Upper Columbia Swallow Habitat Enhancement Project – Year 1 (2021-2022)

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Executive Summary

The Upper Columbia Swallow Habitat Enhancement Project (UCSHEP) is a five-year (2021-2026) initiative using a multifaceted approach to conserve and enhance habitat for two at-risk swallow species (bank and barn swallow) in the region extending from Canal Flats to Donald. The main overarching goals of the UCSHEP are: a) erect artificial nesting structures (ANS) for barn swallows to increase available breeding habitat, b) complete effectiveness monitoring (in 2022-2026) at ANS, restoration, and enhancement sites, c) build increased awareness for swallow species and their conservation status, d) coordinate citizen-scientists to inventory/monitor swallow nests, and d) collaborate with partners to establish a Motus Wildlife Tracking System (including tagging) in the Columbia Valley.

Old buildings and barns are being replaced with structures not conducive to nesting barn swallows. Nests are less likely to remain attached to smooth lumber, steel or vinyl (rebuilt barns often use these materials). In Year 1 (2021-2022), the UCSHEP erected three ANS for barn swallows between Invermere and Donald and additional structures will be erected from 2022-2024. These structures are located where barn swallows already breed to increase the amount of nesting substrate available, in areas where formally used nesting structure(s) have been (or will be) removed, or in areas where nests are being removed due to health or aesthetic concerns.

In 2021, 45 artificial nest cups for barn swallows were installed on private land, as well as on the three erected ANS. The cups were used to entice barn swallows to existing sites by making pre-existing structures more suitable for nesting. An enhancement project to increase barn swallow breeding habitat along with a restoration project to restore a bank swallow breeding habitat occurred through collaborations with project partners. The UCSHEP identified additional opportunities for habitat enhancement or restoration that require further development before implementation in future years of this project. For instance, work occurred with the provincial government and a federal agency to assess the feasibility of restoring a bank swallow breeding colony at Birchlands Creek near Parson.

The UCSHEP developed and filmed a training session for volunteer citizen-scientists who monitored bank swallow colonies and/or barn swallow nest sites. Sixty-seven volunteers collected data at 64 bank swallow colonies and 67 barn swallow nesting sites. All inventory and monitoring data was compiled and submitted to the provincial government and to the federal government to assist with the identification of critical habitat for bank swallows. Public and private landowner outreach was aimed towards conserving swallows and their habitats and soliciting public information regarding the location of any new nest site(s).

The 2021-22 UCSHEP involved Indigenous groups native to the area. Bank swallow breeding colonies at Shuswap Band (SB) land were monitored by a SB member. Collaborations with SB, the Ktunaxa Nation, Akisqnuk community, and Métis Nation Columbia River Society occurred to determine how traditional Indigenous knowledge on swallows could be incorporated on future interpretive/educational signage. Communicating the Indigenous perspective on swallows will be further developed in 2022-2023 of the UCSHEP.

The FWCP Columbia Action Plan that the UCSHEP most closely aligns with is ‘Wetland and Riparian’. The action type is ‘Species of Interest’ and the priority action is ‘habitat-based actions - enhancing wildlife habitat features’. The secondary Columbia Action Plan that the UCSHEP aligns most closely with is ‘Rivers and Riparian’. The applicable action type is ‘Cross Ecosystem Plan’ with the secondary action ‘habitat-based actions – connectivity habitat.’

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1.0 Introduction

1.1 Background and context for the proposed project

The Upper Columbia Swallow Habitat Enhancement Project (UCSHEP) is a five-year (2021-2026) project providing landscape level benefits using a multifaceted approach to conserve and enhance habitat for two at-risk swallow species in the North and Upper Columbia. The main overarching goals of the project are to: a) erect artificial nesting structures (ANS) for swallows to increase habitat availability, b) complete effectiveness monitoring (in 2022-2026) at ANS, restoration and enhancement sites, c) build increased awareness for swallow species and their conservation status; d) coordinate citizen-scientists and Indigenous members to inventory/monitor swallow nests; e) establish a Motus Wildlife Tracking System (with Indigenous involvement) with project partners in the Columbia Valley to track bank swallow movements around local breeding colonies and during large-scale migration.

Populations of birds that catch insects on the wing (avian aerial insectivores) have been declining for decades. Conservation actions must be put into place to help halt and reverse this trend. Bank swallows have been facing one of the fastest population declines for a species in Canada with an estimated 98% population loss in Canada over a recent 40-year period. With only 2% of their population remaining in Canada, this species requires urgent conservation action. Reasons for the significant decline are not well understood, but are thought to be cumulative and include the loss of breeding, foraging and winter habitat, widespread pesticide use, climate change and destruction of nest sites (Berzins et al., 2020; COSEWIC, 2013). Similarly, barn swallows have an overall population decline of an estimated 76% in Canada over a recent 40-year period. Reasons for barn swallow population declines are also not well understood, but are attributed in part to losses of important types of artificial nests sites (e.g., open wooden barns) (COSEWIC, 2011). There is a need to conserve and restore habitat conditions in the North Columbia and Upper Columbia that are deemed important for the recovery of bank and barn swallows.

