National Park Service
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Natural Resource Stewardship and Science

Cascades Fisher Reintroduction Project

Final Project Report

Natural Resource Report NPS/PWR/NRR—2022/2418

ON THIS PAGE
A fisher near Buck Creek, in the Mount Baker-Snoqualmie National Forest
NPS / JASON RANSOM

ON THE COVER
A fisher being released at Mount Rainier National Park
CONSERVATION NORTHWEST / PAUL BANNICK

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Natural Resource Report NPS/PWR/NRR—2022/2418

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Executive Summary

Fishers (*Pekania pennanti*) are a mid-sized member of the weasel family that historically occurred in the dense coniferous forests of Washington. Unregulated harvest, loss and fragmentation of habitat, and predator control campaigns beginning in the late 1800s collectively resulted in the decline and extirpation of fishers from Washington by the mid-1900s. Fishers were subsequently listed as an endangered species by the state. We established a partnership between federal, state, and non-profit organizations with the goal of re-establishing self-sustaining fisher populations in their former range in Washington, which includes the Cascade Range. Our objectives were to 1) Release ≥80 fishers into the South Cascade Ecosystem and ≥80 fishers into the North Cascades Ecosystem, with ≥50% female composition, 2) Release fishers at few locations in each reintroduction area to increase the likelihood of fishers interacting, 3) Release as many fishers as possible before January 1st each season, so that the stress of the reintroduction process occurred well before the active gestation period of female fishers, and 4) Monitor post-release movements, survival, home range establishment, and reproduction to evaluate initial success of the reintroduction project during the two years following their release.

From 2015–2020, we translocated 81 fishers (69 fishers (38 F, 31 M) from British Columbia, Canada, and 12 fishers (7 F, 5 M) from Alberta, Canada) into the South Cascades, including Mount Rainier National Park, and Gifford Pinchot National Forest. From 2018–2020, we translocated 89 fishers (48 F, 41 M) from Alberta, Canada, into the North Cascades, including North Cascades National Park Service Complex and Mount Baker-Snoqualmie National Forest. We monitored fishers using radio-telemetry from 2015–2021, and collected 1,298 fisher locations during those efforts. We supplemented those data with incidental verified detections captured on remote trail cameras during the same time period, which totaled an additional 277 locations. Collectively, these detections ranged across 18,573 km^2 of the South Cascades and 15,452 km^2 of the North Cascades.

The project was a successful conservation action: we achieved our stated objectives and met most benchmarks of success for reintroduction and animal welfare. We were able to translocate 170 fishers from Canada to the Washington Cascades that met all optimal health criteria and represented a young founder population with a slightly female-biased sex ratio. We moved fishers efficiently, reduced their time in captivity throughout the project, and met high standards of animal care and welfare. We released fishers at a few centralized locations in each portion of the recovery area, hopefully facilitating interaction and reducing the tendency for animals to wander far in search of conspecifics. We also released most fishers before January 1 of each year, which allowed animals to settle and begin establishing a home range before the onset of breeding season. Reproduction was documented in both the North and South Cascades within two years of release, with one female in the North Cascades producing a litter of 4 kits (which equals the highest known litter size in the western US). Survival one year after reintroduction was high in the South Cascades (76%), but lower than expected in the North Cascades (42%). Juvenile females represented the highest survival of all ages and across all cohorts, at 83% in the South Cascades, and 55% in the North Cascades. At the end of 2021, fishers were well distributed across much of the Cascades Fisher Recovery Area. Some animals were located enough times to determine that a home range had likely been established; and

based on the consistent distribution within the recovery area through time, we can assume that many other fishers have settled into a home range that includes the west slope of the Washington Cascades.

This report details all elements of the Cascades Fisher Reintroduction Project, including capture and handling, transport, veterinary care and assessments, movements, survival, reproduction, genetics, necropsy information, and on-going research associated with predator-prey relationships, allometry, behavior, and stress physiology. It is our hope that much of this information will be used to improve animal welfare and success of future wildlife reintroduction projects. The successes of this project arose from collaboration of four federal agencies, three state and provincial agencies, eight Tribes and First Nations, two universities, and 22 non-government organizations. Approximately 900 people attended the 32 release events in the Cascades, including several school and youth groups. Children released almost every fisher.

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Introduction

Fishers (*Pekania pennanti*) are a stocky mid-sized member of the weasel family (Mustelidae), endemic to North America. The fisher's diet consists of tree squirrels (e.g., *Tamiasciurus* spp.) and snowshoe hares (*Lepus americanus*), as well as a broad array of small mammals, birds, reptiles, insects, ungulate carrion, and berries (Hayes and Lewis 2006). They also are efficient predators of porcupines (Powell 1993). For their body size, fishers in the western US use relatively large home ranges (mean size is 18.8 km^2 for females and 53.4 km^2 for males) to meet their resource needs (Lofroth et al. 2010). Females can become pregnant as early as age 1 and give birth as early age 2 (this year long pregnancy is due to delayed implantation); however, most females are >2 years old when producing their first litter (Powell 1993, Mead 1994). Following implantation and an average of 36 days of gestation, fishers give birth to 1–4 kits in late March to early April, with an average litter size of two kits surviving more than seven days postpartum (Frost et al. 1997). Kits are weened at 6–8 weeks and have some limited climbing ability at 10 weeks. Females are solely responsible for rearing kits, and provision young with prey in the den tree following weaning. Kits become independent in late summer to early fall (Powell 1993, Hayes and Lewis 2006). The lifespan for fishers may be approximately 10 years, though empirical data on natural deaths in populations that were not reintroduced, and are not trapped, is lacking (Powell 1993).

Fishers historically occurred from the latitudinal tree line in northern Canada, southward through Washington, Oregon, and California to the southern end of the Sierra Nevada Mountains. Rocky mountain populations extended south from Canada into northern Utah, and eastern populations ranged through parts of the mid-west, and south into the Appalachian Mountains. Following European settlement, fishers were extirpated from much of their range in the US and experienced a range contraction in the southern portions of their historical range (i.e., northern US, and southern Canada, Lewis et al. 2012). Fur trapping, predator control efforts, and habitat loss due to logging and land conversion for farming were responsible for the dramatic declines in the fisher's range and populations. In the 1920s and subsequent decades, many areas ceased fisher trapping in an effort to salvage remaining populations (Powell 1993).

Despite protection, populations in the western US have remained small and disjunct (Aubry and Lewis 2003). Native populations persist in the Sierra Nevada, and the Klamath Siskiyou region of northwestern California and southern Oregon, and a population in the southern Oregon Cascades is the result of translocations from British Columbia and Minnesota (Aubry and Lewis 2003). In 2020, the southern Sierra Nevada population was listed as endangered under the federal Endangered Species Act. In Washington, fishers once occurred throughout the Olympic Peninsula, Cascade Range, possibly in southwestern and northeastern Washington, and in the Blue Mountains. Unregulated harvest, habitat loss and fragmentation, and predator control campaigns beginning in the late 1800s collectively resulted in the decline and extirpation of fishers from Washington by the mid-1900s (Lewis and Stinson 1998, Hayes and Lewis 2006). Trapping seasons for fishers in Washington were closed in 1933 (Lewis and Stinson 1998). The last verifiable fisher sighting in Washington was an incidentally trapped fisher on the eastern side of the Olympic Peninsula in 1969 (Lewis & Stinson 1998).

Fishers are currently listed as a state endangered species in Washington, and recovery actions were outlined to restore them (Lewis and Hayes 2004, Hayes and Lewis 2006). Given the success of reintroductions for restoring fisher populations in other parts of their historical range (see Lewis et al. 2012), Washington Department of Fish and Wildlife (WDFW), the National Park Service (NPS), Conservation Northwest (CNW) and U.S. Geological Survey (USGS) partnered to plan, implement, and monitor the success of fisher reintroductions on the Olympic Peninsula, beginning in 2008 (Lewis 2014, Happe et al. 2017, 2019). These same partners began reintroduction of fishers in the southern Cascade Range in 2015, and the Calgary Zoo joined the collaboration in 2017 to reintroduce fishers to the northern Cascade Range (Lewis et al. 2018a). These efforts collectively aimed to restore fishers in the largest portions of their historical range in Washington.

Planning for the Cascades Fisher Reintroduction Project began in 2013 with WDFW's Implementation Plan for Reintroducing Fishers to the Cascade Range in Washington (Lewis 2013). North Cascades National Park Service Complex (NOCA) and Mount Rainier National Park (MORA) led the National Environmental Policy Act process and completed a Fisher Restoration Plan / Environmental Assessment in May 2015 (NPS 2014). Project partners worked with the British Columbia Ministry of Forests, Lands and Natural Resource Operations (BCFLNRO), British Columbia Ministry of Environment (MOE), and the Tsilhqot'in, Secwepemc, and Dakelh First Nations to obtain capture and transport permits for the translocation of up to 160 fishers over five years to Washington. Planning efforts also required contracting with organizations to 1) coordinate trapping efforts with licensed British Columbia trappers, 2) house and care for captive fishers, and 3) provide veterinary services for health inspections and preparing fishers for release.

The planning efforts established for project operations in British Columbia were completed in 2015 and these plans were implemented effectively until the summer of 2017, when our implementation efforts were interrupted by large forest fires that occurred throughout the fisher capture area in central British Columbia. Because of the extensive loss of habitat that resulted from these fires, BCFLNRO officials were concerned about the conservation status of fishers in central British Columbia and discontinued our permits. Consequently, in the autumn of 2017 we explored the possibility of working with government officials and other potential partners in Alberta, Canada, to complete our reintroduction implementation for the Cascades Fisher Recovery Area. From 2017 to 2021, we operated this project with the Alberta Ministry of Environment and Parks (ABMOEP), the Calgary Zoo/Wilder Institute, the Alberta Trapper's Association, and Bushman, Inc. We moved our capture, housing and veterinary operations to Alberta in the summer of 2018 and continued the Cascades fisher reintroductions through March 2020.

Our goal was to re-establish a self-sustaining fisher population in both the southern (hereafter, South Cascades) and northern (hereafter, North Cascades) portions of the Cascades Fisher Recovery Area as outlined in the fisher recovery plan for Washington State (Hayes and Lewis 2006) and the National Park Service Detailed Implementation Plan for Re-establishing Fisher in the Washington Cascades (NPS Project 195423) (Figure 1). We used the following objectives to meet our goal in the South Cascades and North Cascades:

- **Objective 1:** Capture at least 160 fishers, of which ≥50% are female, from central and northern British Columbia and/or Alberta, Canada, and release at least 80 into the South Cascades over two years, and at least 80 into the North Cascades over two years.
- **Objective 2:** Release fishers at few (i.e., 2–3) locations in each reintroduction area to increase the likelihood of fishers interacting (i.e., finding mates and obtaining social cues from previously released fishers).
- **Objective 3:** Release as many fishers as possible before January 1st each season, so that the stress of the reintroduction process occurs well before the active gestation period of female fishers (from late-February to late-April). This is expected to improve reproductive success in the first year (Facka et al. 2016).
- **Objective 4:** Monitor post-release movements, survival, home range establishment, and reproduction to evaluate initial success of the reintroduction project during the two years following their release. Each released fisher will be equipped with a VHF radio-transmitter with a 2-year lifespan.

We established basic measures of success for this reintroduction effort as:

- **Objectives:** Meeting Objectives 1–4 within the time and budget scope planned for this conservation action.
- **Community:** Engaging and educating the public, agencies, Tribes, First Nations, and communities in and around the ecosystem on the fisher reintroduction purpose and process, in order to develop a grassroots sense of resource stewardship.
- **Animal welfare:** Placing welfare of each individual fisher before all other project considerations and exceeding animal welfare standards set by Institutional Animal Care and Use Committees (IACUC), the guidelines of the American Society of Mammalogists for the use of wild mammals for research (Sikes et al. 2016), and Provincial government approved protocols and permits. Take demonstrative steps to improve animal welfare for future wildlife reintroduction actions.
- **Survival:** ≥50% of reintroduced fishers survive their first year following release, or at least through one breeding season (based on Lewis and Hayes [2004]).
- **Home range establishment:** ≥50% of reintroduced fishers establish a home range, which is a positive indicator of habitat suitability (Lewis and Hayes 2004).
- **Reproduction:** Confirm reproduction for at least one female in each reintroduction area, within two years post-release.

Figure 1. Map of the Cascades Fisher Recovery Area, Washington, showing the North Cascades and South Cascades reintroduction areas of the recovery zone outlined.

In this report we provide a detailed summary of the fisher reintroduction project in the southern and northern Cascade Range in Washington, through completion of this project in 2021. While monitoring of fisher recovery in Washington will persist for years to come, this is the final project report for the initial phase of fisher recovery: all animals have now been translocated and the lifespan of their radio-transmitters has concluded (~2 years post-deployment). Additional details may be found in the previous progress reports for this project (Lewis et al. 2017, 2018b, 2019, 2020).

Primary Objectives

Objective 1

Our first objective was to capture at least 160 fishers consisting of ≥50% females from central and northern British Columbia and/or Alberta, Canada, and release at least 80 fishers into the South Cascades over two years, and at least 80 fishers into the North Cascades over two years. Initial release sites were selected central to the core habitat within each reintroduction area (Lewis and Hayes 2004).

South Cascades

In the first year of the project (December 2015 to November 2016), we successfully captured 23 fishers (11 female [F], 12 male [M]) in central British Columbia, Canada, and transported them to Washington. We released these fishers on four occasions from 3 December 2015 to 6 February 2016 near the Cispus Learning Center, Randle, WA (herein Cispus) (Figure 2, Appendix A). In this report, these 23 fishers are referred to collectively as Cohort 1. In the second year of the project (December 2016 to November 2017), we captured 46 fishers and transported them to Washington (27 F, 19 M; Appendix A): 16 (8 F, 8 M) were released at the MORA – Longmire release site and 30 (19 F, 11 M) were released at Cispus. In this report, these 46 fishers are referred to collectively as Cohort 2. From October 2018 to January 2020, we released 12 additional fishers (7 F, 5 M from Alberta, Canada) at MORA and Cispus in order to meet our objective of releasing ≥80 fishers in the South Cascades (Table 1).

Table 1. The number of fishers released and fisher release sites in the South Cascades from December 2015 to January 2020. Fishers from central British Columbia were released from 2015 to 2017, and fishers from central Alberta were released after 2017.

