# SOUTH OKANAGAN SIMILKAMEEN CONSERVATION PROGRAM
# CONSERVATION TARGETS

By

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# EXECUTIVE SUMMARY

The south Okanagan Valley is an important conservation area for both common species and species at risk, nationally in Canada and provincially in British Columbia. The area is also an important low elevation corridor from the Great Basin north to grasslands in the Thompson and Fraser drainages in British Columbia. The South Okanagan Similkameen Conservation Program (SOSCP) was established in 2000 to conserve this important landscape.

The SOSCP has focused on protecting habitat as a coarse filter surrogate for conserving species at risk. In 2000, the SOSCP established non-spatial, habitat conservation targets (in hectares) for four broad habitats within three land tenures as criteria to guide conservation actions, measure Program success and support effectiveness evaluation.

This report updates literature on setting conservation targets, summarizes past SOSCP conservation target approaches and updates conservation targets in the SOSCP study area. Key recommendations are summarized below.

1. Use 50% of the historic area of each community type as an aspirational conservation target. This approach is supported by substantial conservation literature.
2. Ensure that SOSCP planning documents, approaches and data from past projects are available to current Partners and communicated for consideration in future planning.
3. Do not use broad ecosystems to quantify conservation targets because they seriously underestimate the most impacted and "at risk" ecological communities. They may still be useful for communication.
4. Ecological communities should be used to set coarse filter conservation targets and prioritize conservation actions (provided in this report).
5. Fine filter conservation measures (i.e. species at risk site protection and other important features) and habitat connectivity need to be considered spatially when choosing among coarse filter conservation options.
6. Formal protection measures alone are not likely to achieve SOSCP conservation targets. Land and species management tools need to be used to meet conservation targets, quantified spatially and in area (ha), and evaluated for effectiveness. Dudley 2008 may be useful as a standardized rating system.
7. Spatial evaluation processes, like the one in this report, need to be automated to reduce costs and be more responsive to evaluating specific conservation measures, options and success in a timely way.
8. Conservation implementation plans should be developed for each high and moderate priority ecological community, to coordinate strategic and continuing actions among SOSCP partners. Annual evaluation is also recommended (see draft approaches in Appendix 3).

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# INTRODUCTION

The south Okanagan Valley is an important conservation area for both common species and species at risk, nationally in Canada and provincially in British Columbia (SOSCP 2000, Warman et al. 2004a, Freemark et al. 2006, Scudder 2010, World Wildlife Fund 2019). The area is also an important low elevation corridor from the Great Basin to grasslands in the Thompson and Fraser drainages in British Columbia (SOSCP 2000).

The South Okanagan Similkameen Conservation Program (SOSCP) was established in 2000 to conserve this important landscape (SOSCP 2000). The SOSCP focused on protecting habitat as a surrogate for conserving 23 nationally listed species at risk, about 1/3 of all provincially listed species at that time (SOSCP 2000). Habitat protection also conserves common species, rare ecological communities and species or habitat connectivity (SOSCP 2000, Warman et al. 2004a), if strategically placed on the landscape.

The SOSCP established non-spatial, habitat conservation targets (in hectares) for four broad habitats within three land tenures as criteria to guide conservation actions, measure Program success and support effectiveness evaluation (SOSCP 2000).

This report updates literature on setting conservation targets, summarizes target setting approaches in the South Okanagan, evaluates progress toward achieving targets and makes recommendations on priorities for additional actions.

Management targets to address threats should be examined in a separate process in the future.

# ACKNOWLEDGMENTS

We would like to thank Ted Lea and his team for developing and supporting both current and historic terrestrial ecosystem mapping in the south Okanagan. This is one of the few areas in the Province that has historic mapping. Without it, spatially explicit and quantified conservation targets, at an effective scale, could not be identified and supported scientifically using the approach taken in our report. We also thank Bryn White, SOSCP manager, for initiating this project and providing advice.

# STUDY AREA

The study area focuses on historic and current terrestrial ecosystem mapping in the South Okanagan and Lower Similkameen Valleys. It includes low elevation, threatened habitats with high numbers of species at risk. This area was chosen for setting conservation targets because it has historic mapping. Historic mapping is necessary to identify targets based on the original habitat area, rather than using current mapping, which sets targets far lower than recommended for the most threatened habitats with the greatest impacts from humans.

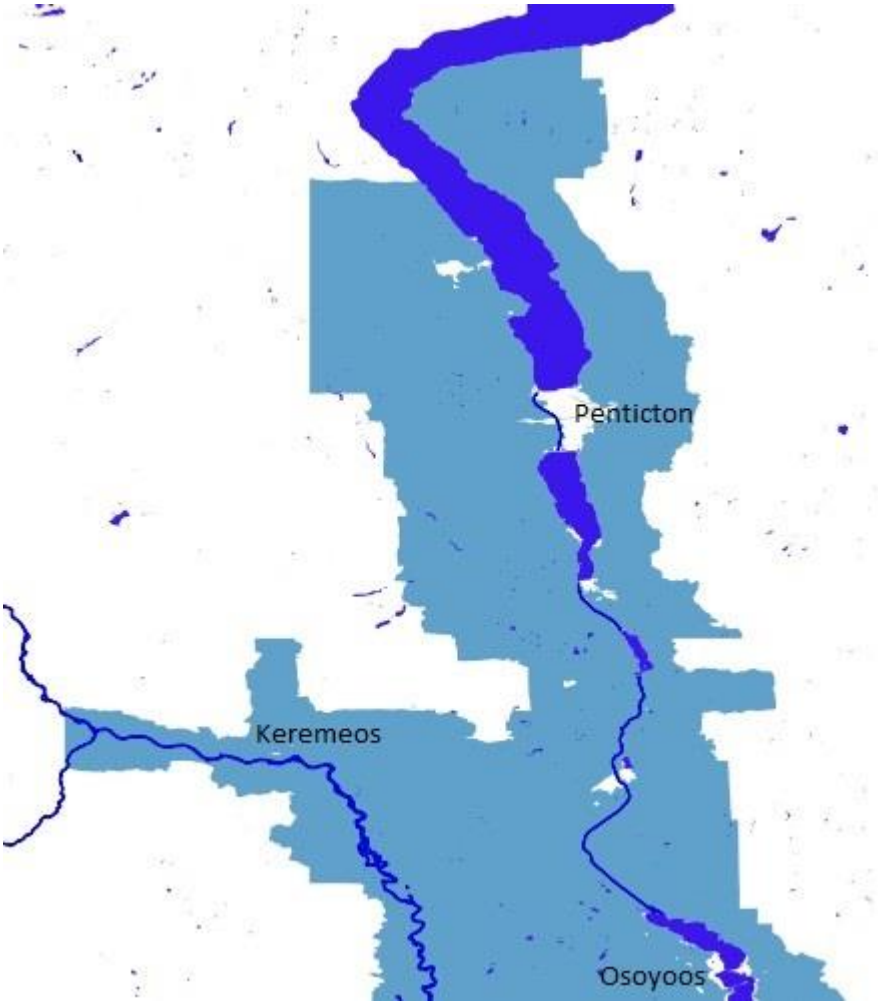


**Figure 1: Study Area**

# METHODS

Selected conservation literature was reviewed and summarized to provide a context for setting and evaluating SOSCP targets.