In 2021-22, the UCSHEP completed an inventory to locate all bank swallow colonies in the study area and also identified numerous locations important to breeding barn swallows. Some breeding sites require private landowner outreach and education, restoration, and/or enhancement, in order to conserve them for swallows. The UCSHEP is expanding the amount of available breeding habitat by erecting artificial nesting structures (ANS) for barn swallows at places where current nests are slated to be removed and in areas where there are breeding barn swallows. Additional structures suitable for nest attachment expands the amount of breeding habitat available. Artificial nesting structures (ANS) are built for swallow use only; no human use (livestock, tool storage, etc.) is authorised, this is confirmed through a dually-signed landowner agreement.

The UCSHEP involves citizen-scientists that gain considerable appreciation and knowledge of birds through participation. The UCSHEP conducted private landowner outreach visits, developed communications for education, interpretive signage, and has provided information regarding the Migratory Birds Convention Act including obligations to protect migratory birds, their eggs and nests, under this Act. Artificial nest cups (provided by the Lake District Rod and Gun Club) were provided to UCSHEP to install at strategic locations to attract barn swallows by enhancing structures already in place. Benefits also come from engagement with the Shuswap Indian Band and volunteers in hands-on stewardship activities such as erecting artificial nesting structures and monitoring, which assists with at-risk species conservation in the Upper Columbia Valley. The UCSHEP has been collaborating with

partners (Environment and Climate Change Canada, BC Parks), working to establish a Motus Wildlife Tracking System in the Upper Columbia to better understanding the movements of bank swallows in urban/rural landscapes around their breeding colonies and to learn about large-scale migratory routes (large-scale connectivity).

The Upper Columbia Swallow Habitat Enhancement Project (UCSHEP) is important for conservation since it works to halt and reverse significant population declines facing two at-risk bird species. Conserved breeding sites and more contiguous breeding habitat patches for bank and barn swallows helps facilitate connectivity networks for these at-risk species. Shanahan et al. (2011) states "greater connectivity enhances the habitat area that colonists [e.g., bank and barn swallows] can arrive from (resulting in greater species richness), whereas increased patch area allows for increased abundance by expanding the habitat available to species already present in a patch. A combined approach where connectivity and overall habitat area is enhanced across the landscape is likely to be necessary to meet long-term conservation objectives".

2.0 Goals and Objectives and Linkage of FWCP Action Plans and specific Action(s)

The Columbia Action Plan that the UCSHEP most closely aligns with is 'Wetland and Riparian'. The action type is 'Species of Interest' and the priority action is 'habitat-based actions - enhancing wildlife habitat features'. Three artificial nest structures (ANS) for barn swallows were erected in year 1 (2021-22). Available wetland/riparian areas were improved by creating and enhancing at-risk swallow breeding habitat with nest cups. Forty-five nest cups for barn swallows went up on ANS and previously erected structures in year 1 of the project. Additional habitat features (nest cups) will be installed in years 2 and 3, with effectiveness monitoring at all structures in years 2-5 (2022-2026). The UCSHEP had 67 volunteers monitor bank and barn swallows at specific locations to work on establishing a baseline inventory (a reference condition). The five-year project will result in habitat enhancement at multiple sites in the North Columbia leading to more large-scale habitat connectivity for two at-risk swallow species.

The secondary Columbia Action Plan that the UCSHEP aligns most closely with is 'Rivers and Riparian'. The applicable action type is 'Cross Ecosystem Plan' with the secondary action 'habitat-based actions – connectivity habitat.' Significant habitat for bank swallows have been identified in the region, some sites are under threat and there is a lack of suitable breeding habitat north of Brisco. The UCSHEP restored bank swallow habitat with BC Parks at Windermere Lake Provincial Park, enhanced barn swallow breeding habitat at The Nature Trust of British Columbia's Edgewater property, and worked on developing bank swallow colony restoration plans with CP Rail and MFLNRORD at Birchlands Creek near Parson. We started to determine the feasibility (including cost-benefit analysis) of creating artificial nesting habitat for bank swallows. Creating/restoring bank/barn swallow breeding habitat in the North Columbia produces more contiguous breeding habitat patches helping facilitate connectivity networks for these species that are facing severe population declines with limited habitat. A combined approach where connectivity and overall habitat areas are enhanced across the landscape is necessary to meet long-term conservation objectives for at-risk swallows.