Location	Date	Females	Males	Total
Cispus Learning Center	December 3, 2015	4	3	7
Cispus Learning Center	December 23, 2015	1	3	4
Cispus Learning Center	January 16, 2016	2	4	6
Cispus Learning Center	February 6, 2016	4	2	6
Mount Rainier National Park – Longmire	December 2, 2016	4	6	10
Cispus Learning Center	December 10, 2016	4	2	6
Mount Rainier National Park – Longmire	December 17, 2016	4	4	8
Cispus Learning Center	December 31, 2016	2	4	6
Cispus Learning Center	January 13, 2017	4	3	7
Cispus Learning Center	February 3, 2017	4	0	4
Cispus Learning Center	February 20, 2017	5	0	5
Mount Rainier National Park – Ohanapecosh	October 27, 2018	3	1	4
Cispus Learning Center	November 8, 2019	2	2	4
Mount Rainier National Park – Longmire	January 10, 2020	2	2	4
Totals	–	45	36	81

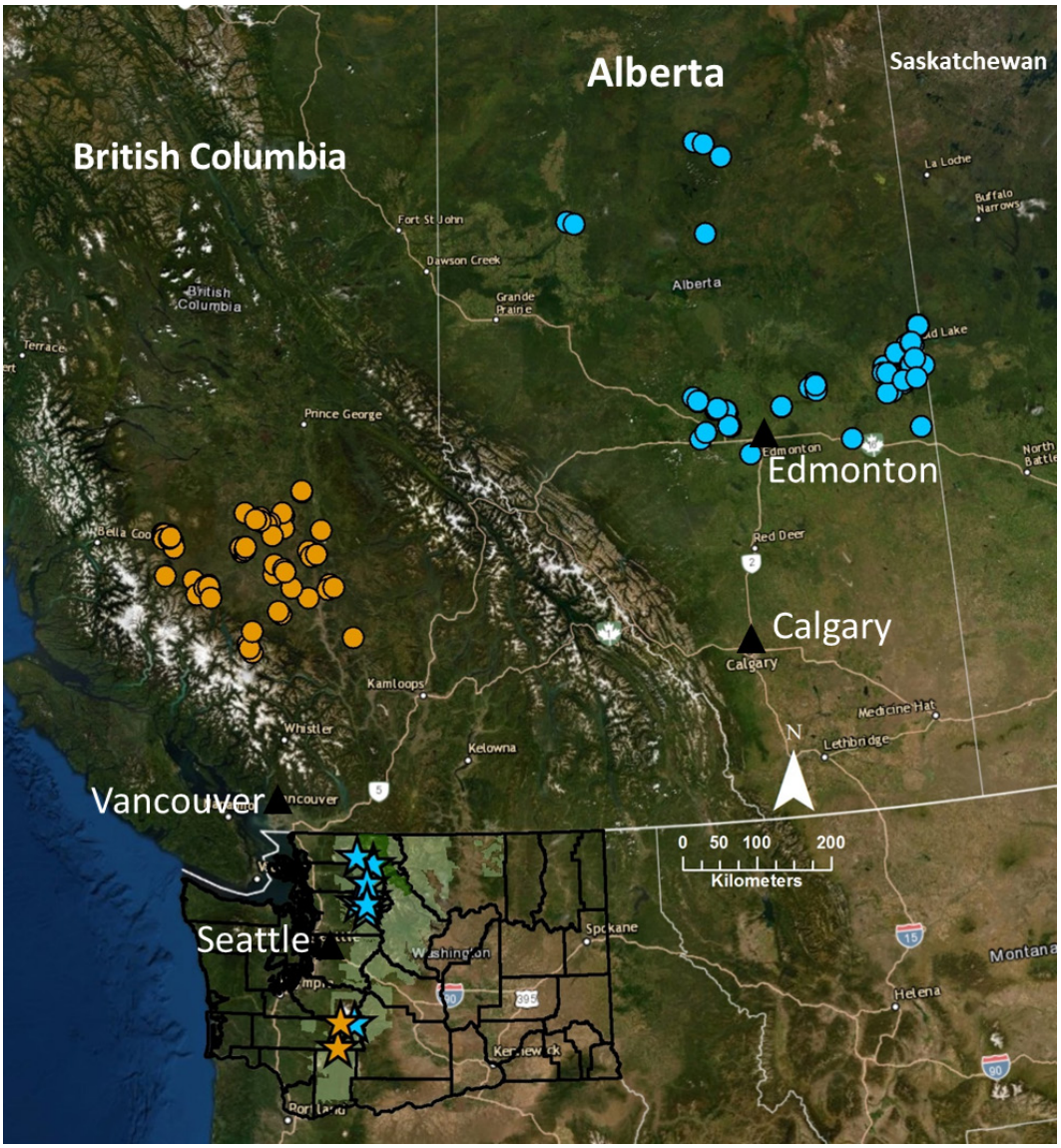

Figure 2. Locations of captures (circles) in British Columbia and Alberta, Canada, and fisher release sites (stars) in the Cascades Fisher Recovery Area. Capture locations for 69 British Columbia (orange circles) fishers correspond to releases in the South Cascades, and capture locations for 101 Alberta (blue circles) fishers correspond to releases in both the North and South Cascades.

North Cascades

We released a total of 89 fishers (48 F, 41 M) in the North Cascades. From October 2018 to March 2019, we successfully captured 26 fishers (15 F, 11 M) in a 125,664 km^2 area in central and north-central Alberta (Table 2, Appendix B): in this report, these 26 fishers are referred to collectively as Cohort 3. From October 2019 to March 2020, we captured 63 fishers (34 F, 29 M) across the same area: in this report, these fishers are referred to collectively as Cohort 4 (Table 2, Appendix B). Following veterinary evaluation at Calgary Zoo, we transported Cohort 3 fishers to Washington and released them on five occasions from 5 December 2018 to 7 March 2019, and we transported Cohort 4 fishers to Washington and released them on 13 occasions from 12 October 2019 to 27 February

2020 (Table 2). Releases took place at seven locations within the North Cascades National Park Service Complex and Mount Baker-Snoqualmie National Forest (Figure 3).

Table 2. The number of fishers released and their release sites in the North Cascades, including locations in North Cascades National Park Service Complex (NOCA) and Mount Baker-Snoqualmie National Forest (MBSNF) from December 2018 through February 2020.

Release site	Date	Females	Males	Total
Newhalem Visitor Center (NOCA)	December 5, 2018	5	1	6
Newhalem Visitor Center (NOCA)	December 13, 2018	0	1	1
Buck Creek Campground (MBSNF)	December 13, 2018	2	3	5
Buck Creek Campground (MBSNF)	January 17, 2019	4	2	6
Buck Creek Campground (MBSNF)	February 6, 2019	2	4	6
White Chuck R.-Sauk R. confluence (MBSNF)	March 7, 2019	1	1	2
Baker River Trailhead (MBSNF)	October 12, 2019	3	3	6
Slide Lake Trailhead - Illabot Creek (MBSNF)	October 17, 2019	1	3	4
Buck Creek Campground (MBSNF)	October 24, 2019	4	4	8
Slide Lake Trailhead - Illabot Creek (MBSNF)	October 31, 2019	4	1	5
Buck Creek Campground (MBSNF)	November 7, 2019	1	2	3
Crystal Creek Trailhead/White Chuck R. (MBSNF)	November 14, 2019	2	4	6
Buck Creek Campground (MBSNF)	November 21, 2019	1	4	5
Crystal Creek Trailhead/White Chuck R. (MBSNF)	November 29, 2019	5	2	7
Buck Creek Campground (MBSNF)	December 5, 2019	4	1	5
Crystal Creek Trailhead/White Chuck R. (MBSNF)	December 12, 2019	3	2	5
Bedal Campground (MBSNF)	January 9, 2020	4	0	4
Bedal Campground (MBSNF)	February 13, 2020	2	2	4
Bedal Campground (MBSNF)	February 27, 2020	0	1	1
Totals	–	48	41	89

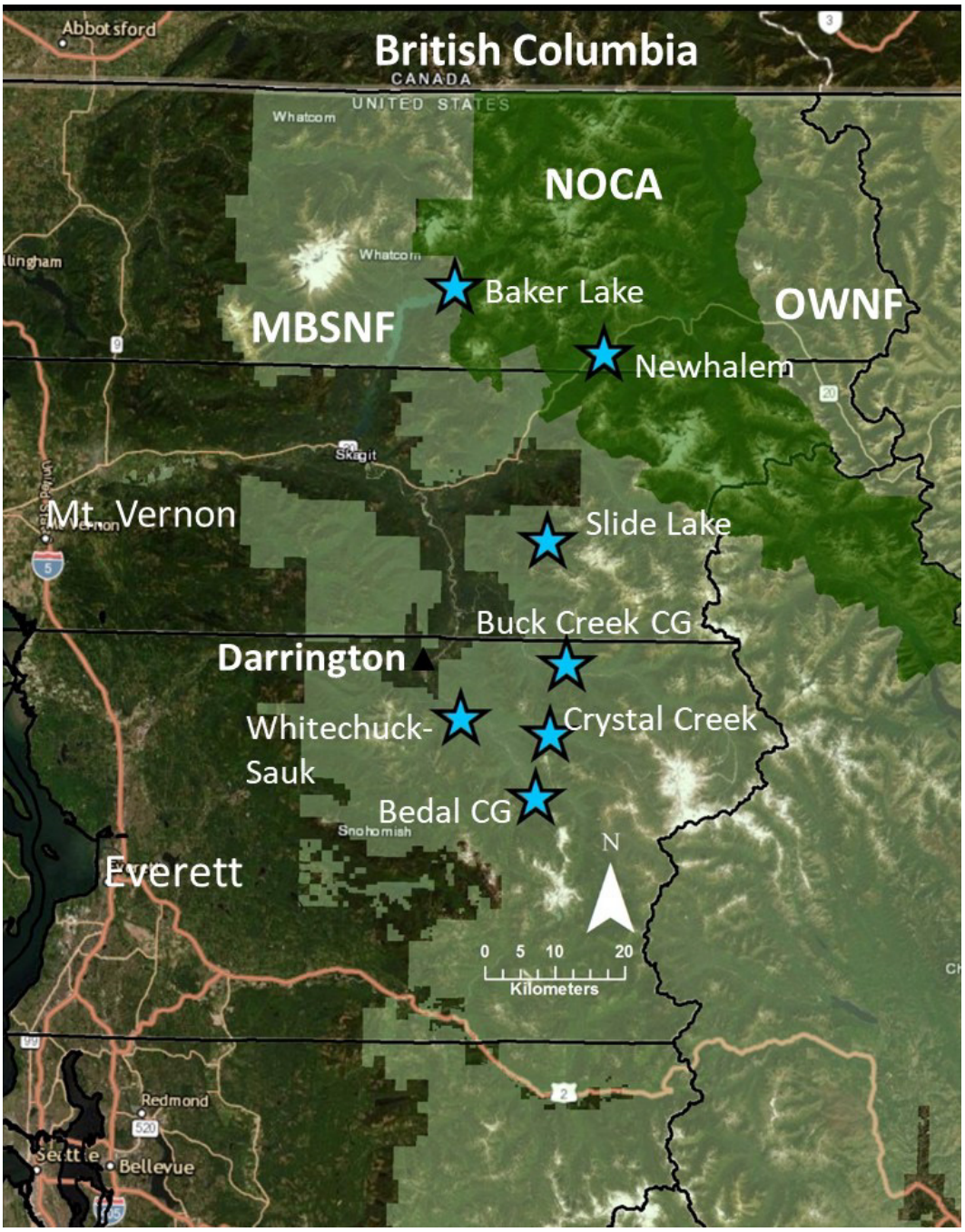

Figure 3. Locations (blue stars) of the seven sites where fishers were released from December 2018 to February 2020 in the North Cascades. MBSNF= Mount Baker - Snoqualmie National Forest, OWNF = Okanogan-Wenatchee National Forest, and NOCA = North Cascades National Park Service Complex.

Objective 2

Our second objective was to release fishers at few locations (preferably two or three sites) to increase the likelihood of fishers interacting, i.e., finding mates, and learning habitat suitability from previously released fishers. We met this objective in the South Cascades by releasing all 69 fishers in Cohorts 1 and 2 at two primary release sites that were approximately 34 km apart (Cispus and

MORA – Longmire), 2015–2017. We released the remaining 12 fishers (from Alberta) at a third location in 2018 that was approximately 27 km away from the previous release sites (MORA – Ohanapecosh; Table 1), in order to help fill in areas around the reintroduction area that appeared to have lower occupancy (but were geographically connected and consisted of good fisher habitat). We met Objective 2 in the North Cascades with Cohort 3, releasing all 26 fishers of that cohort at Newhalem, Baker River, and Buck Creek (Figure 3), but needed to adjust release locations for Cohort 4 due the rapid rate at which fishers were arriving for release. While we used more release sites and alternated the release sites between weeks, the five southernmost release sites were relatively close to each other and still met our goal of focusing releases on few localities, to facilitate social interaction (Figure 3). The average distance between each release site in the North Cascades was 39 km.

Objective 3

Our third objective was to release as many fishers as possible before January 1st in order to facilitate reproductive success, by conducting the reintroduction process well before the active gestation period of female fishers (Facka et al. 2016). Specifically, we aimed to provide females ample time to locate and establish a home range prior to birthing and mating seasons (these two life events overlap from late March to May), so that the stress of the translocation process did not coincide with active gestation and potentially reduce reproductive success. We met this objective in the South Cascades by releasing 24 of 45 translocated females (53%) before January 1st (Table 1), and in the North Cascades by releasing 74% of fishers (35 of 48 females [73%] and 31 of 41 males [76%]) prior to January 1 (Table 2). The 73% success rate for females in the North Cascades is much higher than achieved in the South Cascades (54%, Table 1) or during the Olympic reintroduction project (30%; Lewis 2014). For context, 15 of the 50 females (30%) translocated during the Olympic fisher reintroduction project were released before 1 January (Lewis et al. 2011). Our success in meeting this objective was due to early recruitment of trappers, an earlier trapping start-date in Alberta operations (October 1, instead of November 1 as in British Columbia), more efficient spatial and temporal coordination of trappers, improved financial incentives, and favorable early-season trapping conditions in the fall/winter of 2016/2017 and in the fall of 2018 and 2019.

Objective 4

Our fourth objective was to monitor post-release movements, survival, home range establishment, and reproduction to evaluate initial success of the reintroduction project during the two years following each cohort's release, when we could track fishers with functioning radio-transmitters.

Radio-telemetry

We used very high frequency (VHF) radio-telemetry transmitters to obtain data and evaluate post-release movements, survival, home range establishment and reproduction of released fishers. Our goal was to fly in a fixed-wing aircraft as many as five times per month to locate transmittered fishers; however, poor flying weather (and occasionally pilot/plane unavailability) prevented us from flying this frequently. From the telemetry data collected, we determined fisher locations and survival status (live vs. mortality signal) and assessed movements between locations and the clustering of locations that may indicate home range establishment. We also obtained ground telemetry locations,

as possible, and used those data to help locate potential fisher den sites for reproduction monitoring, and to investigate mortality signals and recover dead fishers to determine causes of death. Supplemental data from verifiable non-telemetry detections (via trail cameras) were used to further document distribution of fishers in the recovery area.

In the South Cascades, we conducted 88 aerial telemetry flights over a period of 34 months (2.58 flights per month) from 26 December 2015 to 19 September 2018, which included 347 hours of flight time, at a total cost of $160,706. During these flights we obtained 861 aerial telemetry locations (533 for females, 328 for males; Figure 3), for an average of 2.48 locations per hour and an average cost of $186.65 per location. We obtained 49 ground telemetry locations (39 for females, 10 for males) in the South Cascades in that same time period. From August 2016 to October 2021, we also received 167 non-telemetry detections that could be verified (e.g., trail camera images, photos and videos from public and partners) (Figure 4). Collectively, these detections ranged across 18,573 km^2 of the South Cascades (Figure 4).

In the North Cascades, we conducted 42 aerial telemetry flights from 15 January 2019 to 21 July 2021, which included 185.9 hours of flight time, at a total cost of $85,565. Required maintenance of our primary airplane and flight restrictions due to the SARS-CoV-2 virus pandemic constrained our ability to locate fishers between January and May of 2020; however, aircraft availability and the lifting of restrictions in May 2020 allowed us to resume some data collection and begin locating missing fishers and reproductive females. During all North Cascades flights, we obtained 231 locations (148 for females, 83 for males; Figure 5), for an average of 1.24 locations per hour and an average cost of $460.18 per location. Because of the break in aircraft service, continued restrictions on personnel in aircraft during the pandemic, and difficulty finding fishers from the air, we invested considerable time in attempting to locate fisher VHF signals from the ground as well. From November 2019 to September 2021, we listened for fishers along 18,040 miles of roads and trails, over the course of 1,199 hours. We obtained 157 ground telemetry locations (111 for females, 46 for males) during those efforts. From January 2019 to April 2021, we also received 110 non-telemetry detections that could be verified (e.g., trail camera images, photos and videos from public and partners). Collectively, these detections ranged across 15,452 km^2 of the North Cascades (Figure 5).