SOSCP approaches to setting and evaluating conservation targets were reviewed and summarized to provide a local context for developing next steps for the Program. It is also a reminder of the substantial, scientific work that is available in this area to help set supportable and sustainable targets.

Terrestrial ecosystem mapping (Iverson and Haney 2010) and associated land ownership summaries (Haney 2009) were updated to 2019 following previously used methods. This mapping was overlaid with land ownership layers using QGIS. A shapefile of Terrestrial Ecosystem Mapping with ownership was produced (this report). The data from the shapefile was summarized using a pivot table in MSExcel to produce a table of ecological communities by area in several categories of ownership and year (e.g. 1800, 2009, 2019).

Maps and data were reviewed to provide examples of implementation approaches for next steps by ecosystem, land ownership category and conservation approach.

# RESULTS AND DISCUSSION

## Summary of Selected Literature on Conservation Targets

"A conservation target is an explicit goal that quantifies the minimum amount of a particular biodiversity feature that we would like to conserve through one or several conservation actions (Possingham et al. 2006)." Setting conservation targets is an important part of a conservation strategy (Vold and Buffet 2008, Margules and Pressey 2000, Tear et al. 2005. Groves et al. 2018). Targets are aspirational, rather than legal requirements or commitments (Pressey et al. 2015). Targets can include land conservation and land management to address threats. This report only focuses on land conservation. Approaches to address threats through land management should be considered in the future.

Land conservation targets are often considered to be a coarse filter approach to ensure representation, redundancy and resilience for ecosystems and species (Tear et al. 2005). "Coarse filter approaches include the management of landscapes through a network of representative protected areas and management practices in the non-protected matrix" (Vold and Buffet 2008). A fine filter approach will also need to be developed in the future to address feature such as species at risk habitats.

Definitions of "protected area" vary. The international Union for the Conservation of Nature (IUCN) defines a protected area as: "A clearly defined geographical space, recognized, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values" (Dudley 2008). Dudley (2008) also identifies six levels of protected area ranging

from the strongest (e.g. strict nature reserve) to the weakest (e.g. sustainable use of natural resources). In British Columbia, Vold and Buffet (2008) wrote the following. "Protected area … refers to any area that has some form of protection and typically has a minimal human footprint. In B.C. that would include all federal or provincially designated parks and protected areas as well as many areas that are managed primarily for biodiversity. Examples are National Wildlife Areas, Wildlife Management Areas, riparian reserve zones, old growth management areas, wildlife habitat areas and ungulate winter ranges. Some private lands protected through acquisition or agreement would also qualify."

Margules and Pressey (2000) stated "Reserves alone are not adequate for nature conservation but they are the cornerstone on which regional strategies are built." Butchart et al. (2014) suggest conservation targets are "highly unlikely to be achieved through further designation of formal PAs (protected areas) alone. Other "effective area-based conservation measures…will be essential." Bezener et al. (2007), in the SOSCP area, stated that the target "may be achieved through a number of mechanisms including best management practices, stewardship, conservation covenants, national wildlife areas and protected areas."

Richardson (2004) summarized current literature on conservation targets by reviewing nine publications on 11 species or habitat groups. Conservation targets ranged from 20% for deciduous forest birds in Norway (Saetersdal et al. 1993) and 34% for rare taxa in Florida (Kautz & Cox, 2001) to 74% for plants in Norway (Saetersdal et al. 1993) and 75% for plants and wetland conservation in Australia's Macleay Valley floodplain (Margules et al. 1988). Richardson (2004) concluded that there was "significant evidence to suggest that 40% of the land-base is not an unreasonable estimate of what is required to maintain biodiversity" in the SOSCP study area.

Noss et al. (2012) reviewed several meta-analyses of conservation targets that examined 80 evidence-based conservation targets (e.g. Svancara et al. 2005, Schmiegelow et al. 2006). The authors stated that "scientific studies and reviews suggest that some 25–75% of a typical region must be managed with conservation of nature as a primary objective to meet goals for conserving biodiversity." They also stated that from a "precautionary perspective, 50%, slightly above the mid-point of recent evidence-based estimates, is scientifically defensible as a global target." In areas of high conservation value and ongoing development, it may be reasonable to set targets higher to incorporate fine feature elements (e.g. species and ecosystems at risk) and compensate for historic and ongoing habitat loss.

Most recent conservation planning publications now focus on conservation targets of 50% (Noss et al. 2012, Locke 2014, O'Leary et al. 2016, Wilson 2016, Dinerstein et al. 2017). This has become know as "Nature Needs Half." The approach has the following four goals (Noss and Cooperrider 1994): " (1) represent all native ecosystem types and successional stages across their natural range of variation, (2) maintain viable populations of all native species in natural patterns of abundance and distribution, (3) maintain ecological and evolutionary processes, and (4) address environmental change to maintain the evolutionary potential of lineages)."

From another perspective, Price et al. (2007) reviewed twenty papers on ecological thresholds (e.g. "points where ecological function shifts rapidly") related to abundance and extinction and came to a similar conclusion. Research suggested that species or communities began to decline when about 70% of habitat remained and started a steep linear decline at about 60% remaining habitat. They stated, "more than one-third of species or communities crossed thresholds above 50% of total habitat; nearly two-thirds reached thresholds before their habitat dropped to 30%." The authors concluded that "maintaining habitat at greater than 60% of total habitat therefore equates to low risk (i.e. a high probability that ecological integrity will be maintained)." Thresholds are often used in assessing risks due to cumulative effects.

## History of Conservation Targets in the South Okanagan

The South Okanagan Similkameen Conservation Program established non-spatial, area based (hectares), habitat conservation targets (Table 1) for four broad habitats within three land tenures (SOSCP 2000). These broad habitats were identified to protect ecosystems that supported 23 species, designated nationally by the Committee on the Status of Endangered Wildlife in Canada, and one-third of all provincially Red-listed species as of 2000 (SOSCP 2000). The targets were developed using available science, expert opinion on what might be achievable and Program consensus (McKelvey pers. comm. 2019). Targets included 44% of the SOSCP study area and were intended to be refined as better information became available (McKelvey pers. comm., 2005). These targets were also meant to measure Program success and support effectiveness evaluation (SOSCP 2000).