3.0 Study Area

The study area for the UCSHEP is the Columbia Valley, from Canal Flats north to Donald (50°51'37.31"N, 116°20'12.06"W), situated at the northern end of the Rocky Mountain Trench in southeastern British Columbia (BC), Canada. The valley bottom contains one of the largest wetland complexes (Columbia Wetlands) within the southern interior of BC (Hammond, 2007). These wetlands are an important refuge for species which rely on wetlands for important stages of their life history (Darvill, 2020a). Swallows are strongly associated with wetland ecosystems because of the accompanying abundant food supply (e.g., mosquitoes, midges, dragonflies). Much of UCSHEP inventories, monitoring, restoration and enhancement work took place in the Columbia Wetlands, although higher elevation sites were reported occasionally (some barn swallow monitoring sites were at the Kinbasket Reservoir).

The Columbia Wetlands is an essential habitat component of the Pacific Flyway. In North America, these wetlands are the furthest west primary migratory bird corridor of which there are four (Wilson, 2010). This wetland ecosystem plays an important role as migration stopover habitat for birds (Darvill, 2020a; Kaiser, McKelvey & Smith, 1977) and it provides a refuge where birds can fuel up and rest during the necessary long migratory flights that require substantial amounts of energy. The Columbia Wetlands also provide vital habitat for a number of ungulate, mammal, amphibian, reptile, invertebrate, fish and plant species, several of which are at risk (Darvill, 2020b).

4.0 Methods (in 2021)

4.1 Project start-up

- Expert advice [Environment and Climate Change Canada Canadian Wildlife Service (ECCC CWS), BC Hydro] was provided for designing artificial nest structures (ANS) for barn swallows. Using a structured approach, three different designs (with varying parameters) will be tested for barn swallow ANS. The agreed upon parameters were: varying roof type (shed, gable), amount of openness (low/high), and overall size of the structure (12'x18' and 18'x24'). A local building contractor was hired to design/draw building plans for the structure, create a materials list, and construct the ANS.
- Meetings were had with specific groups that can have an influence on swallow conservation actions (e.g., Columbia Wetlands Stewardship Partners, Lake Windermere Rod and Gun Club, BC Hydro, etc.) along with multiple meetings with the UCSHEP project assistant to coordinate/assign project tasks.

4.2 Field work

- Meetings with primary building contractor (Don Stenner Cabinet Maker) occurred to ensure ANS were designed and erected in chosen locations, taking into account all guidance provided by ECCC CWS and BC Hydro.
- Locations for structure placements was based on Columbia Valley Swallow Project data collected in 2020 (Darvill, 2021). Several field visits and correspondence occurred with land managers, private landowners, etc. A permit with the Ministry of Transportations Infrastructure (MoTI) was made and approved to build an ANS in a MOTI right of way in Donald. A building permit application was made and approved for the ANS to go within land of the Town of Golden's

jurisdiction. Landowner agreements were written and dually signed by Wildsight Golden and respective landowners (for Invermere and Parson ANS).

- Monitored a subset of natural bank swallow colonies and barn swallow nests in the region, which included a large volunteer coordination effort.
- Inventory for bank swallow colonies was completed in the study area, including the river route between Edgewater and Brisco, and at additional sites where colonies had been reported but species had not been confirmed (e.g., private land in Donald).
- Most barn swallow nests were monitored weekly (mid-May to mid-August), and selected bank swallow colonies were monitored 3 times during the breeding season (mid-June to late July).
- Barn swallow nest cups were erected on ANS and previously erected structures to make them more suitable for nesting barn swallows.

4.3 Data collection

4.3.1 Bank swallow inventory and monitoring protocols

Bank swallow inventories were conducted on foot or by kayak depending upon the location of the colony. Inventory and monitoring activities for Columbia Lake and Lake Windermere were conducted by motorboat. Boat use was coordinated by the Columbia Lake Stewardship Society (for Columbia Lake) and Lake Windermere Ambassadors (for Lake Windermere). On private land, the project biologist ensured that all nest inventory and/or monitoring activities were undertaken with landowner's permission and ensured that any necessary authorizations were obtained ahead of time (e.g., permission requested and approved by the Shuswap Band (SB) for bank swallow inventories on SIB reserve lands).