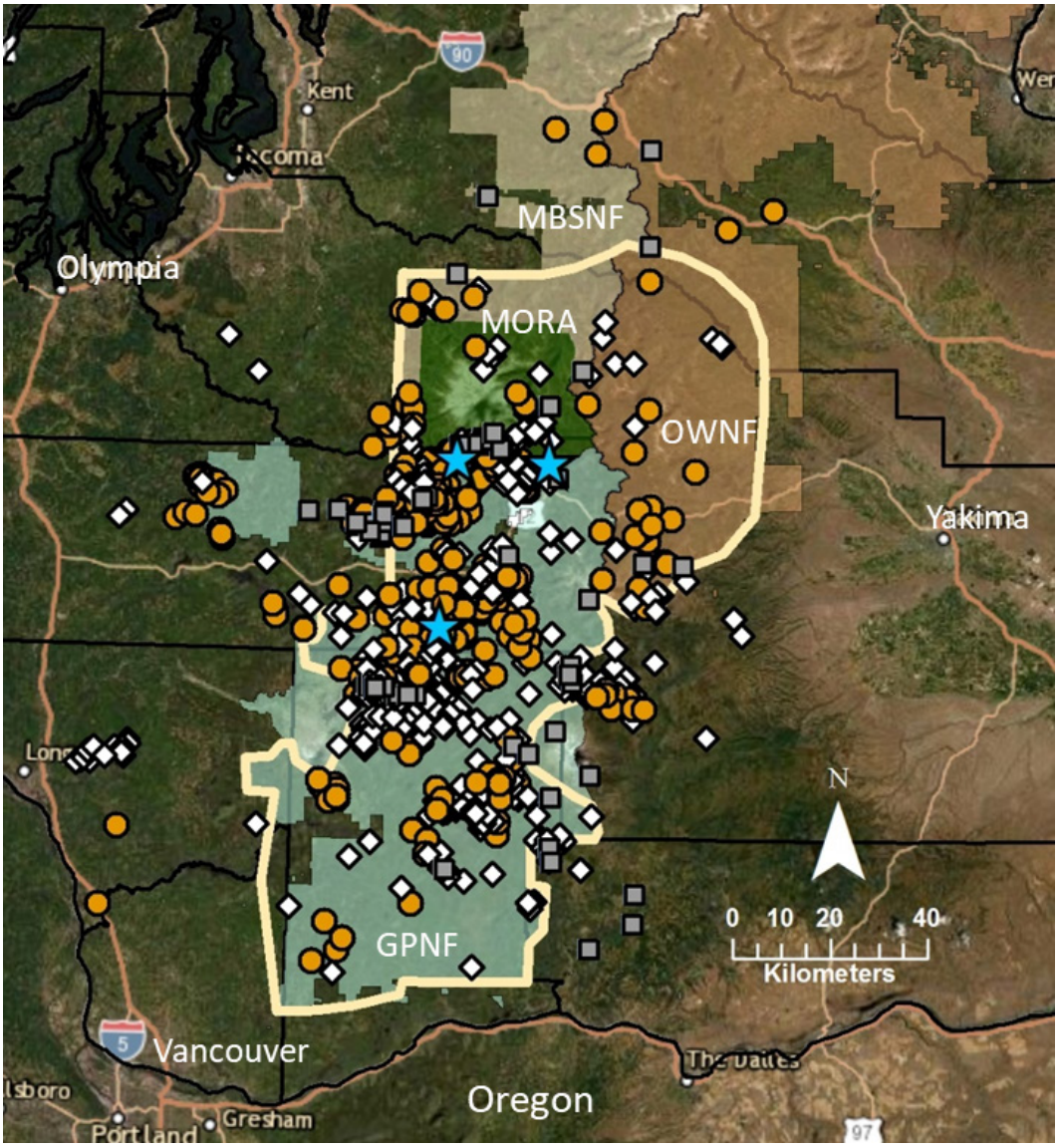

Figure 4. Aerial and ground telemetry locations (*n*=910; 572 female [white diamonds], 338 male [orange circles]) obtained from December of 2015 to September of 2018 for 69 fishers released in the South Cascades (see Table 1). Blue stars indicate the locations of the Mount Rainier National Park – Longmire (northwest star), Cispus Learning Center (southern star), and Ohanapecosh (northeast star) release sites. Additional confirmed non-telemetry detections (*n*=167) from August 2016 to October 2021 are depicted as gray squares.

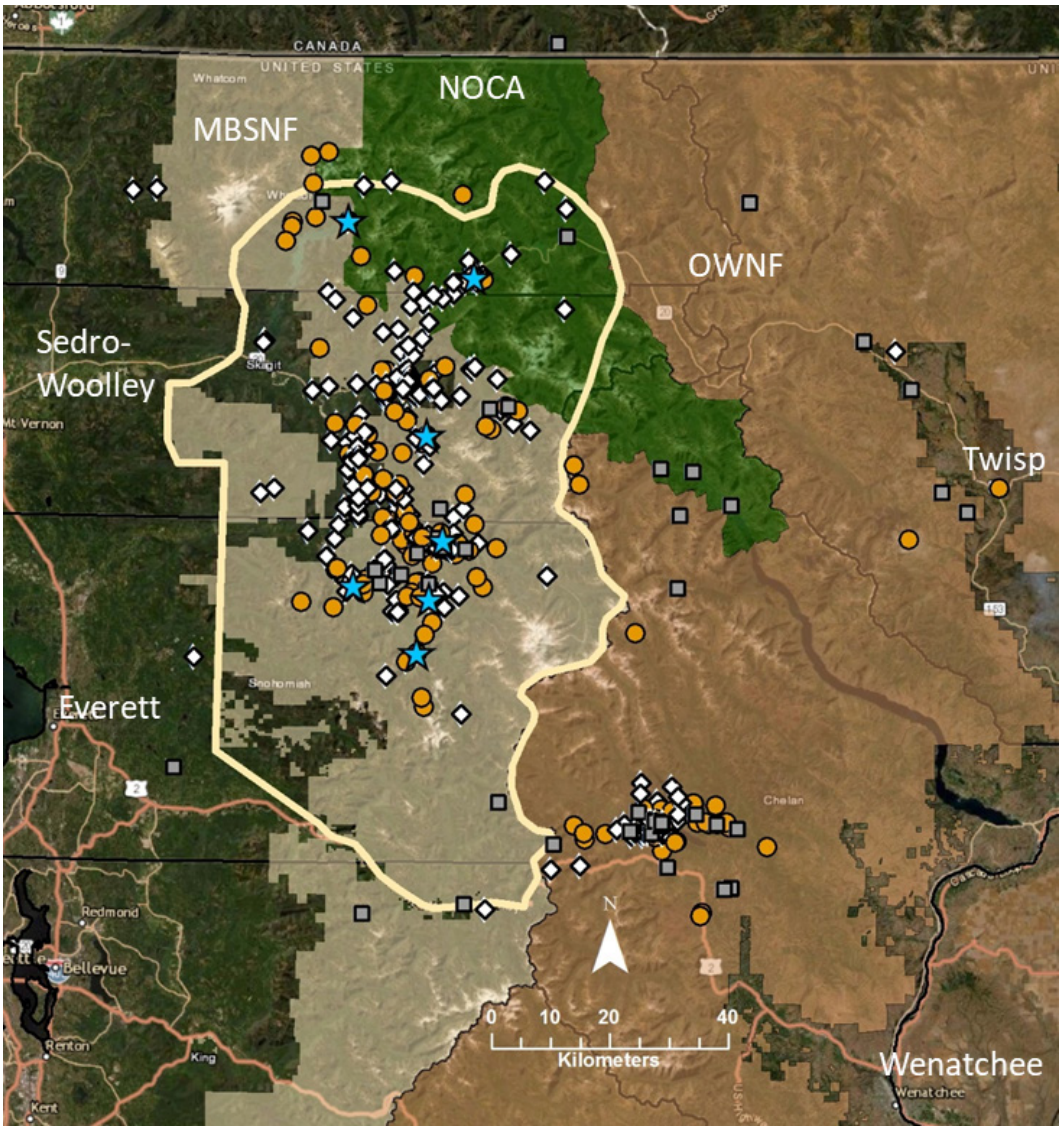

Figure 5. Aerial and ground telemetry locations (*n*=231 locations: 148 female [white diamonds], 83 male [orange circles]) obtained from December 2018 to July 2021 for 89 fishers released in the North Cascades (see Table 2). Blue stars indicate the locations of release sites. Additional confirmed non-telemetry detections (*n*=110) are depicted as gray squares.

Movements and Home Range Establishment

Post-release movements and home range establishment by reintroduced fishers are indicators of how individuals perceive the suitability of the habitat within and outside the recovery area. Home range establishment is especially important for females because pregnant females need a suitable den site within a suitable home range to successfully raise kits, and females that establish home ranges prior to the breeding season are more likely to be found by breeding males. Specifically, we assumed that proximity of initiated or established home ranges to release sites was an indication of the habitat suitability in the reintroduction area.

Our analysis of movements indicated that the mean distance to all telemetry locations for Cohort 1 and Cohort 2 fishers that appeared to initiate and establish a home range within two years of release was 25–26 km from the South Cascades release sites (Table 3). While four fishers from Cohort 3 and Cohort 4 appeared to initiate a home range, only one appeared to establish a home range and it was 52 km from its North Cascades release site (Table 3). Lack of robust telemetry locations prevented us from understanding home range establishment with any precision, but the broad view of distribution of locations on the landscape appeared to indicate that fishers in the North Cascades may have moved farther from release sites than did their counterparts in the South Cascades. 50.2% of all locations in the South Cascades were within the defined 9,320 km^2 reintroduction area during the years of telemetry monitoring (Figure 4) and 42.7% of all locations in the North Cascades were within the defined 6,596 km^2 reintroduction area during the years of monitoring (Figure 5).

Table 3. Number of fishers initiating and establishing a home range within two years of release, and mean distance from their release site to the center of their estimated home range in the Washington Cascade Range. *N* is the total number of fishers released with a radio-transmitter.

Population Segment	*N*	Number initiating a home range (%)	Number initiating and establishing a home range (%)	Mean distance from release site to center of initiated home range (±SE)
North Cascades Females	42	3 (7.0)	1 (2.3)	52.2 ± 7.8 km
North Cascades Males	38	1 (2.6)	0 (0.0)	65.5 ± -- km
South Cascades Females	38	13 (34.2)	6 (15.7)	26.5 ± 4.6 km
South Cascades Males	31	10 (32.2)	2 (6.4)	25.0 ± 4.6 km

The apparent shorter mean distance estimated between release site and center of home range in the South Cascades indicates that many fishers used landscapes relatively close to the Cispus release site and the center of the reintroduction area, avoiding extended movements away from a release site that may have posed greater mortality risks (and see *Survival and Mortality*). The mean distance to home range appeared to be less for Cohort 2 females (23.7 km) and substantially smaller for Cohort 2 males (19.6 km) as compared to Cohort 1 fishers (F = 26.8 km, M = 24.7 km). This shorter distance may also be an indication that the presence of previously released fishers (i.e., Cohort 1 fishers) prompted Cohort 2 fishers to remain close to the fishers that occupied areas near the release sites. That effect also suggests that releasing fishers in Mount Rainier National Park facilitated greater occupancy of the recovery area within the Park, and on national forest lands to the south and southwest of the Park (Figure 6).

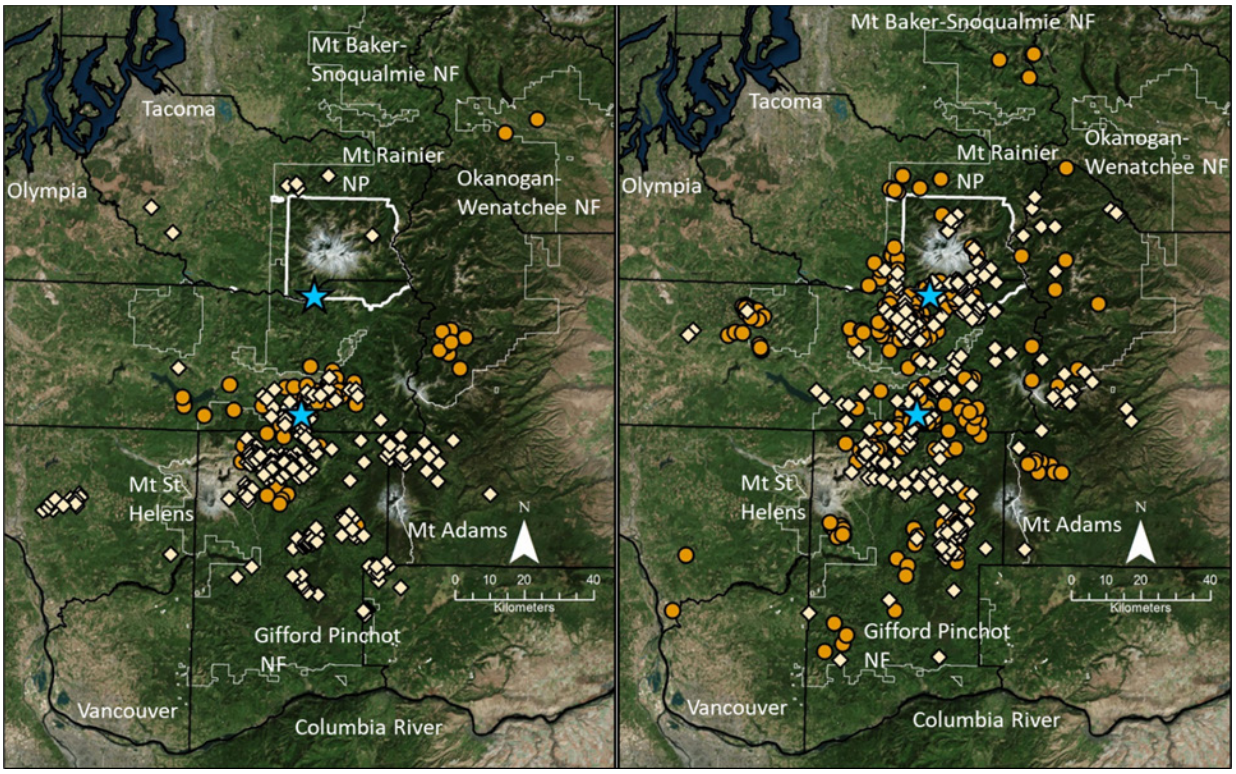

Figure 6. Locations of male (orange circles) and female (white diamonds) fishers from Cohort 1 (those released fall/winter of 2015/2016; all at one release site, the Cispus Learning Center; left graphic) and from Cohort 2 (released at two release sites, fall/winter of 2016/2017; right graphic). The two blue stars indicate the Mount Rainier National Park - Longmire (northern star) and Cispus Learning Center (southern star) release sites.

Compared to the earlier Washington fisher reintroduction efforts on the Olympic peninsula, the mean distances to home ranges observed for fishers released in the South Cascades tended to be smaller than those observed for Olympic fishers (i.e., 30.1 km^2 for females; 44.5 km^2 for males [Lewis 2022a]). Differences in distance to home ranges may have arisen from proximity and timing of releases (i.e., initial density and intraspecific interactions) and prey distribution and availability, as well as differences in habitat types between the Olympic Peninsula and the Washington Cascade Range (also see Humphries [2022], who estimates prey differences between the North and South Cascades).