**Table 1 Original SOSCP Conservation Targets (2000)**

**Habitat criteria in hectares for land conservation, acquisition, and stewardship through the South Okanagan-Similkameen Conservation Program**

| Habitat | Crown Land Conservation | Private Land Acquisition | Stewardship | Total |
|---|---|---|---|---|
| Wetland/ Riparian | 1,500 | 700 | 3,000 | 5,200 |
| Grassland/ Shrub-steppe | 13,000 | 9,500 | 9,000 | 31,500 |
| Coniferous Forest | 13,000 | 500 | 10,000 | 23,500 |
| Rugged terrain | 5,800 | 800 | 3,200 | 9,800 |
| Total | 33,300 | 11,500 | 25,200 | 70,000 |

There has been a long history of science-based support and evaluation of SOSCP conservation targets. Examples are provided here to demonstrate a strong science basis for conservation decisions in the SOSCP study area and to remind planners of available data and mapping.

Warman (2002) used C-Plan software to identify the minimum area (37.2%) necessary to conserve a suite of 29 threatened species in the South Okanagan Valley of British

Columbia. These target areas are available spatially at a fine scale (e.g. 1: 20,000).

Warman et al. (2004b) identified minimum sets and irreplaceable sets of conservation reserves for a suite of 29 threatened vertebrates in the South Okanagan at three scales. Their work suggested studies using only one scale should be used cautiously, as different scales have difference advantages.

Richardson (2004) summarized current literature on conservation targets by reviewing nine publications on 11 species or habitat groups. Conservation targets ranged from 20% for deciduous forest birds in Norway (Saetersdal et al. 1993) and 34% for rare taxa in Florida (Kautz & Cox, 2001) to 74% for plants in Norway (Saetersdal et al. 1993) and 75% for plants and wetland conservation in Australia's Macleay Valley floodplain (Margules et al. 1988). Richardson (2004) concluded that there was "significant evidence to suggest that 40% of the land-base is not an unreasonable estimate of what is required to maintain biodiversity" in the SOSCP study area.

In 2005, the SOSCP Science Team identified a science-based target of managing a minimum of 40% of the historic area of each ecological community in a relatively natural condition within the SOSCP area (Bezener et al. 2005).

Dyer et al. (2005) used data from Lea (2008) to quantify a target of 40% of the historic area for each ecological community in the study area, based on terrestrial ecosystem mapping for 1800. Terrestrial ecosystem mapping from 2005 (Lea 2008) was overlaid with ownership layers using ArcGIS to quantify existing conservation land protection. Protection levels were ranked to clearly identify ecological communities that did not require additional protection (e.g. >40% protected) and prioritize ecological communities that required additional protection or restoration to achieve the conservation target. The data suggested that targets implemented at the broad habitat scale (e.g. riparian/wetland) were likely to underestimate requirements for the most impacted ecological communities (e.g. Water-birch roses with only 8% remaining, Lea 2008). Therefore, targets should be set at the ecological community scale, when data is available (e.g. South Okanagan) or for multiple scales (e.g. ecological communities and broad ecosystems).

Bezener et al. (2006) summarized the SOSCP's approach to implementing conservation targets including a general discussion of management approaches to address threats. In summary, achieving conservation goals "will require the recovery and maintenance of defined populations of numerous species, including but not limited to species at risk, and their required habitats in sufficient quantity, condition, and configuration to ensure their long-term persistence" Bezener et al. (2006).

The Nature Conservancy (Pryce et al. 2006) developed abundance and spatial distribution goals needed to adequately conserve 430 ecosystem and species conservation targets in the Okanagan Ecoregion. The Okanagan Ecoregion includes a large area (e.g. 9,605,000 ha) from north-central Washington State to south-central British Columbia. The authors used Marxan software to select an optimal portfolio of priority conservation areas that would address the combined goals for all targets. This included portfolios for terrestrial and freshwater systems covering 32% and 34% of the Ecoregion, respectively. These portfolios have a 14% overlap, suggesting an overall target of 52% of the Ecoregion.

Priority Conservation Areas were identified at coarse and fine scales and are available spatially. The authors reported that 23% of the terrestrial portfolio and 14% of the freshwater portfolio occur in designated protected areas.

Dyer (2008) assigned numerical values to ecological communities from Dyer et al. (2005) and for species at risk, then overlaid ecological community maps and species records with private land lots. Each lot polygon was populated with rank data for communities and species. This produced an Arcmap shapefile with individual values, and combinations of additive ecosystem and species values, that could be queried to display relative priorities for private land stewardship for acquisition from willing owners.

Terrestrial ecosystem mapping standards changed in 2009 for some ecological communities (Iverson and Haney 2010). Haney (2009) recalculated targets and percentages of conservation protection for each ecological community using updated TEM communities.

The SOSCP produced Keeping Nature in Our Future: A Biodiversity Conservation Strategy for the South Okanagan Similkameen, in 2012 (SOSCP 2012). This document spatially identified priority habitats for the entire South Okanagan Regional District but did not quantify specific targets. “Approximately 13% of the study area falls within lands designated as parks, with most of this consisting of provincial parks and protected areas. Municipal, regional, and provincial parks and protected areas together protect 22.6% of the region's very high and high biodiversity habitats (SOSCP 2012). Connectivity maps were also included.

Latimer and Peatt (2014) summarized reasons for maintaining connectivity, planning options and examples for the SOSCP study area.

Haney updated terrestrial ecosystem mapping to 2019 and recalculated loss and ownership categories for 2009 and 2019 (this document).

Critical habitat was identified spatially in recovery strategies for several federally listed, threatened and endangered, species (Government of Canada 2019)

## SOSCP Broad Ecosystem Targets (2019)

Table 2 shows 2019 SOSCP conservation targets (e.g. 50% of the historic area of each broad ecosystem). SOSCP broad ecosystem conservation targets are achievable, based on ecosystem availability in 2019.

**Table 2 SOSCP broad ecosystem conservation targets 2019**

| SOSCP Broad Ecosystem | SOSCP historic area (1800 in ha) | SOSCP conservation target (50% of historic area in ha) | SOSCP current area (2019 in ha) |
|---|---|---|---|
| **Weland/Riparian** | 15551 | 7775 | 8290 |
| **Grassland/Shrub-steppe** | 51355 | 25678 | 36790 |
| **Coniferous Forest** | 56708 | 28354 | 53142 |
| **Rugged Terrain** | 19721 | 9860 | 19346 |
| **Total** | **143335** | **71667** | **117568** |

Table 3 shows formal protection and options for additional protection by land tenure for each SOSCP broad ecosystem in 2019.