To provide information on breeding success, the UCSHEP monitored a subset of nesting sites. There were approximately 100 bank swallow colonies, many are inaccessible except by watercraft. Due to inaccessibility and the high number of colonies we selected a subset of colonies to monitor. Site visits to colonies aimed to be evenly spaced apart (every 14 days). Survey periods for inventory and/or monitoring at bank swallow colonies were as follows:

- First visit: second week of June
- Second visit: fourth week of June
- Third visit: early July – mid July (before July 21st)

Monitoring methods and standard field data sheets were provided to volunteers in digital format or hard copy format, whichever was preferred. Volunteers were required to review monitoring protocols and data forms prior to conducting surveys in the field. A bank swallow colony record form developed by Bird Studies Canada (2010) (and modified by UCSHEP) was completed at each bank swallow colony site with the following information recorded: date, time, geographical (UTM) coordinates (using a GPS in NAD83), photo documentation (yes/no), site access, colony habitat type, dominant habitat features, breeding evidence, the number of pairs and active nests, and total burrows observed. Comments included any useful information about the colony, site, or habitat, as well as other burrow-nesting species seen at the colony [e.g., northern rough-winged swallow (*Stelgidopteryx serripennis*), belted kingfisher (*Megaceryle alcyon*)] and the habitats being used by foraging bank swallows. Colonies were viewed from a distance, to reduce colony disturbance, but close enough to be able to view burrows.

When counting burrows, every attempt was made to count only those that appeared to be recently constructed (within the current breeding season). Slumped and deteriorated burrows were presumed to have been created in previous years. At colonies that were monitored more than once, a photograph of the colony was taken during the first site visit, subsequently printed, and taken into the field for the second and third monitoring periods. These photographs were used in the field to document active burrows: a burrow was circled on the colony photograph when a bank swallow was seen flying in or out of it or if chicks were seen at the burrow entrance. An active nest was defined as a burrow from which an adult was seen to enter or exit from or as a burrow that had nestlings visible at the entrance. On the colony photo 'map,' it was also indicated where other species were seen entering or exiting a burrow, such as belted kingfisher or northern rough-winged swallow. Volunteers were advised to spend a minimum of 30 minutes at each colony. All data that was transcribed onto the bank swallow colony record forms in the field was subsequently entered into an excel database. All field data collected related to colony monitoring and site descriptions were transcribed into digital databases and submitted to the provincial government (wildlife species inventory – WSI) and to Environment and Climate Change Canada's Canadian Wildlife Service.

4.3.2 Barn swallow inventory and monitoring protocols

The eBird database and the 2020 Columbia Valley Swallow Project (Darvill, 2021) were used to determine locations where barn swallows were nesting. Barn swallow nest site monitoring was undertaken from approximately early-May until late August, capturing the majority of nesting activities between the start (nest building) and end (fledging of juveniles) of the nesting season. This time period allowed for observation of pairs with multiple broods. Volunteers were requested to visit nest sites on a weekly basis to obtain continuous and precise data. However, the frequency of monitoring varied based on volunteer capacity (time, motivation). When necessary, the project biologist ensured that all nest monitoring activities were undertaken with the landowner's permission and that any necessary authorizations were obtained.

Barn swallow nest monitoring followed protocols outlined in the 'Columbia Valley Swallow Project Barn Swallow Nest Monitoring Methods' which largely replicated methods developed by the British Columbia Swallow Conservation Project (n.d.). Monitoring methods and standard field data sheets were provided to volunteers in digital format or hard copies were mailed, whichever was preferred. Volunteers were required to review monitoring protocols and data forms prior to conducting surveys in the field.

For each monitored nest site, volunteers were asked to record the actual or estimated arrival and departure date of barn swallows to that nest site, if possible. All nests present (new, active, old) were recorded as best as possible. Volunteers were asked to survey nests from a distance to avoid any negative effects associated with disturbance. If nests were deemed as inactive, then this status was recorded to ensure complete and consistent nest site monitoring. During each nest monitoring visit the following details were recorded: nest attempt if known (1, 2, 3), survey date, nest condition (new nest, reused nest, damaged nest), nest activity (e.g., courtship, alarm calls, nest building, adult flushed from nest, nest with young seen or heard, nest occupied, unknown nest use, etc.), nest with young seen or heard (if known), nest disturbance (e.g., predation, human disturbance - intentional, human disturbance – unintentional, etc.), any relevant comments, etc. All swallow nests at each nest site structure were described, such as nest type [new, reused, old (abandoned, damaged/degraded)], location in structure (interior, exterior), support structure (horizontal ledge, vertical wall (no ledge), horizontal post/pole/pipe, light fixture, etc.), ledge width, ground to nest bottom, nest bottom to overhang, nest

top to overhang, closest nest, visual barrier between adjacent nest, and any relevant comments. All barn swallow field data collected was transcribed into digital databases and submitted to the provincial government (wildlife species inventory – WSI).