Survival and Mortality

We set Objective 1 for total number of fishers to release (≥80 each, in South and North Cascades) based annual survival rates of ≥50%, as parameterized in the reintroduction feasibility assessment (Lewis and Hayes 2004). We estimated survival rates using the Kaplan-Meier methods, modified for staggered entry of radio-collared animals (Pollock et al. 1989). In the South Cascades, we observed 16 mortalities (10 F, 6 M) during the first year post-release, and we estimated first year survival rates as 73% (95% CI = 57–89%) for females and 76% (95% CI = 60–93%) for males, with a total survival rate (all fishers) of 76% (95% CI = 65–87%) (Table 4). In the North Cascades, we observed 29 mortalities (17 F, 12 M) during the first year post-release, and we estimated first year survival

rates as 42% (95% CI = 22–62%) for females and 38% (95% CI = 16–61%) for males, with a total survival rate (all fishers) of 40% (95% CI = 24–55%) (Table 4). The highest survival rate by demographic was for juveniles (fishers translocated the same year they were born) in both the South and North Cascades. Juvenile females represented the highest survival of all ages and across all cohorts, at 83% (95% CI = 63–100%) in the South Cascades, and 55% (95% CI = 18–91%) in the North Cascades (Table 4). This rate in the South Cascades is higher than as reported in most established populations (Lewis et al. 2022b). At a shorter, but biologically important time scale, survival of fishers through the first breeding season (1 March–30 June) when individuals could have genetically contributed to the population, was relatively high in both reintroduction areas, with an estimated survival rate of 79% (95% CI = 69–88%) in the South Cascades and 61% (95% CI = 45–77%) in the North Cascades (Table 4). Survival rates were higher during kit-rearing season (1 July–30 September) than during the breeding season of the first post-release year, meaning that fishers who may have bred had a high probability of surviving long enough to successfully raise their kits. This rate was 96% (95% CI = 90–100%) in the South Cascades, and 89% (95% CI = 71–100%) in the North Cascades (Table 4).

Table 4. Estimated survival (*S*) rates and 95% Confidence Intervals (CI) for total number of fishers (*N*) with sufficient telemetry detections to estimate survival in the northern and southern portions of the Cascades Fisher Recovery Area, during their first year post-translocation.

Demographic or Season	S_{South}	S_{South} 95% CI	N_{South}	S_{North}	S_{North} 95% CI	N_{North}
Females (All)	0.73	0.57–0.89	38	0.42	0.22–0.62	42
Females (Juvenile)	0.83	0.63–1.00	18	0.55	0.18–0.91	19
Females (Adult)	0.69	0.45–0.93	20	0.32	0.09–0.56	23
Females (Cohort 1)	0.82	0.59–1.00	11	–	–	–
Females (Cohort 2)	0.68	0.47–0.90	27	–	–	–
Females (Cohort 3)	–	–	–	0.48	0.09–0.87	14
Females (Cohort 4)	–	–	–	0.37	0.15–0.59	28
Males (All)	0.76	0.60–0.93	31	0.38	0.16–0.61	38
Males (Juvenile)	0.76	0.55–0.96	21	0.38	0.08–0.67	18
Males (Adult)	0.78	0.48–1.00	10	0.37	0.03–0.70	20
Males (Cohort 1)	0.67	0.36–0.97	12	–	–	–
Males (Cohort 2)	0.83	0.64–1.00	18	–	–	–
Males (Cohort 3)	–	–	–	0.14	0.00–0.39	12
Males (Cohort 4)	–	–	–	0.49	0.21–0.77	26
All Juveniles	0.79	0.65–0.93	39	0.47	0.23–0.70	37
All Adults	0.72	0.53–0.90	30	0.35	0.16–0.55	43
All Fishers	0.76	0.65–0.87	69	0.40	0.24–0.55	80
Orientation Period [a]	0.99	0.95–1.00	68	0.73	0.63–0.84	67
Breeding Season (1 Mar–30 Jun)	0.79	0.69–0.88	67	0.61	0.45–0.77	37

[a] From first release date to 28 February: 12 October–28 February for North Cascades (139 days); 3 December–28 February for South Cascades (87 days)

Table 4 (continued). Estimated survival (S) rates and 95% Confidence Intervals (CI) for total number of fishers (N) with sufficient telemetry detections to estimate survival in the northern and southern portions of the Cascades Fisher Recovery Area, during their first year post-translocation.

Demographic or Season	S_{South}	S_{South} 95% CI	N_{South}	S_{North}	S_{North} 95% CI	N_{North}
Kit-rearing Season (1 Jul–30 Sep)	0.96	0.90–1.00	51	0.89	0.75–1.00	18
Fall-Winter Season (1 Oct–28 Feb)	0.95	0.88–1.00	44	0.87	0.71–1.00	16

[a] From first release date to 28 February: 12 October–28 February for North Cascades (139 days); 3 December–28 February for South Cascades (87 days)

Overall, we observed moderate to high survival rates for males and females in the South Cascades and moderate to low survival rates for males and females in the North Cascades, as compared to survival in established fisher populations (Lewis et al. 2022b). The precision of many of our estimates is low, and the true implications of these survival rates at the population level are confounded with the nature of distribution, habitat connectivity, and reproductive success. Our estimates are limited to the fishers that had adequate detection histories for their first year post-release. Nine fishers (5 F, 4 M) in the North Cascades were never detected after the day of their release. Two additional males were never found after a week post-release, and four other fishers (2 F, 2 M) were never found after a month post-release. The fate of these fishers cannot be assumed or estimated based on the fate of fishers that were detected because the nature of aerial radio-telemetry is biased toward detecting mortalities (stationary signals through time), as opposed to signals emitted from live fishers moving around the landscape and occasionally undetectable. We do not know if the missing fishers were present with failed transmitters, or had left the survey area; however, given the transmitter performance issues we experienced throughout the project, failed transmitters are a likely explanation (see *Challenges Encountered*). It is quite possible that empirical survival rates across the entire population are higher than estimated and some of these missing fishers (that were censored from analysis) may still be contributing to the establishment of a self-sustaining population within the recovery area.

We detected a total of 28 fisher mortalities (17 F, 11 M) in the South Cascades and recovered the remains, or a transmitter (or both), from 22 (16 F, 6 M) of them. In the North Cascades, we located a total of 34 fisher mortalities (19 F, 15 M), and we recovered the remains, or a transmitter (or both), from 18 (9 F, 9 M) of them. Of the total 40 recovered mortalities, we determined a likely cause of death for 24, based on necropsies performed at Northwest Trek Wildlife Park (Eatonville, Washington) or Colorado State University Veterinary Hospital (Fort Collins, Colorado). From these carcasses, we swabbed potential bite wounds, exposed tissues, or exposed transmitters, from 14 fishers (10 F, 4 M) for carnivore DNA and submitted nine of them (6 F, 3 M) to the Integrated Ecology Research Center (Blue Lake, California) for DNA sequencing. We also investigated histopathology as possible, looked for pathology around implant transmitter sites, and conducted toxicology analyses on liver and brain tissue (see the later section, *Anticoagulant Rodenticide*). We banked tissue samples with the National Park Service and the Burke Museum (Seattle, Washington).

Necropsy results indicated that eight fishers died from human actions, including: one female illegally killed by a trapper, five hit by cars (but see M172 toxicology results), and two under suspicious

circumstances (Appendix B). One male fisher (M005) died of wounds consistent with intraspecific aggression, while 13 fishers (12 F, 1 M) appear to have been killed by another carnivore (Appendix B). Six of those 12 depredated females were juveniles (<1 year old), and the only depredated male was a juvenile. Three DNA samples from swabbed carcasses were successfully sequenced to a predator species identity: the sample from F045 was positive for bobcat (*Lynx rufous*), M121 was positive for mountain lion (*Puma concolor*), and F116 was positive for both bobcat and mountain lion (likely one species was a scavenger). A sample from female F118 sequenced positive for a felid predator but could not yield species identification. Two fishers (M016 and F148) appear to have died from accidents: both animals were tangled in woody debris and/or underwater, following high-flow/landslide events. We could not determine cause of death for 16 fishers whose mortality site was found, but not enough remained of the animal to necropsy.

Fifteen fishers (12 F, 3 M) were recovered soon enough post-mortem that internal tissues were sufficiently intact to evaluate tissues around the implant transmitter site (Table 5). Two female fishers (F021, F045) exhibited histological evidence of omental or mesenteric steatitis (an inflammatory condition) that may have been associated with the implanted transmitter. F021 exhibited slightly dark and enlarged mesenteric lymphatic malformations, but no gross evidence of adhesions was associated with the transmitter. F021 had carried her transmitter for 434 days at the time of death, and F045 had carried her transmitter for 134 days at the time of death (Table 5). No evidence of pathology, abscess formation, or adhesions around the transmitter was found in the other 13 fishers, who carried their transmitters for 31–823 days (Table 5). Aside from traumas related to cause of death, scavenging, or decomposition, no other remarkable findings were noted on necropsied fishers. Female F130 did exhibit numerous small white foci on the caudal lobe of her liver, but the other lobes of the liver appeared normal and all toxicology analyses were negative. Four fishers did test positive for at least one anticoagulant rodenticide compound, but none were indicated as the primary cause of death (see the later section, *Anticoagulant Rodenticide*).

Table 5. Necropsy notes for fishers recovered sufficiently intact post-mortem to evaluate the implant transmitter site. Days with transmitter is calculated as the number of days between implant surgery and detection of death.

Fisher ID	Age at Implant	Days with Transmitter	Necropsy Notes
F002	4	823	No evidence of pathology, abscess formation, or adhesions
F021	2	434	Histological evidence of steatitis: no abscess formation or adhesions
F045	0	134	Histological evidence of steatitis: no abscess formation or adhesions
F047	2	197	No evidence of pathology, abscess formation, or adhesions
F051	1	522	No evidence of pathology, abscess formation, or adhesions
F052	0 [a]	313	No evidence of pathology, abscess formation, or adhesions
F065	3	152	No evidence of pathology, abscess formation, or adhesions
F086	2	234	No evidence of pathology, abscess formation, or adhesions
F096	0	695	No evidence of pathology, abscess formation, or adhesions

[a] Age assigned by veterinarian because dental cementum analysis was inconclusive

Table 5 (continued). Necropsy notes for fishers recovered sufficiently intact post-mortem to evaluate the implant transmitter site. Days with transmitter is calculated as the number of days between implant surgery and detection of death.

Fisher ID	Age at Implant	Days with Transmitter	Necropsy Notes
F116	0	73	No evidence of pathology, abscess formation, or adhesions
F118	0	105	No evidence of pathology, abscess formation, or adhesions
F130	0	132	No evidence of pathology, abscess formation, or adhesions
M112	0	31	No evidence of pathology, abscess formation, or adhesions
M124	0	50	No evidence of pathology, abscess formation, or adhesions
M172	2	141	No signs of pathology: band of fibrin around transmitter

[a] Age assigned by veterinarian because dental cementum analysis was inconclusive

Understanding the differences in estimated survival between the South Cascades and North Cascades is difficult, due to many factors, including disparate source populations and genetic characteristics, staggered release dates and stochastic events, differences in terrain and habitat characteristics, and potential differences in prey availability and predator diversity and/or density. Humphries (2022) evaluated some of these differences between the South Cascades and the North Cascades and found relative abundance of important fisher prey species was significantly lower in North Cascades. Fisher habitat in the North Cascades is also more dendritic in nature, fragmented by high mountains, glaciers, and other features not preferred by fishers. Fishers released in the North Cascades may have dispersed farther during initial establishment than fishers released in the South Cascades, but radio-telemetry data were insufficient to adequately assess this measure (see *Movements and Home Range Establishment*). That initial establishment period is higher risk for fishers because they do not have the benefits of local resource knowledge, and are more exposed to predators, compared to a fisher with an established home range; however, estimated survival during the orientation period in this project was quite high (Table 4). Future monitoring of the entire Cascades Fisher Recovery Area will help us better understand where fishers established, and ultimately survived long enough to produce descendants.

Reproduction

We attempted to document reproduction by using clusters of telemetry locations for females that were spatially constrained to a localized area much smaller than a home range, during the breeding season. Once identified, we used ground-based telemetry to locate that female, and then quietly searched the area for signs of a likely den tree. On several occasions, we detected a female occupying what appeared to be a potential den tree. These den trees generally included a visible cavity opening roughly 10–12 cm in diameter (large enough for a female to enter, but not a male), and sometimes with claw marks discernable on the lower trunk of the tree where a fisher had been climbing (Figure 7). Once a potential den tree was located, we quietly deployed an array of trail cameras (Reconyx HC2X Hyperfire 2, Reconyx, Inc., Holmen, Wisconsin) around the base of tree, which were equipped with an infrared flash for nocturnal events so as not to startle fishers or other wildlife. We did not revisit the site until a telemetry signal had been detected consistently away from the area,

indicating abandonment of that den site. Fishers are known to move their kits several times during the kit-rearing season (Powell 1993).

Figure 7. Den cavity opening in a standing deciduous tree, used by female fisher F105, near Lake Wenatchee, Washington.

We were not able to confirm any reproduction among Cohort 1 females during their first spring post-release (2016). Five females in Cohort 1 were of potential breeding age in the spring of 2016, but we did not have sufficient aerial telemetry locations to indicate the localized movements indicative of possible reproduction. We documented reproduction by female F023 (Cohort 1) in May 2017. She was released on 6 February 2016 at 10 months of age, and mated with a reintroduced male fisher in April 2016 at ~1 year of age. In March, April and May of 2017, we found F023 using a small, localized portion of her home range, and in May 2017 we set up trail cameras around a tree we suspected was F023's den site. We obtained photos from this site that showed F023 carrying one kit down this den tree on 1 June 2017 (Lewis et al. 2018).

Female F082 (Cohort 2) was released on 20 February 2017, at ~11 months of age. F082 mated with a male in Washington in the spring of 2017, at one year of age, and gave birth to at least one kit in late March or early April of 2018 at two years of age, which is the youngest age a female fisher can give birth (Mead 1994). We also documented female F082 using a localized area during spring 2018 in the Gifford Pinchot National Forest, near the southwest corner of MORA. We set up cameras at a possible den tree on 14 June 2018 and we revisited the site on 19 June 2018. These cameras captured photos of female F082 repeatedly climbing the den tree with prey items (e.g., a squirrel and a mountain beaver) on 16 and 18 June 2018 (Figure 8). While we did not detect a kit at this time, F082's behavior was consistent with a female provisioning kits.

Figure 8. Female fisher F082 was photographed ascending her den tree with a mountain beaver (*Aplodontia rufa*) in her mouth on 16 June 2018 (left), was detected with a kit on 4 July 2018 (center), and about to ascend a den tree at a second location on 11 September 2018 (right).

On 4 July 2018, we revisited the den site and obtained several photos of F082 interacting with a single kit on the ground by the den tree (Figure 8). The kit appeared to be exploring the area around the den tree while F082 watched over it and attempted to pick it up and move it. F082 appeared to move away from this den site and we were able to set up cameras at a second suspected den site in early September. At this second site, we obtained photos of female F082 repeatedly ascending the suspected den tree and carrying at least one prey item. Based on the evidence we obtained in these photos, it appeared that F082 was still provisioning at least one kit at this site from 11 to 22 September 2018, which indicates the survival of at least one kit for ≥6 months.

Two females in Cohort 3 (2018/2019), and eight females in Cohort 4 (2019/2020) were ≥1 year old and could have been pregnant at the time of release. We did not observe denning behavior among Cohort 3 females in 2019, and monitoring of Cohort 3 and Cohort 4 during denning season in 2020 was preempted by the statewide shelter-in-place order due to the SARS-CoV-2 pandemic. We expect that some of the Cohort 3 and Cohort 4 females bred in 2020, but our lack of telemetry flights during the critical denning period limited our ability to confirm reproduction that year. Once flight restrictions began easing in May 2020, we began searching for reproductive females within the North Cascades reintroduction area. Two females from Cohort 3, F096 (born the same year as release) and F105 (2 years old at release), appeared to have limited their movements in 2020, exhibiting activity patterns consistent with denning behavior, but reproduction could not be confirmed. We again detected F105 limiting her movements in March 2021, and we installed remote trail cameras around her suspected den tree on 26 March 2021. That same day, we detected her descending the tree with something small and unidentifiable in her mouth. She did not return to the den, but we again detected her limiting movements at another potential den tree, and installed cameras at that location on 14 April 2021. Those cameras recorded video and audio of her apparently mating with a male fisher at the base of her den tree on 16 April 2021. On 18 April 2021, we confirmed the first reproduction known in the North Cascades when F105 was filmed moving four kits from her den (Figure 9).