**Table 3: SOSCP broad ecosystem target achievement (2019) and future options**

| 2019 | SOSCP 2019 Target (ha) | Crown/Private Conservation Lands (ha) | Remaining Crown (ha) | Remaining Private (ha) | Remaining IR (ha) | Total (ha) |
|---|---|---|---|---|---|---|
| **Weland/Riparian** | 7775 | 1978 | 1710 | 2441 | 2161 | 8290 |
| **Grassland/Shrub-steppe** | 25678 | 8594 | 6484 | 11088 | 10624 | 36790 |
| **Coniferous Forest** | 28354 | 12066 | 16769 | 9612 | 14696 | 53142 |
| **Rugged Terrain** | 9860 | 6411 | 5021 | 3682 | 4231 | 19346 |
| **Total** | 71667 | 29049 | 29984 | 26822 | 31712 | 117567 |

Table 4 shows trends in SOSCP formal protection over time in 2009 and 2019. Formal land protection has increased in all broad ecosystems in both Crown and Private conservancies over the last decade. There was a 21% increase in formal conservation between 2009 and 2019, largely due to a 69% increase in private conservation land.

**Table 4: SOSCP formal land protection over time in 2009 and 2019 in hectares**

| | Crown Conservation 2009 | Crown Conservation 2019 | Private Conservation 2009 | Private Conservation 2019 | Total Conservation 2009 | Total Conservation 2019 |
|---|---|---|---|---|---|---|
| **Weland/Riparian** | 1348 | 1614 | 203 | 365 | 1551 | 1978 |
| **Grassland/Shrub-steppe** | 6414 | 6955 | 507 | 1639 | 6921 | 8594 |
| **Coniferous Forest** | 9254 | 11270 | 785 | 795 | 10039 | 12066 |
| **Rugged Terrain** | 5096 | 5862 | 481 | 549 | 5577 | 6411 |
| **Total** | 22111 | 25701 | 1976 | 3348 | 24087 | 29049 |

Current formal protection includes National Wildlife Areas, National Research Council, Provincial Parks, Protected Areas, Ecological Reserves, Wildlife Management Areas and Private Conservancies (e.g. The Nature Trust, The Nature Conservancy) where the primary management goal is conservation for a long term (e.g. in perpetuity or the foreseeable future).

Formal protection for Wetland/Riparian is 1978 ha (25% of the SOSCP target). Additional protection for 5797 ha needs to be implemented to achieve the target. Remaining habitat options to achieve additional protection are available, totalling 6311 ha (Table 3), but conservation measures would need to be implemented to protect nearly all Wetland/Riparian on all three land types (e.g. Crown, Private, IR). Conservation options for Wetland/Riparian are more limited than other broad ecosystems (e.g. the SOSCP target is 94% of available habitat).

Formal protection for Grassland/Shrub-steppe is 8594 ha (33% of the SOSCP target). Additional protection for 17084 ha is required to achieve the target. Habitat is available to meet the additional target requirement (28196 ha). Crown land has 6484 ha of unprotected Grassland/Shrub-steppe (38% of the unprotected target). Private land and IR have 11088 ha and 10624 ha of Grassland/Shrub-steppe, respectively, that are not in formal conservation areas.

Formal protection for Coniferous Forest is 12066 ha (43% of the SOSCP target).

Additional protection for 16288 ha is required to achieve the target. Habitat is available to meet the additional target requirement (41076 ha). Crown land has 16769ha of unprotected Coniferous Forest (>100% of the unprotected target). Private land and IR have 9612 ha and 14696 ha of Coniferous Forest, respectively, that are not in formal conservation areas. Although the target could be achieved solely by protecting Crown land, spatial connectivity and fine filter issues (e.g. species at risk, rare ecosystems and other special features) should be considered when picking additional areas to meet the target.

Formal protection for Rugged Terrain is 6411 ha (65% of the SOSCP target). Additional protection for 3449 ha is required to achieve the target. Habitat is available to meet the additional target requirement (12934 ha). Crown land has 5021 ha of unprotected Rugged Terrain (>100% of the unprotected target). Private land and IR have 3682 ha and 4231 ha of Rugged Terrain, respectively, that are not in formal conservation areas. Although the target could be achieved solely by protecting Crown land, spatial connectivity and fine filter issues (e.g. species at risk, rare ecosystems and other special features) should be considered when picking additional areas to meet the target.

Formal protection alone is unlikely to achieve the above conservation targets. Formal protection actions (e.g. parks, private conservation lands) should be continued to contribute to the targets and form core areas for conservation. However, effective management practices in the non-protected matrix need to be quantified to clarify options and achieve the target. For example, the Water Sustainability Act, Riparian Areas Regulation, Community Watersheds, Stewardship Agreements, critical habitat for species at risk, and some local government parks provide various degrees of protection for various time frames. Broad ecosystem targets are theoretically achievable at this scale, if effective management actions can be established to eliminate or reduce losses on tenures that are not formally protected. These types of management protection have not been quantified in this report or rated for effectiveness. In the future, attempts should be made to clarify SOSCP expectations regarding management levels that can effectively contribute to target achievement and attempt to quantify them spatially. Dudley (2008) may be useful in providing a standardized ranking approach.

As mentioned above, Warman et al. (2004b) suggested that single scale conservation planning should be considered carefully, since different scales have different uses. Also, Dyer et al. (2005) demonstrated that SOSCP broad scale ecosystems tend to seriously mask and underestimate targets for the most threatened ecological communities in the South Okanagan Valley.

As an example, targets implemented at the broad habitat scale for Wetland/Riparian appear to be achievable. However, 89% of the Water birch – dogwood ecological community, a component of Wetland/Riparian, has been destroyed by development so the 50% target cannot be achieved without complete protection of remaining habitat and restoration of an additional 2146 ha, which is not possible, given current land uses.

Broad ecosystem targets can be misleading for setting conservation targets, but provide a simpler communication tool, so may still have benefits. However, the authors recommended using Terrestrial Ecosystem mapping for target setting and development of

priority conservation actions.

## SOSCP Ecological Community Targets (2019)

Appendix 1 shows SOSCP ecological community conservation targets (e.g. 50% of historic area) sorted by priority (e.g. restoration required, and percent protected) within broad ecosystem groups. Appendix 2 shows SOSCP ecological community conservation targets sorted by priority (e.g. restoration required, risk represented by historic loss, level of protection). Several similar ecological communities were lumped together into one wetland community. Several communities also were lumped together into a single rugged terrain community. It may be necessary to separate these ecological communities in the future. Twenty-seven (27) ecological communities have conservation targets within the four broad SOSCP ecosystem categories.