4.4 Data entry and analysis

- All data was received from volunteers, and subsequently recorded onto spreadsheets (Google Drive and excel).
- Data was formatted into the provincial database standard (SPI/WSI), and submitted to provincial government and federal government.
- Spatial data was used to create kmz files for bank and barn swallow nesting locations.

4.5 Extension/Community/Outreach

- We continued to build partnerships with landowners, agriculturalists, and other land users/managers (e.g., Regional District of East Kootenay, MFLNRORD).
- The UCSHEP engaged the local communities by offering volunteer opportunities to participate with a biologist in swallow monitoring surveys.

5.0 Results and Outcomes

In year one (2021-22) of the UCSHEP progress was made on all duties and deliverables outlined in the contribution agreement for Project Number: COL-F22-W-3479.

1. Three artificial nesting structures (ANS) for barn swallows were erected in year 1. One in Donald (12'x18') (appendix 1), one in Golden (24'x18') (appendix 2), one in Invermere (12'x18') (appendix 3). Slight modifications were made to previously used designs (such as the barn swallow hotel in Creston) and based upon input from Environment and Climate Change Canada's Dr. Tara Imlay (land bird biologist), as well as input from BC Hydro who had already been testing various barn swallow nesting structures in BC. The UCSHEP ANS are built to withstand elements with two design footprints (12'x18', 24'x18') made with rough wood surfaces near the ceiling where barn swallows are most likely to nest. Rough surfaces are the best for mud nest attachment, there is less likelihood of them sliding off. The buildings have a tin roof. Insulation was placed under the roof to protect nestlings from heat exposure, although one structure used only a reflective material under the roof (rather than reflective material and insulation). The cost of not using insulation is lower and we will test whether there is a cost-benefit to using insulation or not. One structure can accommodate several nests with blocking at the ceiling providing obscured visibility between nesting birds.
2. Metal signage was developed, printed and installed on the ANS (appendix 4). A different sign describing the various swallow species in the Columbia Valley was designed, printed, and installed at a bird watching kiosk at Reflection Lake in Golden (appendix 5).
3. The project biologist met with area manager at Kicking Horse Mountain Resort (KHMR) to determine the most suitable (and allowable) location for erecting an ANS at KHMR for barn swallows. The resort had indicated that they would like 1-2 ANS installed at KHMR; however, this structure was moved to the Town of Golden after the eventual lack of response from KHMR. A Town of Golden building permit was applied for and subsequently approved. The structure was built on Town of Golden land, completed by April 2022.
4. Forty-five artificial nest cups (appendix 6) for barn swallows were installed on pre-erected structures (to private landowners) and also the three ANS (appendix 7).

5. Sixty-seven barn swallow nesting sites were monitored in 2021, with 38 volunteers participating in barn swallow monitoring activities. All monitoring data will be summarized in the 2026 UCSHEP final report providing a reference point for barn swallows in the study area, although 2021 data has been submitted to the provincial data warehouse.
6. We completed bank swallow inventories at 11 colonies at Columbia Lake (use of a volunteer's boat to conduct surveys), and the Lake Windermere Ambassadors assisted us for three days to monitor six bank swallow colonies on Lake Windemere's foreshore (use of District of Invermere's Boat) (appendix 8). In total, 27 volunteers assisted with bank swallow inventory and monitoring. The UCSHEP visited 64 bank swallow colonies for monitoring and/or inventories in 2021. All data will be summarized in the 2026 UCSHEP final report providing a reference point for bank swallows in the study area, although 2021 data has been submitted to the provincial data warehouse.
7. All monitoring data contributes to determining a reference point condition (or baseline) for bank and barn swallows prior (and during) enhancement and restoration works. Recording of various data parameters (e.g., colony size, active burrows, nest disturbance, etc.) occurred and will be summarized in the UCSHEP final report in 2026.
8. Completed bank swallow inventory between all sections of the Columbia River located between Canal Flats and Donald – 98 active bank swallow colonies in the study area from 2021 and 2020 (Darvill, 2021) data.
9. A bank swallow colony at Windermere Lake Provincial Park faced negative impacts (e.g., sticks in burrows, enlarged entrances, unauthorized trail) (appendix 9). UCSHEP restored bank swallow breeding habitat and placed ropes around the colony (intended to keep people away from the colony) with interpretive signage at the site (appendix 10). All work at the park was completed with BC Parks and was funded by BC Parks (not FWCP).
10. Worked with The Nature Trust of BC to enhance barn swallow habitat on their property in Edgewater. A structure that was already standing was enhanced by making it more suitable for nesting barn swallows. The structure was partially enclosed with plywood and eaves trough (rain gutters) were placed at roof edges to funnel water into a rain barrel. This is meant to provide a water source needed during times of drought so that an adequate mud source was available for nest building (appendix 11).
11. Engaged with three Indigenous groups (Shuswap Indian Band, Akisqnuk First Nations, Ktunaxa Nation) to involve them with bank swallow monitoring, to install Motus Wildlife Tracking Stations on Indigenous lands in 2022, and to have the Indigenous perspective on swallows included on interpretive signage (further developed in 2022).
12. Using UCSHEP inventory data, the area between Canal Flats and Edgewater was proposed as Critical Habitat for bank swallows in the 2021 Federal Recovery Strategy (proposed) (Environment and Climate Change Canada, 2021).
13. An in-person meeting was held with three CP Rail representatives (provincial government representative was also meant to come, but was sent for fire duty) to determine the best way to proceed with restoration plans at a negatively impacted bank swallow colony at Birchlands Creek near Parson. At the time of writing, the UCSHEP is awaiting on the Department of Fisheries and Oceans and CP Rail for final permission to move forward with restoration efforts. We had meetings with the Columbia Shuswap Invasive Species Council who received funding to help us with the invasive plant treatment needed at the Birchlands site in 2022.
14. A cost-benefit analysis occurred regarding the potential of building an ANS at the Bush Arm of the Kinbasket Reservoir (above the drawdown zone). It was found to not be possible at this time. It