Based on the size and grey coat color of the kits, we estimate that they were approximately 4 weeks old at the time of the photos. It is likely that having a male discover F105's den site prompted her movement.

Figure 9. Female fisher F105 moving her young kits from a den tree near Lake Wenatchee, Washington, April 18, 2021.

We achieved our reintroduction goal by confirming reproduction by at least one female in each portion of the Cascades Fisher Recovery Area. Although we suspected denning by several other females based on localized behavior documented through aerial and ground-based radio-telemetry, our field teams could not confirm denning by documenting those females. Reproduction by 2-year-old females (F023 and F082) is particularly meaningful because it indicates that even young adult females have the essential resources in the recovery area to produce young, which is a positive indication for population reestablishment. Our documentation of female F105 producing a litter of four kits is noteworthy, as four kits is the largest litter size reported for fishers in western North America.

Capture, Transport, Husbandry, and Veterinary Assessments

Capture

The National Park Service Detailed Implementation Plan for Re-establishing Fisher in the Washington Cascades (NPS Project 195423) guided the general capture, housing, and transport of fishers while the project was operating in British Columbia, and then was modified when the project needed to transition to Alberta and a new set of partners. Throughout the length of the project, we operated under permit from the appropriate governing agencies, including primary research/capture/possession permits from: BCFLNRO Wildlife Act Permit WL15-178739 (2015, and as amended through 2017), and ABMOEP Research Permits 18-721, 19-014, 20-014, and 21-032.

Institutional Animal Care and Use Committee (IACUC) review and approval of our animal capture, handling, and care protocols was performed by various entities across the large collaboration, and through time. The National Park Service did not assign IACUC review to our project because all animal capture and veterinary work was being performed in another country and outside of NPS jurisdiction, so in British Columbia (2015–2017) we followed veterinary review of our protocol from the BCFLNRO (approved in Wildlife Act Permit WL15-178739). We modified that protocol for 2018–2020 operations in Alberta, and that protocol was reviewed and approved by the Calgary Zoo Welfare, Ethics, and Research Committee (CZWERC 2018-15). All animal handling procedures met or exceeded guidelines of the American Society of Mammalogists for the use of wild mammals for research (Sikes and the Animal Care and Use Committee of the American Society of Mammalogists 2016). All health assessments, veterinary care, drug administration, and biological sample collection were conducted by, or under supervision from, licensed veterinarians in British Columbia (Dr. Doug Magnowski [Animal Care Hospital of Williams Lake]), Alberta (Dr. Sandie Black, Dr. Doug Whiteside, and Dr. Adriana Pastor [Calgary Zoo]), and in Washington (Dr. Allison Case [Northwest Trek Wildlife Park]), with additional guidance and situational assistance from NPS Wildlife Health Branch veterinarians and WDFW veterinarians.

We worked with licensed fur trappers in both British Columbia and Alberta to capture fishers, via contract between Conservation Northwest and trapping coordinators in each province. We worked with these coordinators and Ministry officials to determine where fishers would be captured, and in British Columbia limits were set by BCFLNRO for number of fishers allowed to be captured by management area. In Alberta, trapping areas by management area were defined in the research permit. At the beginning of each season, we worked with the local coordinators to train the enrolled trappers in capture goals, safe techniques of live capture, safe techniques for transferring fishers from traps to transport boxes, and operation of transport boxes. We also provided strict guidelines for animal care (length of time in a box, transport limitations, access to food and water, etc.) as per our established protocols. We furnished all equipment to participating trappers. We also developed a payment schedule and guideline to provide sufficient financial incentive for trappers to provide healthy fishers for translocation, and developed a protocol and alternate payment amount for fishers that failed to meet the health criteria for translocation (see *Veterinary Assessments*).

Fisher capture season for this project in British Columbia ran from 1 November to 15 February each year (concurrent with the fur trapping season), and in Alberta ran from 1 October to 15 February each year (partially concurrent with the fur trapping season). All fishers were captured using a Tomahawk™ (Hazelhurst, Wisconsin) Live Trap model 207 or similar trap (81 x 24 x 30 cm wire cage trap). Specific baiting and trap set techniques were implemented based on the trappers' expertise. We built and provided trappers with wooden fisher transport boxes (40 x 40 x 90 cm) (Figure 10) and trap-to-box connectors. These boxes were designed to temporarily house fishers in a safe transport container that did not contain metal edges (which might damage teeth or claws), and provided darkness, bedding, and water, while also allowing handlers to clean boxes and provide food and water via a removable partition. Once each fisher was loaded into a transport box, the trapper would contact the coordinator, who would then meet the trapper and transport the fisher to the longer-term housing facility. We required transports to be conducted within secondary confinement, which generally involved securing occupied transport boxes to the bed of a pick-up truck that was equipped with an enclosed canopy.

Figure 10. Individual fisher transport boxes, closed with center partitions in place (left), and an individual fisher transport box, open on one side, with partition removed (right). Partitions may be used to contain a fisher in one end of the box for staff to safely access the other end for cleaning or providing water or food.

Housing and husbandry

We contracted with partners at a private facility in Williams Lake, British Columbia, and at Calgary Zoo in Alberta to provide captive care and housing for fishers while they were quarantined and underwent health assessments by the veterinary team. Within each captive facility, captured fishers

were placed within individual housing units that consisted of a cubby box, with external run space that included natural structures like branches and logs (Figure 11). Such natural structures allow for chewing and climbing, and provide additional resting sites (LaBarge 1987, Frost and Krohn 1994). Housing units at all locations were placed within secondary containment (inside a closed building, or outside with fully fenced secondary perimeter and roof) and were located in quiet areas with minimal human disturbance. Full capacity at each location averaged 14 housing units. Each facility was staffed by captive wildlife specialists and/or licensed veterinarians and veterinary staff. On arrival, each fisher was visually assessed (without handling) for body condition, obvious injuries, and behavior. Fishers were not handled for 48 hours or more to allow recovery from trapping and transfer. Once in housing, staff checked on each animal at least twice daily in order to monitor well-being, and to feed, water, and clean the enclosure. At Calgary Zoo, indoor housing units were also monitored by remote camera (see *Behavior of Fishers in Captivity*).

Figure 11. A fisher housing unit at the project captive facility in Williams Lake, British Columbia, Canada on a stand, with cubby box and run (left), and a fisher housing unit at Calgary Zoo in Alberta, Canada, with a cubby box and run (right).

Each captive fisher was provided natural bedding, a litter box, ad libitum water, and a diet that promoted weight-gain. Captive fishers have historically been fed a variety of foods including venison or ground beef, mice or rabbits, mink or ferret chow, eggs, and nutritional supplements (Frost and Krohn 1994, Fontana et al. 1999, Mitchelltree et al. 1997). We provided fishers with generous daily portions of a variety of foods (~400 g for females, ~550 g for males) to encourage weight gain. In British Columbia, we provided fishers with a diet consisting of chicken, eggs, salmon, venison, moose, beef, rabbit, and beaver meat, as well as an occasional squirrel carcass. These foods were

largely donated by trappers and local biologists. In Alberta, trappers fed fishers beaver, hare, or lynx meat if an animal was held overnight or had a long transport. Once at Calgary Zoo, fishers received a diet of feline carnivore diet (Toronto Zoo Feline Diet, Markham, Ontario, Canada), herring, smelt, whole mice, and whole chicks. While most fishers ate within the first 24 hours, some took two or three days to settle in and begin eating well. Arrival and exit weights were not tracked closely in British Columbia, but nearly all fishers in Alberta gained weight while in captivity (see *Stress Characteristics*).

Fishers were expected to spend from one to three weeks in captivity. Duration of captivity was determined by the minimum time needed to settle in and have health assessments completed, and by how many animals were captured and available for transport to Washington at a given time. Typically, fishers were not transported to Washington until there were five or more animals that cleared health assessments and could be shipped at one time. Consequently, some individuals spent more time in captivity than others.

Stress characteristics

We worked to reduce stress in captured fishers throughout the course of the project and quantified much of the process during Alberta operations. These efficiencies included 1) minimizing time in captivity, 2) using plastic/plexiglass-lined traps to prevent fishers from biting the metal mesh of a box trap and damaging their teeth, 3) mandating trappers check traps at minimum once every 24 hours, 4) mandating trappers move fishers into wooden transport boxes with bedding material quickly after discovery in the trap, and 5) coordinating trapping efforts so that multiple traps were pre-baited and locked open (i.e., set not to catch) until fishers were detected and then set simultaneously, such that multiple animals were caught within a region on the same night and could be transported together (minimizing wait time for drivers, and fishers in boxes). Throughout all transports from trap to release, fishers spent an average of 39.7 hours in a transport box (with food, water, and bedding), split among an average of six transport events (that included ATV, snowmobile, truck, and/or airplane travel) (Table 6). They were moved between boxes and enclosures an average of 6.7 times while in captivity (including trap to transport box, out of and into enclosures for veterinary exams, and release).

Table 6. Transport and captivity measures for captured fishers in Alberta, Canada, that were subsequently translocated to Washington.

Measure	Average	Min	Max
Trap nights with traps actively set to capture	3.8	1	29
Time between last trap check and fisher discovered in trap (hours)	23.4	12.5	31.5
Number of independent motorized transport events	6.1	3	9
Number of enclosure transfers (trap-box, box-box, box-pen, box-release)	6.7	5	12
Number of cumulative overnights in transport box	1.2	0	6
Number of cumulative hours in a box in motion, travelling by truck	12.9	5.9	30.9
Number of cumulative hours in a box in motion, travelling by ATV / Snowmobile	0.20	0	4
Number of cumulative hours in a box in motion, travelling by airplane	1.4	0	1.9
Number of cumulative hours in a box that is not moving	25.1	2.6	74.3
Total cumulative hours in a transport box	39.7	14.8	93.5
Total nights in captivity (including medical holdsa)	17.4	6	88
Total nights in captivity (excluding medical holdsa)	15.6	6	40
Average weight gain in captivity (F)	0.5 kg	−0.05 kg	1.8 kg
Average weight gain in captivity (M)	0.7 kg	−0.6 kg	2.1 kg

[a] Fishers requiring short-term medical attention were held for additional time in captivity at Calgary Zoo until veterinarians cleared them for transport and release.

Average time in captivity was 15.6 days (range = 6–40) for fishers captured in Alberta and translocated to Washington (Table 6). In British Columbia, average time in captivity was 13 days (range = 3–28). Comparatively, the mean time in captivity for fishers reintroduced to the Olympic Peninsula was 21 days. This reduction in captive time for the Cascades was accomplished through improved efficiencies in capture and ground transport strategies, and commercial airline shipment of fishers from Calgary to Abbotsford, British Columbia. On the day of release, fishers left Calgary in the early morning and were released in the North Cascades the same afternoon.

Weight gain in captured fishers was positively correlated to time in captivity at Calgary Zoo (r=0.53), and mean weight gain was 0.5 ± 0.04 kg for females (range: −0.05–1.8 kg) and 0.7 ± 0.08 kg for males (range: −0.6–2.1 kg), after correcting for the 0.05 kg implant transmitter addition to body weight (Table 6). These averages exclude four animals that were retained for veterinary treatment of medical issues discovered during exams, and thus held in captivity longer than usual (20–68 days). Of the 101 Alberta fishers that were released in Washington, only six fishers (1 F, 5 M) lost weight (0.05–0.55 kg) while in captivity; however, body condition and overall health of these six fishers was good, and their time in captivity was relatively short. We consider weight gain to be a positive indication because released fishers have improved energy reserves prior to the stress of being released into a foreign environment. We also consider weight gain to be an indication that we likely minimized stress to fishers during temporary captivity.

Stress was monitored while fishers were in temporary housing at the Calgary Zoo facilities using two different approaches: 1) measuring behavioral activity of the fishers and 2) quantifying fecal

glucocorticoid metabolites (FGM). We evaluated the behavioral activity of 94 individual fishers for a total of 6,720 hours over 339 days. We collected fecal samples from every fisher upon arrival at the zoo, and then every other day while they were in captivity (*n*=444 samples). All samples from traps and transport boxes were collected (*n*=8). Fecal samples were submitted for FGM analysis. We will compare both approaches and test if FGMs (response to stressors) are correlated with capture and handling, time in captivity, and behavioral traits, and publish those findings.

Veterinary Assessments

During the 2015/2016 and 2016/2017 fisher translocation seasons, health assessments and veterinary care were provided for 88 fishers at the Animal Care Hospital of Williams Lake, British Columbia. During the 2018/2019 and 2019/2020 fisher translocation seasons, health assessments and veterinary care were provided for 110 fishers by the Veterinary Services department of the Calgary Zoo, Alberta. Veterinarians conducted all examinations, medical treatments, and surgeries, and were assisted by veterinary staff, animal care staff, project biologists, and other wildlife specialists. Veterinary examinations were required to determine if individual fishers met our health criteria for translocation, and before a veterinarian could issue a health certificate, which is required for each fisher being transported from Alberta or British Columbia to Washington. Our basic translocation criteria required that a fisher had no broken bones, >2 intact canine teeth, no debilitating wounds or injuries, no missing limbs, no feet with >1 missing toe, no apparent disabilities, was not in poor body condition, did not have diarrhea, had no ocular or nasal discharge, exhibited no significant unexplained hair loss, did not have excessive tooth wear indicative of advanced age, and was not hosting heavy external parasite infestations. 78% (69 of 88: 38 F, 31 M) of the fishers examined in British Columbia and 91% (101 of 110: 46 M, 55 F) of the fishers examined in Alberta were found to be suitable for translocation.

At the time of each fisher's health assessment at each clinic, we moved the fisher into a transport box, and from there shepherded it into a handling cone to administer anesthesia (Figure 12). Once in the cone, we quickly administered an injection in the epaxial muscle or tricep muscles, and the fisher was then free to back into its transport box and quietly lie down. In British Columbia, anesthesia was administered as a mixture of detomidine (0.1–0.04 mg/kg) and ketamine (1.1–8.2 mg/kg). In Alberta, anesthesia was administered as a mixture of dexmedetomidine (0.015–0.025 mg/kg), midazolam (0.08–0.1 mg/kg) and ketamine (2.0–3.5 mg/kg). Induction was rapid, and most fishers were able to be safely handled within 3–4 minutes post injection. A surgical plane of anesthesia was then maintained via inhalant anesthesia with isoflurane (Figure 13). Fishers were also provided with therapeutic oxygen while under anesthesia. All animals received a comprehensive physical exam and health assessment for potential release while under anesthesia. To minimize the stress and risk associated with chemical immobilization and handling, each individual fisher was only immobilized once, unless an animal required additional medical attention.

Figure 12. A fisher is temporarily restrained in a handling cone, in order to safely administer an injection.

Figure 13. Veterinary and research staff conduct a health assessment of a fisher at Calgary Zoo. Anesthesia was maintained using inhalant isoflurane via a cone placed over the nose and mouth of the fisher throughout the exam.

Upon immobilization, each fisher was immediately weighed and transferred to an exam table where it was externally inspected for basic health and condition. Each animal was assigned a general body condition score based on Laflamme (1997), with a categorical range of 1–5, where '3' represents ideal condition. British Columbia fishers averaged a 2.97 (range = 1–4) body condition score, and Alberta fishers averaged a 2.94 (range = 1.5–5) body condition score. A qualitative categorical age was assigned based on the general size, weight, and tooth wear of each fisher (juvenile [young of year, 0 yr old], subadult [1 yr old], adult [>1 yr old]). Ophthalmic ointment (e.g., Optixcare ®, Aventix Animal Health) was applied to both eyes to prevent corneal injury and drying of the eyes while under anesthesia. We monitored heart rate, respiratory rate, capillary refill rate, blood oxygen saturation, and body temperature (rectal) throughout the handling procedures.