Four of 27 ecological communities have been impacted by development to a point where the SOSCP conservation targets are not achievable without restoration: Water Birch – Dogwood swamp, Antelope-brush – Needle and thread grass, Sagebrush – Needle and thread grass, Ponderosa pine – Antelope-brush. These habitats have sustained >50% loss of historic area. This puts them into a high risk category, based on ecological thresholds (Price et al. 2007). They are the most threatened terrestrial ecological communities in the study area and should be considered the highest priorities for conservation. Conservation efforts should focus on protecting all remaining ecosystem areas, restoring habitat where possible, improving management to maximize ecosystem function and increasing conservation targets for surrogate habitats where possible.

Three ecological communities have had between 30% and 50% destruction of historic area: Cottonwood - dogwood floodplain, Sage wheatgrass, Wetlands. This puts them into a moderate risk category, based on ecological thresholds (Price et al. 2007). Rates of target protection are low for Cottonwood (8%), increasing its priority, but higher for Sage wheatgrass (31%) and wetlands (37%).

Thirteen ecological communities have had <30% habitat loss: Pine - saskatoon fan, Beach, Pine – sumac, Pine – wheatgrass, Wheatgrass selaginella, Fescue – wheatgrass, Doug-fir/pine - snowberry – pinegrass, Pine – fescue, Douglas-fir – wheatgrass, Douglas-fir/pine – pinegrass, Pine - rose - poison ivy, Pine – cheatgrass, Aspen copse or gully. These communities are in a low risk category, based on ecological thresholds (Price et al. 2007). Rates of protection range from 0% of the target, for Pine - saskatoon fan, to 49% of the target, for Aspen copse or gully, providing an additional method of ranking priority.

The seven remaining ecological communities have <4% habitat loss, so appear to be at very low risk: Wheatgrass balsamroot, Pine - three-awn, Pine – bluebunch, Spruce - D-fir - maple – dogwood, Rocky Habitats, Douglas-fir/pine - snowberry – spirea, Douglas-fir – maple. They currently do not appear to require additional formal protection and likely can be effectively protected through management tools. Fine scale features within these ecosystems (e.g. old growth trees, snake dens) may still require management attention and impacts of catastrophic wildfire should be considered in the future.

Conservation implementation plans should be developed for each high and moderate

priority ecological community, to coordinate strategic and continuing actions among SOSCP partners. Annual evaluation is also recommended (draft examples included in Appendix 3).

## RECOMMENDATIONS

1. Use 50% of the historic area of each community type as an aspirational conservation target. This approach is supported by substantial conservation literature.
2. Ensure that SOSCP planning documents, approaches and data from past projects are available to current Partners and communicated for consideration in future planning.
3. Do not use broad ecosystems to quantify conservation targets because they seriously underestimate the most impacted and "at risk" ecological communities. They may still be useful for communication.
4. Ecological communities should be used to set coarse filter conservation targets and prioritize conservation actions (provided in this report).
5. Fine filter conservation measures (i.e. species at risk site protection and other important features) and habitat connectivity need to be considered spatially when choosing among coarse filter conservation options.
6. Formal protection measures alone are not likely to achieve SOSCP conservation targets. Land and species management tools need to be used to meet conservation targets, quantified spatially and in area (ha), and evaluated for effectiveness. Dudley 2008 may be useful as a standardized rating system.
7. Spatial evaluation processes, like the one in this report, need to be automated to reduce costs and be more responsive to evaluating specific conservation measures, options and success in a timely way.
8. Conservation implementation plans should be developed for each high and moderate priority ecological community, to coordinate strategic and continuing actions among SOSCP partners. Annual evaluation is also recommended (see draft approaches in Appendix 3).

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# APPENDICES

## Appendix 1: SOSCP 2019 Ecological Community Conservation Targets sorted by Broad Ecosystems, in Hectares

| SOSCP Broad Ecosystem | Ecological Community | Historic area before habitat loss (ha) | SOSCP target: 50% of historic area (ha) | Area remaining in 2019 (ha) | % of historic area remaining in 2019 (ha) | Area protected 2019 (ha) | % of target protected in 2019 | Target remaining in 2019 (ha) | Options remaining in 2019 (ha) | Target Achievable ? | Area of target unprotected (ha) | Minimum Restoration required (ha) | Options remaining on Crown (ha) | Options remaining on Private (ha) | Options remaining on IR (ha) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Weland/Riparian** | Birch - dogwood swamp | 5560 | 2780 | 634 | **11%** | 131 | 5% | 2649 | 503 | No | 2649 | 2146 | 129 | 167 | 208 |
| | Cottonwood - dogwood floodplain | 3696 | 1848 | 2147 | 58% | 157 | 8% | 1691 | 1990 | Yes | 1691 | | 403 | 637 | 950 |
| | Beach | 64 | 32 | 65 | 102% | 3 | 10% | 28 | 62 | Yes | 28 | | 16 | 30 | 16 |
| | Wetlands | 1514 | 757 | 987 | 65% | 280 | 37% | 477 | 707 | Yes | 477 | | 183 | 317 | 208 |
| | Aspen copse or gully | 1847 | 923 | 1663 | 90% | 454 | 49% | 470 | 1210 | Yes | 470 | | 269 | 715 | 225 |
| | Spruce - D-fir - maple - dogwood | 1708 | 854 | 1677 | 98% | 551 | 64% | 303 | 1126 | Yes | 303 | | 596 | 244 | 287 |
| | Douglas-fir - maple | 1162 | 581 | 1116 | 96% | 403 | 69% | 177 | 713 | Yes | 177 | | 115 | 332 | 267 |
| **Grassland/Shrub-steppe** | Antelope-brush - needle-and-thread | 9801 | 4900 | 3129 | **32%** | 653 | 13% | 4247 | 2475 | No | 4247 | 1772 | 170 | 566 | 1740 |
| | Sage - needle-and-thread | 4838 | 2419 | 2057 | **43%** | 410 | 17% | 2009 | 1647 | No | 2009 | 362 | 163 | 679 | 805 |
| | Wheatgrass selaginella | 1915 | 957 | 1870 | 98% | 207 | 22% | 751 | 1663 | Yes | 751 | | 192 | 476 | 996 |
| | Sage wheatgrass | 8283 | 4142 | 5362 | 65% | 1278 | 31% | 2864 | 4083 | Yes | 2864 | | 616 | 1884 | 1583 |
| | Fescue - wheatgrass | 10737 | 5369 | 8881 | 83% | 1665 | 31% | 3703 | 7215 | Yes | 3703 | | 1752 | 2971 | 2493 |
| | Wheatgrass balsamroot | 15782 | 7891 | 15492 | 98% | 4381 | 56% | 3510 | 11111 | Yes | 3510 | | 3591 | 4513 | 3008 |
| **Coniferous Forest** | Pine - antelope-brush | 1652 | 826 | 816 | **49%** | 251 | 30% | 575 | 565 | No | 575 | 11 | 100 | 200 | 265 |
| | Pine - saskatoon fan | 38 | 19 | 30 | 79% | 0 | 0% | 19 | 30 | Yes | 19 | | 7 | 9 | 14 |
| | Pine - sumac | 178 | 89 | 173 | 97% | 11 | 12% | 78 | 162 | Yes | 78 | | 3 | 10 | 150 |
| | Pine - wheatgrass | 7206 | 3603 | 5318 | 74% | 663 | 18% | 2940 | 4655 | Yes | 2940 | | 1268 | 1556 | 1831 |
| | Doug-fir/pine - snowberry - pinegrass | 3703 | 1852 | 3709 | 100% | 598 | 32% | 1253 | 3110 | Yes | 1253 | | 1477 | 472 | 1161 |
| | Pine - fescue | 4070 | 2035 | 4039 | 99% | 680 | 33% | 1355 | 3359 | Yes | 1355 | | 640 | 1042 | 1676 |
| | Douglas-fir - wheatgrass | 8902 | 4451 | 8855 | 99% | 1627 | 37% | 2823 | 7227 | Yes | 2823 | | 4063 | 799 | 2365 |
| | Douglas-fir/pine - pinegrass | 6174 | 3087 | 6021 | 98% | 1158 | 38% | 1929 | 4863 | Yes | 1929 | | 2655 | 854 | 1355 |
| | Pine - rose - poison ivy | 100 | 50 | 96 | 96% | 20 | 39% | 30 | 76 | Yes | 30 | | 4 | 34 | 37 |
| | Pine - cheatgrass | 5969 | 2984 | 5871 | 98% | 1219 | 41% | 1765 | 4651 | Yes | 1765 | | 1287 | 1587 | 1777 |
| | Pine - three-awn | 8879 | 4440 | 8598 | 97% | 2603 | 59% | 1836 | 5994 | Yes | 1836 | | 1673 | 1979 | 2341 |
| | Pine - bluebunch | 5808 | 2904 | 5732 | 99% | 1854 | 64% | 1050 | 3878 | Yes | 1050 | | 2502 | 363 | 1013 |
| | Douglas-fir/pine - snowberry - spirea | 4028 | 2014 | 3887 | 96% | 1381 | 69% | 633 | 2506 | Yes | 633 | | 1088 | 708 | 710 |
| **Rugged Terrain** | Rocky Habitats | 19721 | 9860 | 19346 | 98% | 6411 | 65% | 3449 | 12934 | Yes | 3449 | | 5021 | 3682 | 4231 |
| | **Total** | 143335 | 71667 | 117568 | | 29049 | | 42618 | 88518 | | 42618 | 4290 | 29984 | 26822 | 31712 |