would be very expensive for building materials moved to the Bush Harbour area, and also expensive to have a contractor(s) on site for the required time to build a structure (approximately 3 weeks).

15. Communications - the project biologist developed interpretive signage to be printed and installed on all ANS. A training webinar for volunteers of the UCSHEP was developed (using PowerPoint) and it was live recorded for placement on YouTube (assistance provided by the Kootenay Conservation Program). A poster was created to solicit public information regarding new nest sites for bank and barn swallows on public and private lands. Volunteer opportunities were also on social media, Wildsight website updates, posters, press releases and eBlast communications. Two online presentations (due to Covid-19) were provided to local groups (including Akisqnuk First Nations). Several landowner outreach visits occurred. Developed/delivered letters, eBlasts, press releases for newspapers, etc.
16. The UCSHEP communicated with all partner groups (BC Parks, Parks Canada, Environmental Climate Change Canada – Canadian Wildlife Service (ECC CWS), Lake Windermere Ambassadors, Columbia Lake Stewardship Society, Indigenous groups, provincial government, etc.) to ensure effective communication and collaborations during the project.

6.0 Discussion

The UCSHEP habitat enhancement and restoration projects are improving and expanding habitat for bank and barn swallows, two at-risk bird species that are currently facing severe population declines. Landowner outreach promoting best management practices is also resulting in improved habitat for breeding swallows. By the end of this five-year project at least seven artificial nesting structures for barn swallows will be erected in the study area. Habitat enhancement at multiple sites in the area between Canal Flats and Donald is leading to large-scale habitat connectivity for two at-risk swallow species that utilize this area for critical stages of their lives. There are no standard national guidelines for building artificial nesting structures for barn swallows and the results of this project will help inform future habitat enhancement efforts for barn swallows in B.C. and around the world. More than 75 nest cups for barn swallows will also be installed by the end of the five-year project (45 in year 1), and we will restore 2-3 former bank swallow breeding sites by re-sloping the banks to make them more suitable (vertical) for nesting.

Inventory data identifying where swallow colonies are located is critical for the conservation of those important habitats and will prompt better adjacent land/water use planning in areas around those sites. Inventory data may lead to the development of future habitat enhancement and restoration projects designed for two FWCP Inventory Species in the North Columbia and Columbia Valley. Data on colony locations provide justification for private land purchases for conservation.

This habitat-based, multi-faceted, conservation action project creates exciting and educational volunteer opportunities for First Nations, stakeholders and community members to be involved with bird field work and habitat creation, restoration and enhancement work. Some private landowners have benefited with the opportunity to enhance their properties to become more attractive to at-risk swallows. Communication with groups that have can have large impacts on swallow habitat in wetlands/riparian areas creates opportunities to work on lands which partners would not otherwise be able to access or influence at a meaningful geographic scale.

7.0 Recommendations

Artificial nesting structures for barn swallows should continue to be erected in strategic locations as planned for both 2022 and 2023. Nest cups should also continue to go up on these structures as well as on previously erected structures in order to increase a structures suitability for nesting (ie., protection from elements, prevents a nest from sliding off smooth structure). Restoration and enhancement efforts for both bank and barn swallow, in the entire study area, should continue in order to increase the habitat security and availability for barn and bark swallows. It is recommended that all enhancement and restoration efforts of the UCSHEP be monitored for three to four years (depending on when a structure is erected) using a coordinated approach with an effectiveness monitoring (EM) plan. An EM plan was developed in April 2022. It is recommended that this plan be used to help the project adapt and make any necessary changes to enhancements/restorations and also to determine how effective the restoration and enhancement efforts are. Effectiveness monitoring will enable UCSHEP to understand how well a structure, nest cup, enhancement, or other modification has worked to achieve its desired affect. Monitoring will also help with placement and orientation of future structures and nest cups.