During examination, blood samples were collected for complete blood counts and serum chemistries, serology for diseases of interest, and serum and whole-cell banking. Following a local mandibular nerve block, the first mandibular premolar was extracted from each animal to be used for aging using dental cementum analysis (Matson's Laboratory, Montana, USA: Figure 14). Hair samples were collected for genetic analysis, stable isotope analysis, and banking. Each fisher was vaccinated for rabies and canine distemper and was treated with a topical parasiticide (see *Vaccinations and Parasites*). We captured dorsal, ventral, and lateral identification photographs of each fisher. Fishers can have unique ventral blazes of white hair on their chin, chest, and groin, that may help identify photographs of animals in the future (Figure 15). We also implanted a subcutaneous passive integrated transponder tag (PIT-tag, Biomark ®) behind the right ear of all fishers, in order to identify them if encountered in the future.

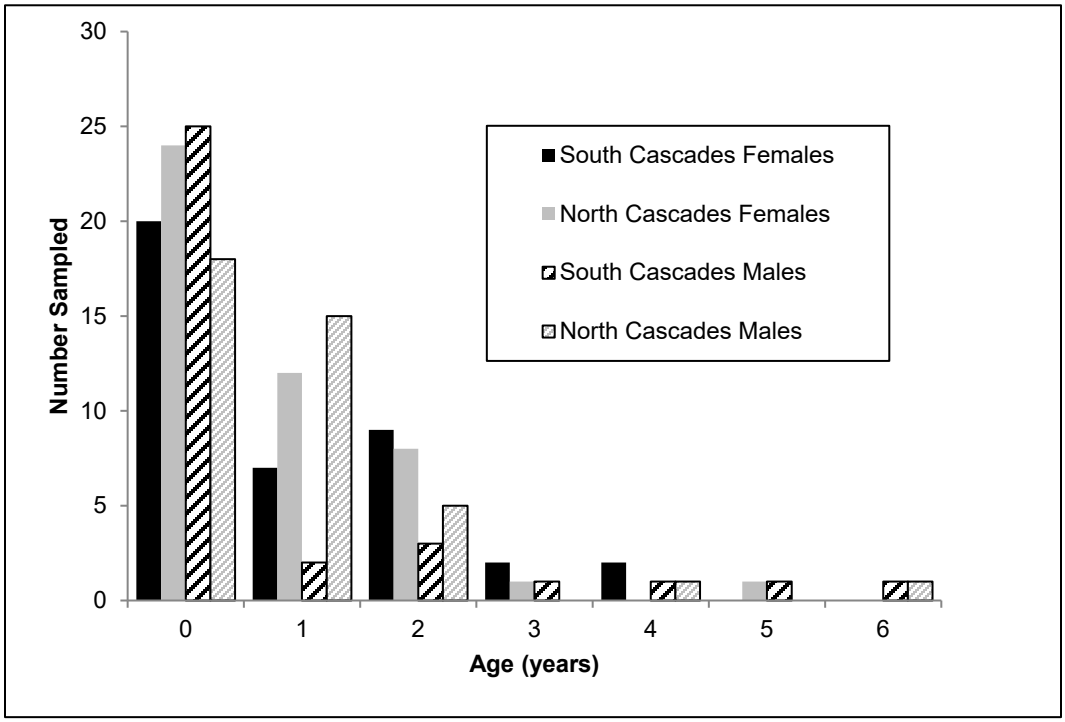

Figure 14. Age distribution of fishers that were translocated to Washington, whose age could be determined by dental cementum annulation (*n*=160).

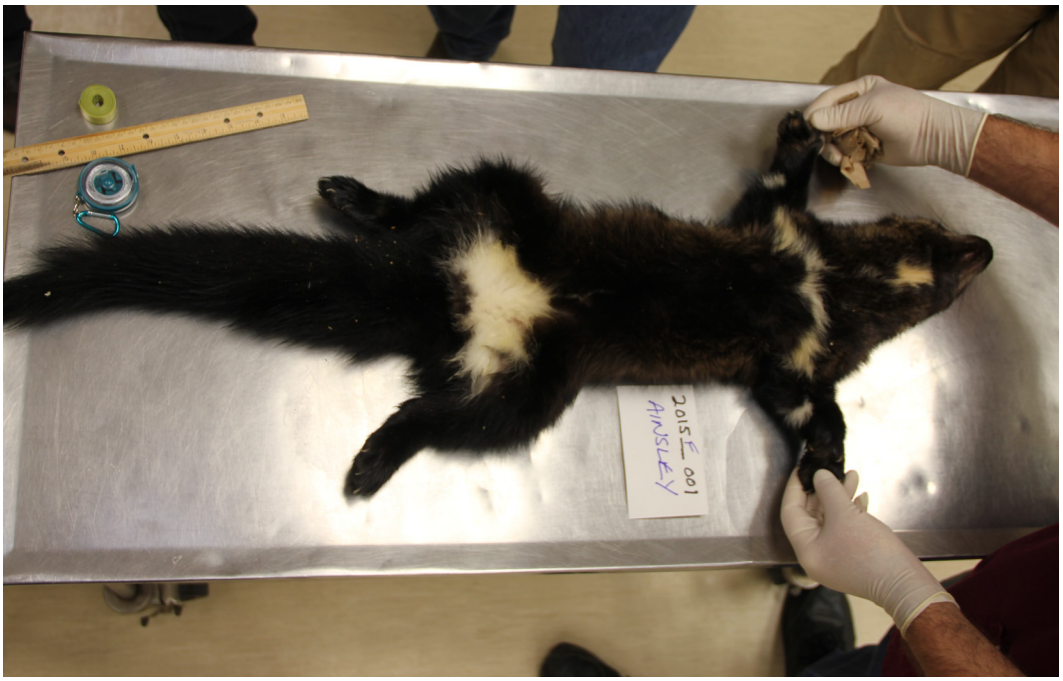

Figure 15. Female fisher F001, ventral view showing the three distinct blaze patterns on her chin, chest, and groin.

We collected several external morphometric measurements on all fishers, using digital calipers to measure height of sagittal crest, ear length (from pinna to tip of ear), hind foot length (heel to tip of nail), length and width of teats (females), length of baculum (males), and using a measuring tape for total body length (tip of nose to tip of tail), tail length, neck circumference, and chest circumference. In Alberta, we also captured whole body digital radiographs in lateral and ventrodorsal views. The radiographs provided the ability to accurately measure the height of the caudal sagittal crest (Figure 16) and length of baculum (in males), which are difficult measures to accurately collect via palpation. Comparison of palpation and radiograph measurements will help us quantify measurement biases in externally-measured morphometric data. Specifically, the more accurate sagittal crest and baculum measurements will be incorporated into future analyses of age as a function of allometry, where age data from dental cementum analyses are available. If correlation is sufficiently high, this measure could provide a less painful and less invasive aging technique than tooth extraction in future years. Notably, Alberta fishers tended to weigh more, and have a higher sagittal crest, by age class, than British Columbia fishers (Appendix C). Future analyses will investigate allometry differences between founder populations, and as a function of genetics.

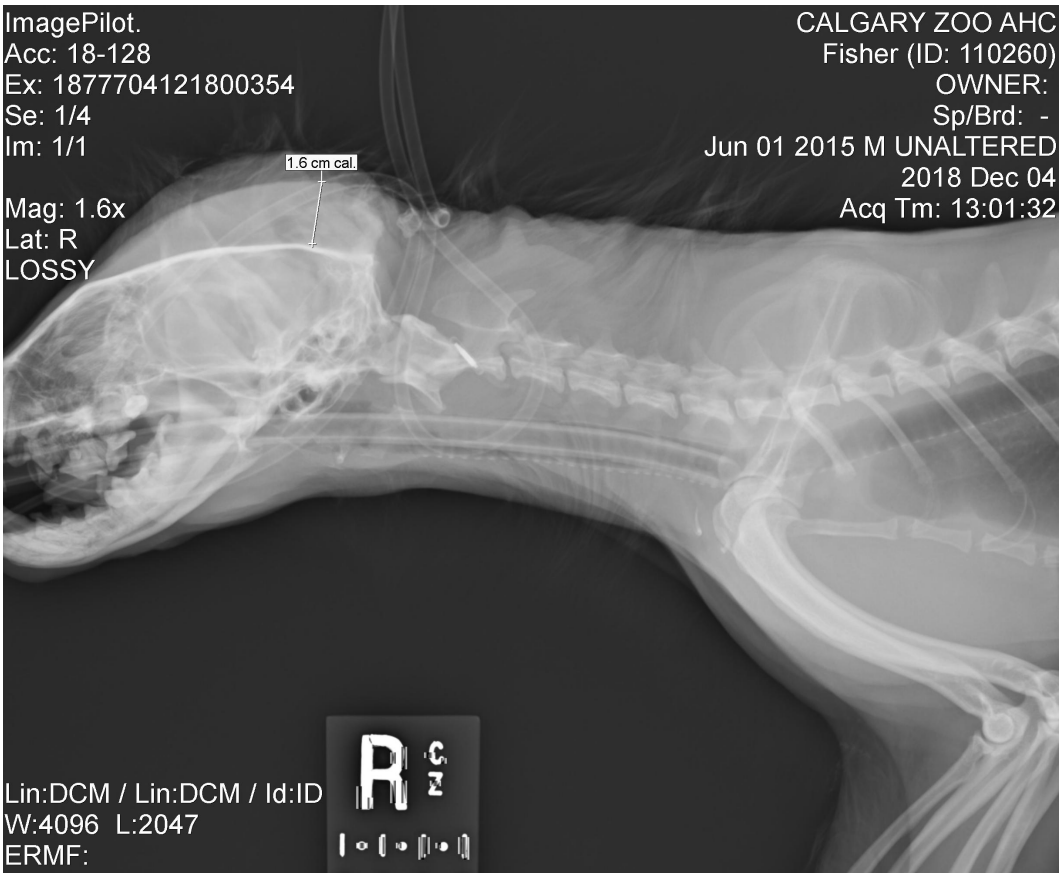

Figure 16. Lateral cranial radiograph of male fisher M104 showing 1.6 cm sagittal crest measurement.

The last veterinary procedure conducted for fishers meeting translocation requirements was implantation of a radio-transmitter (Model AI-2MH, Holohil Systems, Ltd.) via abdominal midline celiotomy, for animals large enough to carry a transmitter. We sterilized each 50 g radio-transmitter by washing with water and disinfecting for ≥15 min in a cold bath of Super Germiphene ® (Germiphene, Ontario, Canada) diluted with distilled water (British Columbia) or via anprolene gas sterilization (Calgary Zoo). After ventral midline desensitization with a local anesthetic (e.g., bupivacaine), using sterile surgical conditions, the attending veterinarian made a 3–4 cm incision through the dermal, subcutaneous, and abdominal wall tissues, and inserted the transmitter directly into the abdominal cavity with an anterior/posterior orientation. The abdominal wall was then closed using either a semi-continuous suture pattern with 3-0 Monocryl (Calgary Zoo) or simple interrupted stitching of chromic gut suture (British Columbia), followed by closure of the subcutaneous layer with a simple continuous pattern with a monofilament synthetic absorbable suture (3-0 Monocryl^{TM}, Ethicon) or a braided synthetic absorbable suture (e.g., Polysorb^{TM}, Covidien). The dermal layer was closed with an intradermal pattern using the same suture material, followed by reinforcement with surgical glue (e.g., Vetbond^{TM}, 3M). In the peri-operative period each animal was treated with a long-acting antibiotic (penicillin), a sustained release non-steroidal anti-inflammatory drug (meloxicam 0.3 mg/kg), an opioid analgesic (buprenorphine), an anti-nausea agent (maropitant), and

subcutaneous crystalloid fluids (Plasmalyte 7.4). Recovery from surgery was uncomplicated in all 147 transmittered animals.

Natural wounds of various types were detected during health assessments, and on some animals that otherwise met our criteria for translocation when first examined, these ranged from minor cuts and broken nails to bites, lacerations, punctures, embedded porcupine quills, and a fractured tail. Minor wounds were treated while animals were induced and no additional steps were taken. Five British Columbia fishers (3 F, 2 M) and three Alberta fishers (3 M) had more extensive pre-capture wounds from predators or other fishers that required veterinary care, but otherwise met our relocation criteria. Those animals were treated by the attending veterinarians, held as long as required for treatment, and re-examined before transport and release. Six fishers (4 F, 2 M) in British Columbia and five fishers (3 F, 2 M) in Alberta did not meet the basic health requirements for translocation but were healthy enough to release back at their capture location. These disqualifications were due to age-related dental fractures or extreme wear (10 fishers), and a chronically dislocated femur (1 M): all 11 animals were found to be in very good body and coat condition. An additional six males were healthy, but returned in British Columbia because too many males had been caught and they weren't needed for the reintroduction effort. We used hair dye to bleach the fur on the back of the head, as well as tail or other conspicuous body parts on all returned fishers, so these animals would not be recaptured for this project or harvested for fur on their home range around trap lines: we compensated those trappers for the fisher at a price that exceeded current market value for a fisher pelt.

Seven other fishers (3 F, 4 M) in British Columbia, and two female fishers in Alberta arrived with terminal health issues including an old fractured leg with continuing complications, osteomyelitis associated with an old fracture, facial edema associated with frostbite, a swollen and frostbitten penis, torn ligaments with joint infection, chronic dental disease/abscessation, oral-nasal abscessation, cataracts, and other damage to the facial area and jaws, including skin loss, bony infection and abscessation. The latter case was likely due to self-inflicted injuries in the live trap. These fishers were all euthanized for humane reasons. Two other fishers (1 F, 1 M) in British Columbia died in captivity: one with a variety of old wounds, and one very old adult with poor body condition and no teeth. One additional male arrived in Calgary with extensive dental issues and poor body condition: the veterinarians completed significant dental reconstruction work, and special arrangements were made to transfer this fisher to Northwest Trek Wildlife Park as a display animal to further public education about this species and the reintroduction efforts in the Cascades. The team took steps throughout the project to alleviate injuries from trapping by continuing and increasing trapper education efforts and introducing the use of plastic/plexiglass-lined traps that prevented animals from accessing metal wire to chew on (the likely source of some broken teeth). None of these types of injuries were found in Cohort 4 captures and no animals were euthanized or returned due to dental issues during the 2019/2020 capture season.

Lastly, juvenile male fisher M167 was captured on 4 November 2019 and placed in housing at Calgary Zoo, but escaped primary and secondary containment without ever receiving a veterinary

exam. Despite numerous recapture efforts, he was last seen at large near a golf course in the greater Calgary metropolitan area.

Vaccinations and Parasites

There are competing hypotheses among professionals involved with wildlife translocations about the benefits and risks of treating translocated animals for all possible parasites and pathogens that may be present. The primary concern about not treating animals is the introduction of novel pathogens and parasites: this risk must be weighed against the potential harm to immune function and other factors related to interventions and effectiveness of treatment, especially for parasites that are widely distributed (IUCN/SSC 2013). Based on consultations and consensus of project veterinarians, we treated captive fishers for ectoparasites and vaccinated against rabies and canine distemper virus. We also considered vaccinating against parvovirus but decided against it, as there was no evidence that the available vaccinations (for cats and dogs) were effective in protecting mustelids against parvovirus, and their response to the vaccination was unknown. Given the ubiquity of common internal parasites and low risk of introducing novel parasites to the recovery area, we determined there was little benefit to deworming fishers prior to release, except for individuals with an unusually heavy parasite load. In those few cases, we administered an anthelmintic such as praziquantel (e.g., Droncit ®, Bayer Animal Health). While we did not typically deworm fishers, we did conduct fecal parasite assays of all released fisher to characterize endoparasites.

