maturing forests. In its recovered state, Spotted Owl would no longer meet the quantitative criteria (A, B, C, or E COSEWIC indicators) for assessment as Endangered or Threatened [55][56].

<u>Protection from human-caused threats:</u> Ongoing human-caused threats must be addressed (ceased, mitigated, or avoided) to ensure the key survival characteristics for Spotted Owl are met and recovery is feasible. It is biologically and technically feasible to mitigate human-caused threats such as logging, roadbuilding, wildfire, and increased fuel loads resulting from fire suppression. However, the most significant threat is competition with Barred Owl in former Spotted Owl range.

Controlling Barred Owls is necessary to reduce their negative impact before augmenting wild Spotted Owl populations with individuals from the breeding centre. In the U.S., Barred Owl removal has been shown to increase local Spotted Owl site occupancy, survivorship, and productivity [17][57]. It will take years to gather sufficient data to assess the effectiveness of Barred Owl removal in B.C. Thus, it remains uncertain if the impacts of Barred Owl can be effectively mitigated to address these survival characteristics for Spotted Owl.

**2. Independence**: Is the species currently able to persist in Canada independent of deliberate human interventions, and/or will it eventually be able to achieve and maintain independence in the state where condition (1) is met, such that it is not reliant on significant, direct, ongoing human intervention?

**UNKNOWN.** The Spotted Owl is nearing extirpation in Canada and requires significant, direct human intervention, specifically population augmentation through conservation breeding and Barred Owl control, for the medium to long term. Barred Owl control may be necessary long term unless Spotted Owl persistence improves through increased breeding success and overwintering survival. Despite considerable uncertainty, it may be feasible for the Spotted Owl population to recover within 50 years to a level that can remain stable without ongoing human intervention.

**3. Improvement:** Can the species' condition be improved over when it was assessed as at risk?

**YES**. It is biologically and technically feasible to improve the condition of Spotted Owl by addressing key survival characteristics impacted by human activity, thereby reducing the species' risk of extinction or extirpation. Population stability and resilience may be improved, and population/habitat connectivity and redundancy restored, through a) ensuring a connected network of habitat that supports all life functions for a population of >250 mature individuals is available when needed for recovery; b) continuing the captive breeding and reintroduction program to repopulate its historical range, and c) continuing Barred Owl control efforts, to allow Spotted Owls to survive and reproduce successfully within protected habitats.

## APPENDIX B: Methodology for determining co-location between potential recovery and survival habitat and existing conservation measures

This appendix details methodology used to determine the extent of co-location between the potential recovery and survival habitat for Spotted Owl and other existing complementary conservation measures. An interactive tool for visualizing these protections is available on the B.C. Spotted Owl Implementation Plan Webmap Application.

A list of spatial protections data was compiled from provincial and federal sources as identified in Table 9. Each layer was categorized into one or more protection categories to determine whether protection against timber harvest was legal and full, legal and partial, or non-legal. Prohibitions relating to other industrial and commercial activities were considered out-of-scope of this analysis; however, it should be noted that many industrial activities (i.e., mining, hydroelectric projects) will be subject to the same restrictions as commercial timber harvest. Legal categories are those protections associated with an Act, where fully protected areas completely prevent timber harvest, and partially protected areas allow for conditional harvest. Non-legal categories include those that are typically honoured by forest licensees and are included in Forest Landscape Planning, although not associated with an Act.

The data were obtained from the source via an FME workbench and manual download. Using SQL queries identified in Table 9, protection categories were applied to each layer. The layers were then merged to create one layer representing all source layers and associated protection categories. In preparation for an area-based spatial analysis, overlaps were removed from the dataset by dissolving on protection category and flattening the data to ensure that the ‘Legal – Fully Protected’ category overrode all others, and the ‘Legal - Partially Protected’ category overrode the ‘Non-legal’ category. This flattening was done using the Erase tool.

The resultant dataset was then intersected with the B.C. Spotted Owl Suitable Habitat model (updated in 2019) to specifically identify protections within habitat suitable for Spotted Owl nesting, foraging, dispersal, and recruitment. This was overlayed with the Spotted Owl Management Plan 2 (SOMP2) data using the Identity tool to further understand the relationship between protections and SOMP2 [12].