In year two (2022), the UCSHEP should also finalize the feasibility of building artificial nesting structures for bank swallows. This assessment should include the viability of land permissions and a cost-benefit analysis. It is important to continue to expand and enhance breeding habitat for two at-risk bird species, especially in areas where habitat is limited (limited or no friable soil and limited vertical faces).

It is recommended to continue collaborations with local Indigenous nations. Incorporation of Indigenous perspectives on swallows will be incorporated into interpretive signage in 2022 and the signage should be erected at all artificial nesting structures. This benefits the local communities by providing an opportunity to learn more about Indigenous historical values related to swallows. Ensuring Indigenous groups are involved from the onset of the UCSHEP also helps move along the path towards reconciliation.

It is also recommended to continue to involve stakeholders and citizen-scientists in the collection of swallow monitoring data. Monitoring barn and bank swallow colonies enables a reference point to be established which is needed to assess population trends. Involving volunteers in the collection of data is beneficial in two ways: 1) more data can be collected over a relatively large spatial area with limited resources, and 2) it grows peoples appreciate for nature. By providing an active citizen-science opportunity, volunteers become directly engaged with wildlife and local landscapes encouraging development of sustainable personal decisions relating to general and specific actions important to the conservation of nature. Monitoring also enables the UCSHEP to determine where to focus additional educational efforts. For instance, if nests are being taken down during the breeding season at a particular location, efforts can be focused to that area to educate landowners/managers regarding their duty (and laws) to protect birds, their eggs and their nests.

Currently, there is no information on the migratory pathway used by western Canada's bank swallow population. Knowing the migratory pathway will help UCSHEP form international collaborations, which will provide landscape level benefits on an immense spatial scale (Upper Columbia to Argentina) by conserving the entire range of required habitats through various life stages. "Understanding migratory connectivity is critical for conservation because it helps elucidate when and where the drivers of population decline may be occurring, and therefore, what conservation interventions might yield the

best results" (Mitchell & Imlay, 2021). Data from Motus tracking will establish migratory connectivity across a large spatial scale for bank swallows by identifying key areas where we need to collaborate with international bird conservation groups. We can work to conserve, enhance, and restore critical breeding and roosting habitat for bank swallows in the Columbia Valley region, but threats during migration and on wintering grounds are largely unknown and are also critical in understanding the species' decline and how to reverse this decline.

In the future (2022-2024), Motus tracking of bank swallows is recommended also because it will enable local movements around breeding colonies to be known, which is needed to determine what areas are important for feeding bank swallows around breeding areas. This type of information should be used to inform regional and local land use plans (e.g., Official Community Plans, CWWMA Management Plan). Furthermore, while wetlands and open water are important as foraging areas, nesting bank swallows mainly rely on open terrestrial habitats for foraging. In California, increased distance between colonies and nearest grassland habitat for bank swallows was positively related to colony extinction probabilities (Moffatt et al., 2005). The widespread and ongoing decline of grassland reliant birds is linked to a number of regional changes, e.g., conversion of native grasslands to row crops, urbanization of abandoned farmland, rangeland degradation, and agricultural intensification. Thus, it is conceivable that some (or all) of these changes have also led to a reduction in suitable foraging grounds for breeding/foraging bank swallows. Motus will enable us to gain an understanding for where bank swallows are feeding, focusing future conservation actions (enhancement, restoration, regulations) towards important feeding areas (e.g., grasslands near colonies, lake habitat).

In 2022, UCSHEP (in collaboration with Environment and Climate Change Canada and BC Parks) aims to erect three Motus Wildlife Tracking System automated radio-telemetry stations in the Upper Columbia Valley, and put Motus tags on 100 individual bank swallows (in 2022 and 2023).