We evaluated 82 fecal samples from fishers captured in British Columbia in the winters of 2015/2016 and 2016/2017 and documented endoparasites in 18 samples. Capillarids were the most common nematodes present (n=17). Fifteen fishers were infected with unidentified capillarids only. One fisher (M061) was co-infected with unidentified capillarids and unidentified ascarids and one (F075) was co-infected with three nematodes (unidentified Ascarids, unidentified Capillarids and *Soboliphyme baturini*). We also documented tapeworms (Taeniid, likely *Taenia martis*) in one fisher (M027).

We also collected fecal samples from all 37 fishers captured in Alberta during the 2018/2019 season and conducted ova and parasite assays. Seven of those (5 F, 2 M) did not contain any discernible parasites and 30 contained one or more endoparasite species. The intestinal trematode *Alaria* sp. was the most commonly identified parasite, seen in 12 males and 15 females in moderate count levels. Three of these females were concurrently infected with low counts of hookworms (*Ancylostoma* sp.), and two females with *Hymenolopis* sp. tapeworms. Three fecal samples from females contained coccidia (*Eimeria* sp.) and two samples (1 F, 1 M) contained Oxyurid pinworm eggs; however, the source of these may be whole prey items such as mice rather than primary infection. No clinical signs were associated with any of these findings.

During the 2019/2020 season, fecal parasite assays were completed for 72 individuals, and only one female in this cohort had no observed fecal parasites. Seventy-one animals were parasitized with *Alaria* sp., most at moderate levels, although there were ten animals with a heavy intestinal burden. Five animals had light burdens of the hookworm *Ancylostoma* sp., and a further five animals had small numbers of dwarf tapeworm *Hymenolopis* sp. We identified one animal with each of a pinworm species *Aspicularis*, threadworm *Capillaria*, and ascarid *Strongyloides*. Unlike the animals from British Columbia, no Taeniid tapeworms were seen, and Capillarids were rare. The trematode

Alaria sp. is widely found across Europe, Asia and the Americas and is not usually associated with intestinal disease, but larvae may cause lung damage in heavily infested animals. *Ancylostoma* sp. hookworm can be a significant cause of morbidity and poor growth, but none of the animals infected in either Cohort 3 or 4 showed any clinical signs. None of the other parasite findings were considered of clinical relevance, and it is not expected that any of these parasites are unique to Alberta, but rather common in small carnivores across temperate North America.

We visually inspected all fishers for fleas and ticks during veterinary health assessments, using a flea comb. We also sampled for ear mites using an ear swab. Ectoparasite loads were generally light across all fishers: 41.3% (38 of 92) fishers captured in British Columbia, and 55.5% (65 of 117) fishers captured in Alberta hosted flea (Siphonaptera) and/or louse (Phthiraptera) species, but the average number of fleas found per individual was only 1.6 (range = 0–32) for Alberta fishers (counts were not recorded for British Columbia fishers). The average number of lice found was 0.1 (range = 0–4) for Alberta fishers. We did not detect any ear mites (Acariformes) or ticks (Parasitiformes-Ixodida) on fishers. We collected all ectoparasites and preserved them in ethanol. These specimens are curated at the National Park Service and may be used for future research questions. On completion of their health assessment, each fisher was treated with a topical parasiticide (Ovitrol™ Plus, Sandoz Agro Canada, Inc. or Revolution®/MD, Zoetis Canada, Inc.) to help mitigate potential for ectoparasites to be translocated to Washington from Canada.

Genetics

We collected tissue (ear plug sample) from 23 fishers and hair samples from 46 fishers captured in British Columbia, 2015–2017, and hair samples from 107 fishers captured in Alberta 2018–2020. We changed sampling protocols from tissue to hair in 2016 in order to improve animal welfare when it became apparent that the less invasive collection technique of hair sampling could produce genetic data of sufficient quality. These samples were analyzed and results summarized by Kristine Pilgrim, Megan Murdoch, and Michael Schwartz at the National Genomics Center for Wildlife and Fish Conservation in Missoula, Montana. DNA was extracted from all tissue and hair samples using the DNeasy Tissue Kit (Qiagen, Valencia, CA).

Samples were tested for mitochondrial haplotype, sex and individual using a 300bp region of the mitochondrial DNA (mtDNA) control region (Drew et al. 2003, Vinkey et al. 2006, Schwartz 2007). While fishers in British Columbia have been previously analyzed for haplotype (Drew et al. 2003, Vinkey et al. 2006), Alberta fishers have not been well described. Four mtDNA haplotypes were identified in our samples from British Columbia and are common to other fishers sampled in that province: Drew-Hap4, Drew-Hap6, Drew-Hap7 and Drew-Hap9. Five mtDNA haplotypes were identified in our samples from Alberta, including Drew-Hap3, Drew-Hap7, and Drew-Hap11, as described by Drew et al. (2003). These haplotypes have been previously detected in Alberta (Warheit 2004). Haplotype Drew-Hap3 has also been reported from fishers sampled in New Brunswick and is associated with the *pennanti* subspecies, while Drew-Hap7 and Drew-Hap11 have also been found in populations of fishers from British Columbia, and the Midwest. The other two haplotypes we identified in Alberta samples have not previously been described. These two new haplotypes branch from between Drew-Hap7 and Drew-Hap3 on the mtDNA haplotype network of all 14 described

fisher haplotypes (Figure 17). In this report, we refer to them as Hap13 and Hap14. Drew-Hap7 was the only haplotype common to both British Columbia and Alberta fishers among the fishers we sampled. All other haplotypes observed were specific to either British Columbia or Alberta. Among the Alberta samples, haplotypes Drew-Hap7 and Drew-Hap11 show a wide distribution across capture locations (see Figure 1), while the novel haplotype Hap14 occurred in fishers captured just northwest of Edmonton, as well as near Cold Lake, Alberta. Hap13 was detected only in fishers captured around the Cold Lake area.

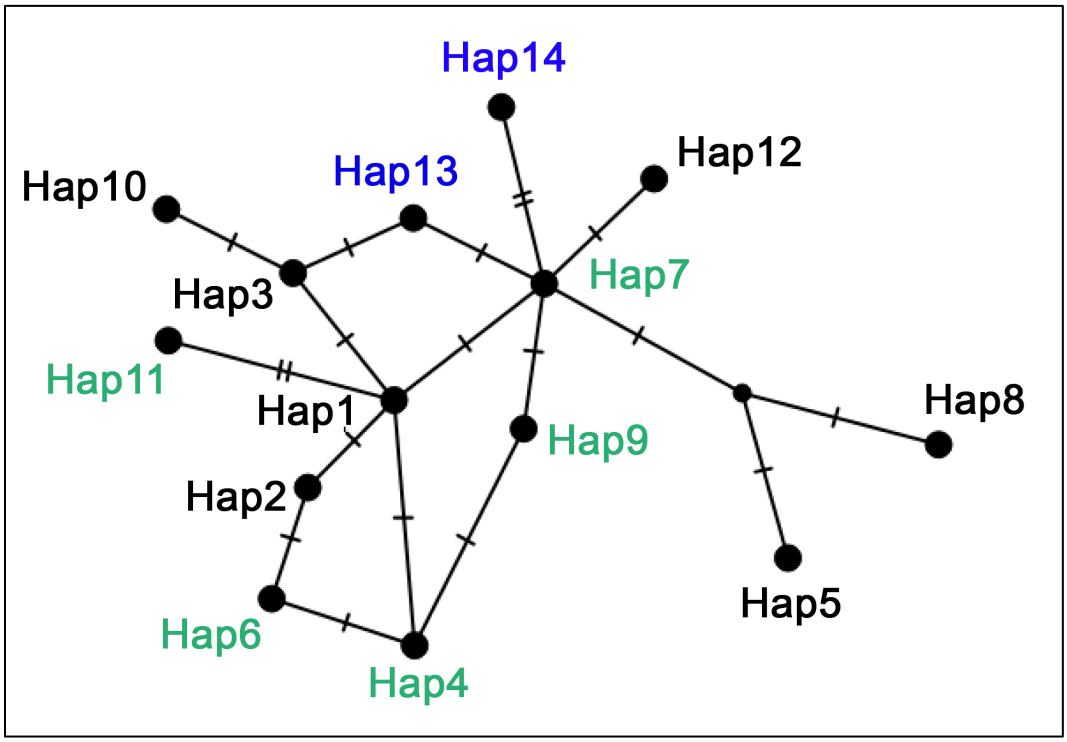

Figure 17. Mitochondrial DNA haplotype network of 14 fisher (*Pekania pennanti*) haplotypes. Colored labels represent haplotypes that were present in fishers translocated to Washington. Hap13 and Hap14 (shown in blue) have not previously been described for fishers.

Genotyping was successful for all 176 fisher samples. Samples were analyzed using a panel of 17 microsatellite loci previously used by the National Genomics Center for Wildlife and Fish Conservation for fishers: MP0059, MP0144, MP0175, MP0197, MP0200, and MP0247 (Jordan et al. 2007), GG4, MA1 (Davis and Strobeck 1998), PV9 (Allen et al. 1995), GGU101, GGU216, GGU234 (Duffy et al. 1998), MVIS020, MVIS72, MER022 (Flemming et al. 1999) and LUT733 and LUT604 (Dallas and Piertney 1998). We summarized the number of samples, by capture season, that produced a genotype at each microsatellite locus, the number of alleles at each locus in the population, the number of alleles scaled by abundance (N_e, the effective number of alleles), genetic variation as measured by observed heterozygosity (H_o), and expected heterozygosity (H_e) given population genetic assumptions (Table 7, Appendix D). The mtDNA of sampled fishers in British Columbia and Alberta varied little, but the populations that these animals were captured from are distinctive (Figure 18). Across the 17 loci, 11 alleles that were present in the British Columbia fishers

were not observed in Alberta fishers, and 18 alleles present in Alberta fishers were not observed in British Columbia fishers. Observed heterozygosity and effective alleles were similar in British Columbia and Alberta fishers.

Table 7. Mean ± Standard Error for genotypes of fishers captured for translocation to Washington. *N* is the number of samples that produced a genotype at each locus, *N*e is the effective number of alleles, *H*o is observed heterozygosity, and *H*e is expected heterozygosity.

Capture season (Location)	*N*	Number of Alleles	N_e	H_o	H_e
2015–2016 (British Columbia)	22.94 ± 0.06	4.59 ± 0.52	3.10 ± 0.37	0.58 ± 0.05	0.61 ± 0.04
2016–2017 (British Columbia)	46.00 ± 0.00	4.94 ± 0.45	3.27 ± 0.37	0.58 ± 0.05	0.63 ± 0.04
2018–2019 (Alberta)	35.76 ± 0.60	5.24 ± 0.48	3.42 ± 0.28	0.66 ± 0.04	0.67 ± 0.04
2019–2020 (Alberta)	69.59 ± 1.02	5.71 ± 0.56	3.10 ± 0.24	0.63 ± 0.04	0.64 ± 0.04
All British Columbia fishers	69.00 ± 0.00	5.24 ± 0.48	3.27 ± 0.39	0.58 ± 0.05	0.63 ± 0.04
All Alberta fishers	105.0 ± 1.61	5.82 ± 0.60	3.28 ± 0.25	0.60 ± 0.04	0.65 ± 0.04
2015–2020 (All Fishers)	87.18 ± 3.26	5.53 ± 0.38	3.28 ± 0.23	0.59 ± 0.03	0.64 ± 0.28

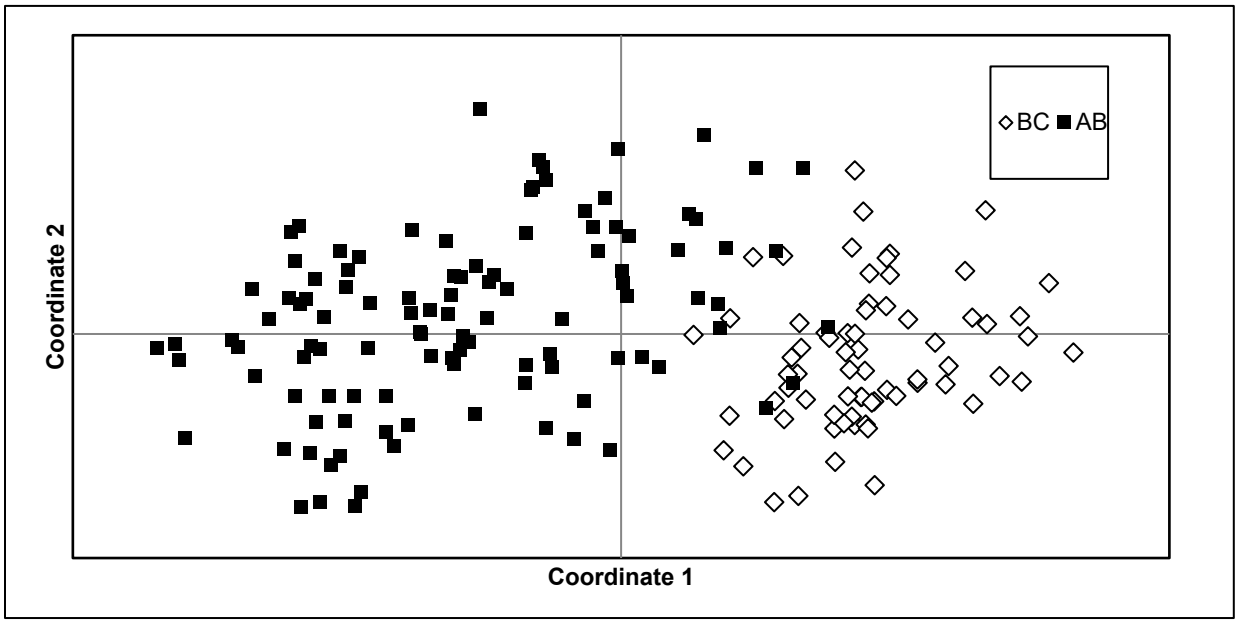

Figure 18. Principal coordinates analysis plot of similarity between microsatellite DNA sequences from fishers captured in British Columbia (BC) and Alberta (AB), Canada.

Anticoagulant Rodenticide

Anticoagulant rodenticide (AR) poisoning is a known threat to many wildlife species, including fishers (Gabriel et al. 2012). Fishers in our project could have been exposed to ARs at their capture location (see Thomas et al. 2017, for example), and/or could be exposed at their reintroduction location through a variety of sources. Typically, such AR exposure arises from ingesting rodents that

are incapacitated or killed by household rat poisons, but also may arise from larger-scale agricultural uses of wildlife pesticides. AR compounds can accumulate in the organs and tissues of fishers and can be fatal.

The California Animal Health and Food Safety Laboratory System (University of California, Davis) performed toxicology screening on liver samples from 11 fishers (9 F, 2 M) that died during this study, and whose carcasses were recovered with adequate tissue to sample. Two first-generation AR compounds (Chlorophacinone, Diphacinone) and three second-generation AR compounds (Brodifacoum, Bromadiolone, Difethialone) were detected. Seven of these 11 fishers (F051, F052, M112, F096, F116, F118, and F130) did not test positive for any AR compounds. Toxicology screening was negative for all screened organic compounds (pesticides, environmental contaminants, drugs and natural products) in all fishers tested. Four fishers (F002, F049, F065, and M172) had positive results for at least one AR compound: F002 tested positive for Brodifacoum (trace - below quantifiable detection limit), Bromadiolone (82 ppb), and Diphacinone (1200 ppb), F049 tested positive for Bromadiolone (trace - below quantifiable detection limit), F065 tested positive for Brodifacoum and Bromadiolone (both trace - below quantifiable detection limit), and M172 tested positive for Brodifacoum (300 ppb), Bromadiolone (190 ppb), Chlorophacinone (340 ppb), Difethialone (52 ppb) and Diphacinone (trace - below quantifiable detection limit).