Note that Beach appears to have increased in habitat area. This is due to increased effort in mapping beach habitats and mapping them in finer detail, because of its importance to several plants at risk. The result is finer scale mapping in recent years that does not correspond to the level of mapping for historic habitats. Beach habitat has not increased and most Beach habitat is too small to map using terrestrial ecosystem mapping.

# Appendix 2: SOSCP 2019 Ecological Community Conservation Targets sorted by Conservation Priority, in Hectares

| Priority | Ecological Community | SOSCP Broad Ecosystem | Historic area before habitat loss (ha) | SOSCP target: 50% of historic area (ha) | Area remaining in 2019 (ha) | % of historic area remaining in 2019 (ha) | Area protected 2019 (ha) | % of target protected in 2019 | Target remaining in 2019 (ha) | Options remaining in 2019 (ha) | Target Achievable ? | Area of target unprotected (ha) | Minimum Restoration required (ha) | Options remaining on Crown (ha) | Options remaining on Private (ha) | Options remaining on IR (ha) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | **Birch - dogwood swamp** | Weland/Riparian | 5560 | 2780 | 634 | **11%** | 131 | 5% | 2649 | 503 | No | 2649 | 2146 | 129 | 167 | 208 |
| 2 | **Antelope-brush - needle-and-thread** | Grassland/Shrub-steppe | 9801 | 4900 | 3129 | **32%** | 653 | 13% | 4247 | 2475 | No | 4247 | 1772 | 170 | 566 | 1740 |
| 3 | **Sage - needle-and-thread** | Grassland/Shrub-steppe | 4838 | 2419 | 2057 | **43%** | 410 | 17% | 2009 | 1647 | No | 2009 | 362 | 163 | 679 | 805 |
| 4 | **Pine - antelope-brush** | Coniferous Forest | 1652 | 826 | 816 | **49%** | 251 | 30% | 575 | 565 | No | 575 | 11 | 100 | 200 | 265 |
| 5 | **Cottonwood - dogwood floodplain** | Weland/Riparian | 3696 | 1848 | 2147 | 58% | 157 | 8% | 1691 | 1990 | Yes | 1691 | | 403 | 637 | 950 |
| 6 | **Sage wheatgrass** | Grassland/Shrub-steppe | 8283 | 4142 | 5362 | 65% | 1278 | 31% | 2864 | 4083 | Yes | 2864 | | 616 | 1884 | 1583 |
| 7 | **Wetlands** | Weland/Riparian | 1514 | 757 | 987 | 65% | 280 | 37% | 477 | 707 | Yes | 477 | | 183 | 317 | 208 |
| 8 | **Pine - saskatoon fan** | Coniferous Forest | 38 | 19 | 30 | 79% | 0 | 0% | 19 | 30 | Yes | 19 | | 7 | 9 | 14 |
| 9 | **Beach** | Weland/Riparian | 64 | 32 | 65 | 102% | 3 | 10% | 28 | 62 | Yes | 28 | | 16 | 30 | 16 |
| 10 | **Pine - sumac** | Coniferous Forest | 178 | 89 | 173 | 97% | 11 | 12% | 78 | 162 | Yes | 78 | | 3 | 10 | 150 |
| 11 | **Pine - wheatgrass** | Coniferous Forest | 7206 | 3603 | 5318 | 74% | 663 | 18% | 2940 | 4655 | Yes | 2940 | | 1268 | 1556 | 1831 |
| 12 | **Wheatgrass selaginella** | Grassland/Shrub-steppe | 1915 | 957 | 1870 | 98% | 207 | 22% | 751 | 1663 | Yes | 751 | | 192 | 476 | 996 |
| 13 | **Fescue - wheatgrass** | Grassland/Shrub-steppe | 10737 | 5369 | 8881 | 83% | 1665 | 31% | 3703 | 7215 | Yes | 3703 | | 1752 | 2971 | 2493 |
| 14 | **Doug-fir/pine - snowberry - pinegrass** | Coniferous Forest | 3703 | 1852 | 3709 | 100% | 598 | 32% | 1253 | 3110 | Yes | 1253 | | 1477 | 472 | 1161 |
| 15 | **Pine - fescue** | Coniferous Forest | 4070 | 2035 | 4039 | 99% | 680 | 33% | 1355 | 3359 | Yes | 1355 | | 640 | 1042 | 1676 |
| 16 | **Douglas-fir - wheatgrass** | Coniferous Forest | 8902 | 4451 | 8855 | 99% | 1627 | 37% | 2823 | 7227 | Yes | 2823 | | 4063 | 799 | 2365 |
| 17 | **Douglas-fir/pine - pinegrass** | Coniferous Forest | 6174 | 3087 | 6021 | 98% | 1158 | 38% | 1929 | 4863 | Yes | 1929 | | 2655 | 854 | 1355 |
| 18 | **Pine - rose - poison ivy** | Coniferous Forest | 100 | 50 | 96 | 96% | 20 | 39% | 30 | 76 | Yes | 30 | | 4 | 34 | 37 |
| 19 | **Pine - cheatgrass** | Coniferous Forest | 5969 | 2984 | 5871 | 98% | 1219 | 41% | 1765 | 4651 | Yes | 1765 | | 1287 | 1587 | 1777 |
| 20 | **Aspen copse or gully** | Weland/Riparian | 1847 | 923 | 1663 | 90% | 454 | 49% | 470 | 1210 | Yes | 470 | | 269 | 715 | 225 |
| 21 | **Wheatgrass balsamroot** | Grassland/Shrub-steppe | 15782 | 7891 | 15492 | 98% | 4381 | 56% | 3510 | 11111 | Yes | 3510 | | 3591 | 4513 | 3008 |
| 22 | **Pine - three-awn** | Coniferous Forest | 8879 | 4440 | 8598 | 97% | 2603 | 59% | 1836 | 5994 | Yes | 1836 | | 1673 | 1979 | 2341 |
| 23 | **Pine - bluebunch** | Coniferous Forest | 5808 | 2904 | 5732 | 99% | 1854 | 64% | 1050 | 3878 | Yes | 1050 | | 2502 | 363 | 1013 |
| 24 | **Spruce - D-fir - maple - dogwood** | Weland/Riparian | 1708 | 854 | 1677 | 98% | 551 | 64% | 303 | 1126 | Yes | 303 | | 596 | 244 | 287 |
| 25 | **Rocky Habitats** | Rugged Terrain | 19721 | 9860 | 19346 | 98% | 6411 | 65% | 3449 | 12934 | Yes | 3449 | | 5021 | 3682 | 4231 |
| 26 | **Douglas-fir/pine - snowberry - spirea** | Coniferous Forest | 4028 | 2014 | 3887 | 96% | 1381 | 69% | 633 | 2506 | Yes | 633 | | 1088 | 708 | 710 |
| 27 | **Douglas-fir - maple** | Weland/Riparian | 1162 | 581 | 1116 | 96% | 403 | 69% | 177 | 713 | Yes | 177 | | 115 | 332 | 267 |
| | **Total** | | 143335 | 71667 | 117568 | | 29049 | | 42618 | 88518 | | 42618 | 4290 | 29984 | 26822 | 31712 |