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10.0 Appendix

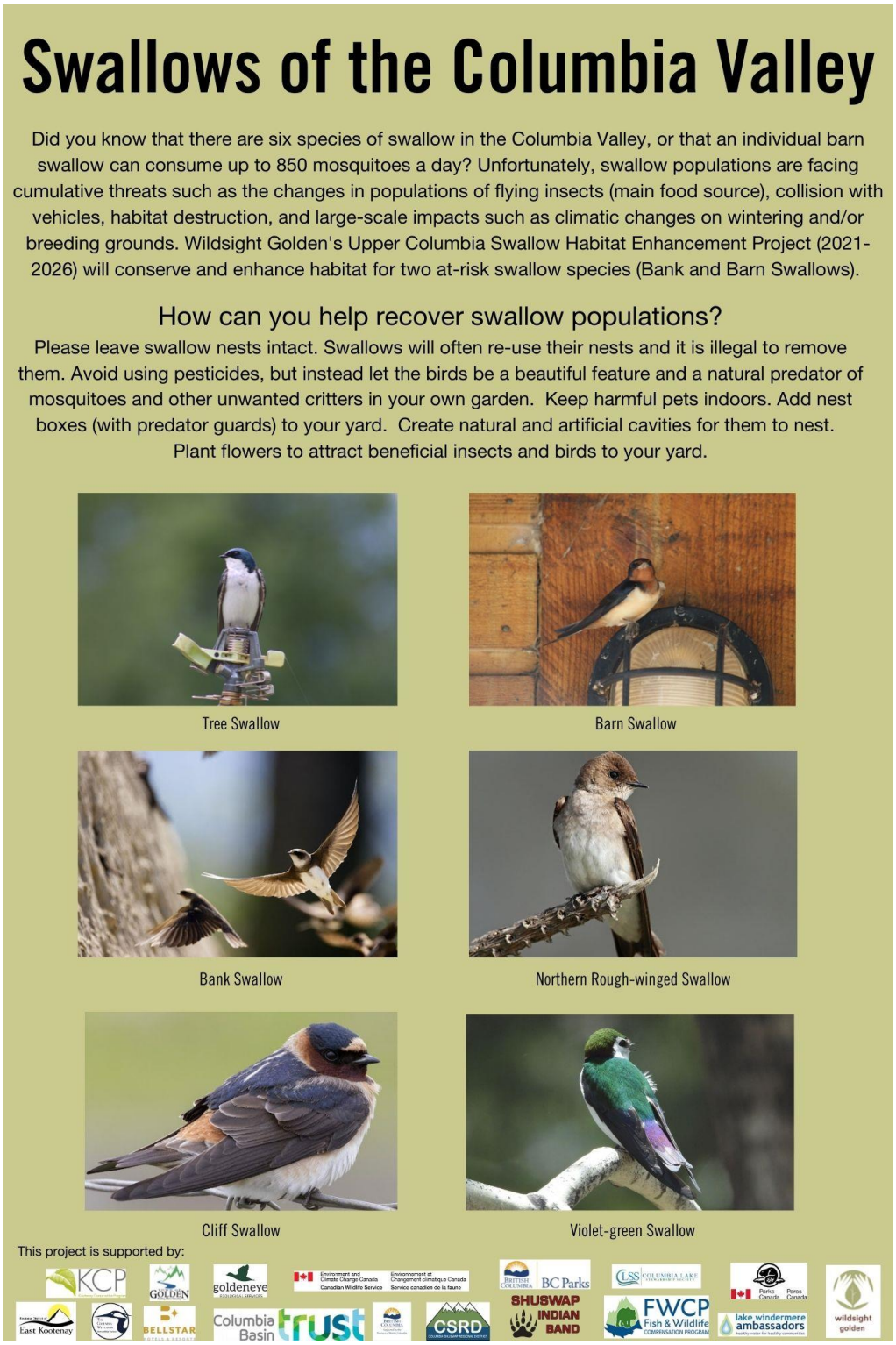
Appendix 1. Photograph showing the artificial nesting structure (for barn swallows) built and installed in Donald.

Appendix 2. Photograph of the artificial nesting structure (for barn swallows) built and installed in Golden.

Appendix 3. Photograph of the artificial nesting structure (for barn swallows) built and installed in Invermere (Zehnder Farm).

Appendix 4. Metal signage designed, printed and installed on artificial nesting structures.

Appendix 5. Metal signage developed, printed and installed at Reflection Lake bird watching kiosk. To provide education on the six swallow species found in the Columbia Valley.



Appendix 6. Barn swallow nest cups provided to the project by the Lake Windermere District Rod and Gun Club.

Appendix 7. Barn swallow nest cups installed in an artificial nest structure.

Appendix 8. Volunteers conducting inventory and monitoring at a bank swallow colony.

Appendix 9. Sticks and mud located in bank swallow burrows located at a bank swallow colony at Windermere Lake Provincial Park.

Appendix 10. Interpretive signage and securing bank swallow colony at restoration site.

Appendix 11. Enhancement project to increase barn swallow breeding habitat on The Nature Conservancy of BC's Edgewater property; a) before and b) after.

a) before enhancement work

b) after enhancements