**Table 9.** List of spatial protections data used in co-location analysis, by protection status (Section 2.3).

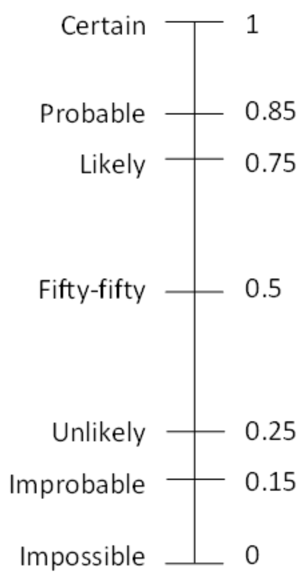
| Status | Layer | Query (if applicable) |
|---|---|---|
| **Legal – Fully Protected** | Canadian Protected and Conserved Areas Database | |
| | Conservancy Areas | |
| | FADM Designated Area (Forest Act Part 13) | Status = “Current” |
| | Greater Vancouver Water District | |
| | Local and Regional Greenspaces | |
| | Lower Seymour Conservation Reserve | |
| | Migratory Bird Sanctuaries | |
| | National Wildlife Areas | |
| | Natural Wildlands | |
| | NGO Conservation Areas - Fee Simple | |
| | Old Growth Management Areas - Legal | |
| | Private Conservation Land | Conservation Land Type = "Administered Lands" or "Reserve Lands" |
| | Provincial Parks, Eco Reserves and Protected Areas - All | |
| | Resource Management Plans (Legal) | Name = "Sea to Sky Wildland Zone" or "Nlhaxten/Cayoosh Wildland Area" |
| | Strategic Land and Resource Plans | |
| | Ungulate Winter Range - Approved | |
| | Wildlife Habitat Areas - Approved (No Harvest) | Timber Harvest Code = "No Harvest" |
| | Wildlife Management Areas | |
| **Legal – Partially Protected** | Archaeology Sites Government Users View | Registration Status = "Decision Pending", "Registry Candidate", or "Registered" |
| | Community Watershed | |
| | Fisheries Sensitive Watersheds | |
| | South Chilcotin Mountains Mining and Tourism Areas | Legal Objective = "Mining and Tourism Area" |
| | VIMS - Established Visual Quality Objective | Objective = "Preservation", "Retention", or "Partial Retention" |
| | Wildlife Habitat Areas - Approved (Conditional Harvest) | Timber Harvest Code = "Conditional Harvest" |

| Status | Layer | Query (if applicable) |
| --- | --- | --- |
| **Non-Legal** | IPCA Donut Hole | |
| | Old Growth Management Areas - Non-Legal | |
| | Old Growth Strategic Review (OGSR) - Deferral Areas | |
| | Timber Harvest Land Base (THLB) | |

## APPENDIX C: Methodology for Cost-Effectiveness Analysis

This appendix details the Cost-Effectiveness Analysis process and the equations used to determine cost-effectiveness values.

Subject Matter Experts (SMEs) use the scale below to translate their subjective estimates of the probability of successful recovery and survival with ($P_{i_1}$) and without ($P_{i_0}$) each action or set of actions($i$), as well as the probability of an action succeeding ($P_{success}$) or being taken up ($P_{uptake}$). This scale translates words of estimative probability, such as “unlikely” or “probable,” into numeric probabilities.




Success is defined as the probability the action successfully achieves its purpose given technological, methodological, or logistical limitations (e.g. the probability that the owl breeding program [Action C1] will successfully breed owls).

The probability of uptake ($P_{uptake}$) is equivalent to the odds that the action will be successfully implemented. In the above example, uptake is achieved for Action C1 if the breeding program is started and executed as intended, even if its implementation does not fully achieve the breeding program’s objectives.

The probability of success and probability of uptake are used to determine the feasibility ($F$) and benefit ($B$) of an action or set of actions.

> Feasibility ($F$) of an action or set of actions is equal to the product of its probability of uptake and success ($P_{uptake} * P_{success}$)

Benefit $(B)$ is equal to the difference between the probability of achieving the species recovery objectives if an action or set of actions is implemented and the baseline scenario without this action or set of actions ( $P_{i_1} - P_{i_0}$).

For Spotted Owl, $Pi_1$ represents the benefit of implementing all action sets collectively, while $Pi_0$ represents the benefits when all action sets are implemented except the action in question.

The resulting estimates of the feasibility $(F)$ and benefit $(B)$ of actions are then combined with data on the costs of actions $(C)$ to determine the cost effectiveness $(CE)$ of each action or set of actions. As shown in Equation One, cost-effectiveness values $(CE)$ are determined by multiplying the feasibility of an action or set of actions $(F)$ by its benefit $(B)$ and then dividing by the cost of the action or set of actions $(C)$.

$$\boldsymbol{Equation\ One}: CE_i = \frac{F_i * B_i}{C_i}$$

$$\boldsymbol{Where}: F_i = P_{uptake} * P_{success}\ and\ B_i = P_{i_1} - P_{i_0}$$

In this analysis, a single estimate of recovery and survival probability ($P_{i_1}$and $P_{i_0}$) and feasibility $(F)$ is developed through a collaborative process involving multiple SMEs rather than creating independent estimates for each SME. Additionally, this analysis exclusively examined the impact of the proposed actions on Spotted Owl recovery and survival probability and did not estimate the effect on other species.

When multiple species and/or SME estimates are considered for an action or set of actions, analysts should use the general Equation Two to calculate the overall benefit.

$$\boldsymbol{Equation\ Two}: B_i = \sum_{j=1}^{N} \frac{\sum_{k=1}^{M_j}(P_{i'jk} - P_{i_0jk})}{M_j}$$

$\boldsymbol{Where}$:

$N$ is the number of species.
$M_j$ is the number of SMEs making an independent prediction.
$P_{i'jk}$ is the probability of achieving the species' recovery objective for species $j$ if action or action set $i$ is implemented in addition to the baseline set of actions, estimated by SME $k$
$P_{i_0jk}$ is the probability of achieving the species' recovery objective for species $j$ if the baseline set of actions is implemented excluding action or action set $i$, estimated by SME $k$