# Appendix 3: Example Conservation Approaches for Ecological Communities

## Wetland/Riparian

The South Okanagan Wetland/Riparian broad ecosystem totalled 15,551 ha in 1800. In 2019, 8290 ha remain (53% of the original area). It is the most impacted terrestrial broad ecosystem in the South Okanagan.

This report differs from previous reports because different combinations of habitat types and different study areas were used. Sarell (1990) reported that 85% of low elevation wetlands/riparian between Vaseux Lake and Osoyoos Lake had been lost to development, including oxbows, marshes and riparian woodlands. Lea (2008) reported that low elevation wetlands (including marsh, shrub swamp, meadow, shallow open water) in the Okanagan Valley from Vernon to the U.S. border had an 84% loss since European contact.

The Wetland/Riparian broad ecosystem is a combination of wetland ecosystems and riparian ecosystems, which have very different characteristics and associated species. Each broad ecosystem should have separate strategies that should include targets and actions for each of their component ecological communities.

**Wetlands**

Wetlands in this report include Alkaline Pond, Nuttall's alkaligrass – Foxtail barley graminoid meadow, Bulrush Marsh, Silverweed – Bulrush marsh, Cattail Marsh, Summer-cypress – bentgrass meadow, Cattail Marsh, Open Water, and Sedge Marsh.

Future analyses can consider separating these ecological communities because they have different characteristics, different species associations and different rates of habitat loss. For example, Dyer et al. (2005) reported that 43%, 69% and 92% of Silverweed – Bulrush marsh, Cattail Marsh, and Open Water, respectively, remained in 2005. Note that "Open Water" also included new wetlands (e.g. oxbows) created by Okanagan River channelization (Dyer et al. 2005).

Wetland ecosystems totalled 1514 ha in 1800 and now total 987 ha (65 % of the historic area) in 2019. The SOSCP conservation target is 757 ha. And is achievable with currently available habitat. However, it should be noted that wetlands are legally protected under the Water Sustainability Act (Government of BC 2014), so the legal protection target is 100% or equivalent to the existing 987 ha.

Wetland habitats have legal protection from destruction without authorization through the Water Sustainability Act (Government of BC 2014). The Species at Risk Act (SARA) (Government of Canada 2002) provides protection of many wetlands on federal land as part of identified critical habitat for threatened and endangered species (e.g. Blotched Tiger Salamander, Great Basin Spadefoot) (Government of Canada 2019).

Despite this legal protection, and previous protection under the Water Act (Government of BC 1979), South Okanagan wetlands continue to be lost due to habitat destruction

(Harrison and Moore 2013). The authors reported that 38% of low elevation (<1000m) wetlands in their study, between Peachland and the U.S. border, were converted or impacted in some way between 1988 and 2010. The losses were mainly due to agriculture "via drainage or water extraction for hay production." The authors suggested there is no reason to believe wetland loss has ceased. The same conclusion is drawn by Haney (this report), who recorded a wetland loss of 39 ha (from 1026 to 987 ha) between 2009 and 2019, a loss of 4% over 10 years. Shallow, small wetlands on private land are more vulnerable than other wetlands, due to decreased visibility, especially during drought years, and are easier to fill (O. Dyer, personal observation).

Previous conservation projects prioritized improving stewardship on spatially identified high priority wetlands including wetlands <1ha (highly productive and more at risk due to greater vulnerability to infilling), and sites with known species at risk locations (e.g. Great Basin Spadefoot, Blotched Tiger Salamander, small flowered lipocarpha, short-rayed aster, scarlet ammania toothcup, annual paintbrush). Projects include the Okanagan Puddle Project (2002), Draft Wetland Infill Response Protocol (White 2007), Stewardship Communications and Landowner contact (Ashpole 2018 and ongoing projects), Ecosystems Program: Qualified Professional Workshops, Pesticide Outreach Project (O. Dyer pers. comm), Guidance for Foreshore Plants in the Okanagan, Okanagan Wetlands Strategy (Ecoscape 2014) and formal habitat protection (e.g. BC Parks, NCC, TNT). Ashpole et al. (2018) strategically restored wetlands in locations where population connectivity for amphibians had been impaired. Few, if any, of these projects have maintained effective continuity or long-term effective protection.

Future actions should resurrect, strengthen, build on and support past and current projects, rather than reinventing another approach. Since legal protection is in place, efforts should focus on informing and reminding stewards of legal regulations, monitoring potential impacts at high priority/high risk sites (e.g. wetlands <1ha and sites with species at risk records on private land within the Agricultural Land Reserve), supporting enforcement of existing laws (White 2007), and mitigating impacts (e.g. cattle and ATV damage) at priority sites. Actions should also continue to include habitat acquisition of priority sites that are at high risk on private land, to address expectations of continued illegal infilling.

Recommendations:

- Develop and share a spatially explicit map of priority sites (e.g. wetlands <1ha and sites with species at risk records on private land within the Agricultural land reserve).
- Implement recommendations in White 2007 by developing and following a written strategy and annual implementation plan that includes coordinated and sustained stewardship/outreach, enforcement, evaluation and land securement. Utilize past and existing partnerships (e.g. South Okanagan Similkameen Stewardship Society (SOSS); Okanagan Similkameen Conservation Alliance (OSCA), Environmental Farm Plan, Ducks Unlimited, Provincial Government (Ecosystems Program, Pesticide Program, Conservation Officer Service), Okanagan Water Board, Local Government).

## Riparian

Riparian areas include Aspen copse or gully, Birch – dogwood swamp (now called Waterbirch – Roses), Beach, Cottonwood – dogwood floodplain, Douglas-fir – maple, and Spruce – Douglas fir – maple – dogwood.

Riparian ecosystems totalled 14036 ha in 1800 and now total 7303 ha (52 % of the historic area) in 2019. The SOSCP conservation target is 7018 ha and is achievable with currently available habitat at this scale. However, riparian communities have been impacted by development to varying degrees and require conservation targets at a finer scale (Table 5).

**Table 5: Habitat areas and targets for riparian ecological communities**

| Ecosystem | SOK 1800 (ha) | SOSCP target (50% of historic area) | SOK 2009 (ha) | SOK 2019 (ha) | % of Historic left in 2019 |
|---|---|---|---|---|---|
| Birch - dogwood swamp | 5560 | 2780 | 730 | 634 | 11% |
| Cottonwood - dogwood floodplain | 3696 | 1848 | 2368 | 2147 | 58% |
| Aspen copse or gully | 1847 | 923 | 1681 | 1663 | 90% |
| Douglas-fir - maple | 1162 | 581 | 1126 | 1116 | 96% |
| Spruce - D-fir - maple - dogwood | 1708 | 854 | 1679 | 1677 | 98% |
| Beach | 64 | 32 | 70 | 65 | 102% |
| Total | 14036 | 7018 | 7654 | 7303 | |

**Water birch – dogwood swamp (Water birch – Roses)**

Water birch – dogwood swamp, now known as Water birch – Roses, is a critically imperiled (S2) – red listed plant community in British Columbia (BC Conservation Data Centre 2019). This community is the main habitat used by Yellow-breasted Chat (*auricollis* ssp), listed by SARA as Endangered in Canada. It is one of four high priority ecosystems identified in Appendix 2 because of high habitat loss, requirement for restoration and low levels of formal protection.

In our study area, 89% of this habitat has been lost. Ninety-six ha (~2% of the original total) was lost in the last decade, between 2009 and 2019 (Haney, this report), demonstrating that habitat loss continues. The SOSCP target of 2780 ha cannot be achieved by protecting the current 634 ha that remain (11% of the original area). If all 634 ha of remaining habitat is protected, an additional 2146 ha would need to be restored to meet the target. One hundred and thirty-one (131) ha are protected. Unprotected habitat remains on Crown (129 ha), Private (167 ha) and IR (208 ha).

Riparian habitats have some legal protection through the Riparian Areas Regulation (RAR) (Government of British Columbia 2004a). “The Regulation applies to riparian fish habitat only in association with new residential, commercial and industrial development on land under local government jurisdiction” (Government of British Columbia 2004b). The RAR uses qualified professionals to identify a streamside protection and enhancement area (SPEA) where protections apply.

However, this legal regulation has limited effectiveness. A 2014 annual report on RAR implementation identified a 63% overall non-compliance rate for a variety of topics

including SPEA not marked and development encroached (30%) (Government of British Columbia 2015). “In March 2014, the Office of the Ombudsperson of BC issued *Striking a Balance: The Challenges of Using a Professional Reliance Model in Environmental Protection- British Columbia’s Riparian Areas Regulation*. This report summarized issues with compliance, professional reliance, monitoring, and complaints, making 25 recommendations to improve RAR.

Restoration options were investigated by Jackson (2002). Historic locations of Water birch Dogwood were mapped. Areas currently occupied by high value land uses (e.g. houses, orchard, vineyard) were eliminated as potential restoration candidates. Areas with existing Water birch habitat and low value crops (e.g. moist pasture) were retained as options for restoration. Sites on formal conservation land (e.g. National Wildlife Area, South Okanagan Wildlife Management Area (SOWMA), private conservancies: Nature Conservancy (NCC), Ducks Unlimited (DU), The Nature Trust (TNT)) were identified as the lowest cost restoration options. Some restoration was attempted but efforts are not quantified, and current managers may not be aware of past recommendations. GIS files may have been lost but would be easily replicated.

Recommendations:

- Develop and share a spatially explicit map of priority sites for Water birch (e.g. current Water birch habitat and potential restoration sites), with ownership and critical habitat displayed.
- Clearly communicate protection and restoration priorities and opportunities to existing and past partners and funders.
- Develop a clear, written strategy and annual implementation plan to protect existing sites and restore sites where feasible, in collaboration with SOSCP Partners. Include references to Yellow-breasted Chat and other critical habitat.
- Implement recommendations through coordinated and sustained stewardship, securement and restoration. Utilize past and existing partnerships (e.g. SOSS, Environmental Farm Plan, DU, NCC, TNTN, Provincial Government Ecosystems Program, Federal Government).
- Evaluate results and adapt plans on a regular basis.