The levels of AR compounds detected in F002, F049 and F065 were an order of magnitude lower than those reported on public lands in California (Gabriel et al. 2012); however, the level of AR compounds detected in M172 were at or above levels that Gabriel et al. (2012) reported in fishers that died of AR ingestion. The initial report was that M172 was likely struck by a vehicle near Wenatchee, WA, and was taken to a wildlife rehabilitation center, where he died two days later. There were no obvious signs of a vehicle impact found during necropsy. The necropsy did not reveal gross signs of AR poisoning, though pooled blood was present in the neck, the spleen had darkened margins, pancreas was mildly hemorrhagic, and the liver and both left and right renal cortex were red and injected. Gabriel et al. (2012) reported mortality in an adult male fisher that was exposed to three AR compounds, that were quantified from liver tissue as Brodifacoum (380 ppb), Bromodiolone (110 ppb), and Chlorophacinone (trace, below quantifiable limits). M172 was substantially larger (5.41kg) than the California fisher (3.45 kg) reported to have died from acute AR poisoning and had similar results for Brodifacoum and Bromodiolone, at least six times higher level of Chlorophacinone (detection limit 50 ppb), quantifiable Difethialone, and trace Diphacinone.

First-generation ARs require several doses while second-generation ARs require a single dose for toxicity that leads to death. Fisher exposure to ARs may occur due to direct consumption or by consuming prey that was exposed to ARs. The sources of AR exposure for fishers in our study are unknown and cannot be determined because the compounds are approved for use in both the recovery area in Washington and the trapping areas in Canada. Chlorophacinone is used for mountain beaver control in Washington, and although mountain beavers are suggested to die from exposure underground, mustelids are identified as potential non-target species that may be at risk for secondary exposure because they may hunt debilitated mountain beavers or scavenge their carcasses (Arjo et al. 2004). Brodifacoum and Bromodiolone are common rodent poison baits and were the most

frequently detected AR in California but, Diphacinone was not reported (Gabriel et al. 2012). AR compounds are also used throughout the trapping area in Alberta and live-trapped wild fishers have been reported to have detectable levels of the three AR compounds studied in their liver tissues: Brodifacoum (maximum 188 ppb), Bromodiolone (maximum 9 ppb), and Difethialone (265 ppb) (Thomas et al. 2017). We cannot be certain if M172 was exposed to AR compounds only in Washington, only in Alberta, or in both locations. There does not appear to be evidence that AR exposure was the direct cause of M172's death but is likely that these exposures played a role. The level of ARs present in M172's liver tissues were demonstrated to cause behavior changes and death in fishers in other populations.

Export / Import

For transport to Washington from British Columbia 2015–2017, we used our individual wooden transport boxes with the partition removed, or with a modified partition top that blocked light but allowed movement between ends of the box (Figure 10). We provided all fishers food, water, and bedding. Each transport box was secured in the bed of a pick-up truck with an enclosed canopy. On the day of transport, overland travel took approximately 10–12 hours; thereafter, fishers remained in their transport boxes overnight with bedding and fresh food and water, and were released the next morning. From Alberta, we were able to fly the fishers from Calgary, Alberta, to Abbotsford, British Columbia on a commercial airline, through arrangements made by Calgary Zoo. We built custom transport boxes for air travel that met the required International Air Transport Association (IATA) specifications (Figure 19). These each accommodated two fishers in individual compartments, except for large males; in which case, we had one box with no partition and a single male could occupy the entire crate. Food and bedding were provided in each crate, and water was provided in the form of an ice block frozen in the water bowl. This allowed for water, without spillage during air transport. All air crates were sealed at the clasps and were labeled with emergency instructions and contact information. Fishers from Calgary were booked on an early morning flight, which was met by Washington staff in Abbotsford. The crates were then transferred into the bed of an enclosed pick-up and transported to Washington overland, in the same manner as the British Columbia fishers.

Figure 19. Fisher transport box for two animals, meeting International Air Transport Association (IATA) specifications. Fully open internal view (left) and individual release external view (right).

Several tasks were involved in successfully importing fishers to Washington from Canada. These served to meet federal, state and provincial requirements and included completing health certifications, obtaining permits, permit processing by federal authorities, border-crossing inspections by customs and USFWS inspectors, and notifications. At the Sumas, Washington, border crossing, USFWS officers and US Department of Homeland Security reviewed our documentation and conducted an inspection of the trucks and cargo. These were visual inspections of fishers in their transport units, and no additional handling or chemical immobilization occurred.

Canadian Provincial Requirements

Fishers captured in Alberta or British Columbia were required to be inspected by a veterinarian accredited by the Canadian Food Inspection Agency. After having been inspected, fishers deemed suitable for transport and reintroduction in Washington were individually listed on a health certificate. We held BCFLNRO Wildlife Act Permit VII18-380016, as amended 12 November 2019, and ABMEP export permit 581857PE, 588716PE and 605167 PE, to legally export fishers from British Columbia and Alberta, respectively.

Washington State Requirements

The Washington State Department of Agriculture (WSDA) requires that an accredited and licensed veterinarian inspect each animal. WSDA granted an import permit for those individuals free from infectious and communicable diseases, and permanently and individually marked, as certified by the

veterinarian. The inspection and certification were designed to meet the requirements of all state, provincial or federal agencies requiring inspection of captured fishers. Upon completion of the health certificate, the WSDA agent provided an importation permit number over the phone, which was then written on the health certificate.

Canadian Federal Requirements

Canadian customs agents (or Port Officer) required prior notification by the project leaders that a shipment of fishers was leaving Canada. Before departure, a Canadian customs agent inspected the fishers, their holding units and associated paperwork, and questioned personnel accompanying the fishers.

U.S. Federal Requirements

U.S. Customs agents also required prior notification that a shipment of fishers was arriving in the U.S. Before entry into the U.S., Customs agents joined USFWS officers to inspect fishers, their transport boxes and associated paperwork, and questioned personnel transporting the fishers. The USFWS required prior notification of the expected port of entry, as well as a declaration of importation (completed USFWS form 3-177) for live animals and tissues being transported into the U.S. A USFWS agent reviewed the paperwork and inspected fishers to confirm humane transport and cleared each shipment. No Convention on the International Trade of Endangered Species (CITES) permit was required for import/export of fishers.

Research

Much of the research associated with our reintroduction project involves investigating intrinsic and extrinsic factors (e.g., age, sex, release date, stress, time in captivity, cohort) that could influence measures of reintroduction success (survival, reproduction, post-release movement, and home range establishment). Many of these studies will utilize the telemetry data collected as we monitored released fishers. Other research investigations focus on resource selection, influences of competitors and predators, disease exposure, parasite load, food habits, and animal welfare. These research projects rely heavily on collaborations with our project partners and the assistance of graduate students.

Predator and Prey Densities

There have been three predator/prey studies for this fisher project. One of these studies investigated how habitat use by fishers in the year following release was influenced by prey and predator densities, and how these densities varied across forest conditions within the South Cascades. This work was completed as a collaboration with graduate student Mitchell Parsons and his Advisor Dr. Laura Prugh at the University of Washington (UW), with Dr. Jeff Lewis serving on the graduate student committee. Mitchell completed his Master of Science thesis in 2018 and has published two journal articles (see *Publications*). The second study is similarly focused on pre-reintroduction predator and prey densities in the North Cascades, paired with post-reintroduction habitat selection by fishers. Methods are comparable to those employed in the South Cascades in order to facilitate long-term analysis and modeling of the entire reintroduction effort. The North Cascades study was conducted in collaboration with University of Montana (UM) graduate student Tanner Humphries and his Advisor at UM, Dr. Jedediah Brodie. Dr. Jason Ransom served on the graduate student committee. Tanner completed his Master of Science thesis in 2022 and journal articles are in preparation (see *Publications*).

The third study focuses specifically on fisher selection of mountain beaver (*Aplodontia rufa*) and coincident exposure to anticoagulant rodenticides. Mountain beaver have been a confirmed diet component in the South Cascades, and while no active mountain beaver poisoning is known to occur in the recovery area, it is a common practice in regional timber management. Dr. Laura Prugh's lab at the University of Washington is leading this study on the diet habits of Cascade fishers and subsequent risks of anticoagulant rodenticide exposure. Between October 2020 and August 2021, Rogue Detection Dog Teams were contracted on 26 days to search for scat samples near telemetry locations in the North Cascades. Between detection dog searches, summer trail searches, and 29 km of winter snow tracking, 335 putative fisher scats were collected for diet analyses. 182 scats from other carnivore species within fisher territories were opportunistically collected to assess dietary overlap and competitive dynamics. Scat analysis is underway and graduate student Kayla Dreher, who is advised by Dr. Laura Prugh with Dr. Jason Ransom serving on her graduate committee, has an expected thesis defense in September 2022.

Behavior of Fishers in Captivity

Research efforts at the Wilder Institute and Calgary Zoo are providing essential data on a number of factors (e.g., sex, age, health, allometry, endoparasite occurrences, blood chemistry, timing of release, duration of captivity, body weight) that may influence reintroduction success. We are also conducting studies on two additional factors: stress response and personality, which may be relevant influences on reintroduction success (Teixeira et al. 2007, Bremner-Harrison et al. 2004). Stress physiology can be related to personality (Koolhaas et al. 1999), so we are investigating this relationship and its potential influence on reintroduction success. This research is expected to help us determine what makes a good or excellent translocation candidate and can inform our efforts to shape founder populations that provide the greatest likelihood for reintroduction success.

To characterize the personality of individual fishers, we designed a study to quantify two different behavioral traits and test their consistency: 1) Docility, by scoring the resistance of a fisher to leave a transport box and 2) Fearfulness, using a novel object test to score the interaction between fishers and 2–3 different unfamiliar objects (such as colored balls and chew toys). Docility is scored by a direct observer when fishers are receiving an anesthetic injection, as well as using a continuous video recording system when fishers are moved into a transport box. Fearfulness measures were recorded using only the video recording system to avoid the potential interference of the observer: fishers initially detected observer presence and stayed hidden when an observer was monitoring the tests in real time, even from an adjacent room using the video recording system. Methodology was thus adjusted to accommodate the sensitivity of some fishers, eliminating any real time observation and extending the exposition time to ensure some animal activity during the novel object test (some fishers had latency times of several hours, and irregular activity patterns). Docility was tested in 37 fishers from Cohort 3 and 73 fishers from Cohort 4, with a total of 68 tests measuring latency to leave the nest box in Cohort 3 and 130 tests in Cohort 4. The fearfulness trait was tested in 32 individual fishers from Cohort 3, with a total of 89 tests performed during 1068 hours of video, measuring a number of variables (such as latency to interact with a novel object) (Figure 20). The fearfulness trait was tested in 71 individual fishers from Cohort 4, with a total of 166 tests performed during 1,992 hours of video. The correlation between both traits will be analyzed to describe potential behavioral patterns. Most of the tests were replicated at least once, spaced at least 24 hours apart, with the order of novel objects randomized.

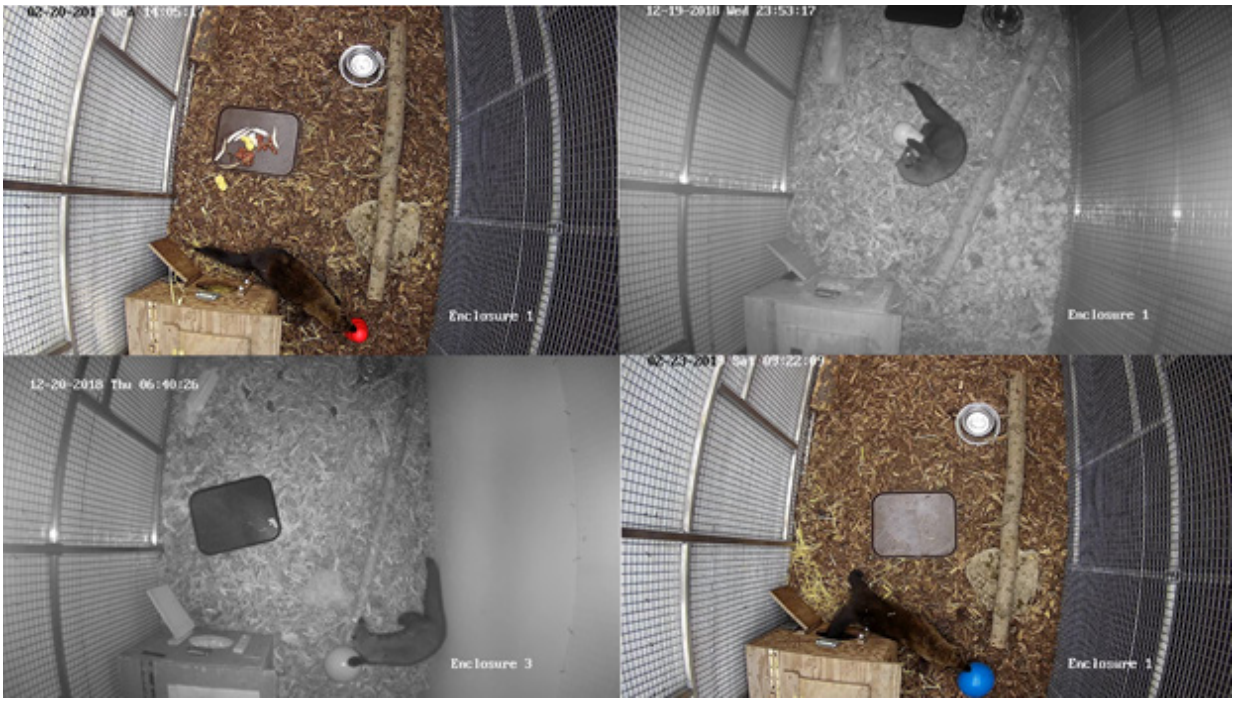

Figure 20. Fishers investigating novel objects (balls and plastic toys) as a test of fearfulness while in temporary holding facilities at Calgary Zoo. Fisher pens routinely included a den box, substrate, water bowl and a food tray.

In Fall 2019, we also distributed 40 trail cameras (Reconyx PC800 HyperFire Professional, Reconyx, Inc., Holmen, Wisconsin) to fisher trappers with the help of Bushman, Inc., in order to monitor the behavior of fishers in the wild, and to determine if the behavior of fishers measured in captivity is consistent with the same traits measured in the wild. The behavioral trait compared was fearfulness, assuming the live trap is an unfamiliar object for most of the fishers in the wild. This allowed us to compare latency to approach the novel object in the wild and captivity, among other variables (Figure 21). Analyses from all of these studies are currently in progress at the Wilder Institute, and will explore the relationship between these behavioral traits and stress with post-release survival.

Figure 21. Fisher M142 investigating the live trap in Alberta, Canada, and getting caught.

Challenges Encountered

Like all complex wildlife projects, we faced a number of challenges that emerged throughout our 2015–2021 reintroduction and monitoring efforts. Our first capture season required recruiting new trappers and developing the infrastructure for the project, setting up the housing facility, and working with the veterinarian and field staff to learn and implement capture and handling protocols. While we held training sessions for trappers, we also needed to continually make adjustments throughout the season to help them succeed in meeting our requirements. Trapping was slow during the first season, and constraints around how many fishers we could capture in a given management unit were complicated by the disjunct relationship between our live capture limits and fur trapping limits in the same area: in short, both numbers were important for the overall management of the unit, but fur harvest wasn't reported in real time and we needed to be very conservative in our live capture efforts. Consequently, our Cohort 1 was only 23 fishers, which was lower than expected.

In an effort to track released females through three consecutive breeding/denning seasons (denning and breeding coincide during March–June) after they were released, we purchased radio-transmitters with a 30-month life-expectancy for Cohort 1. Most fishers of Cohort 1 were released between December 2015 and February 2016, with the expected lifespan of transmitters allowing us to track surviving females until June to August of 2018. While a certain amount of premature transmitter failure is expected, we unexpectedly and repeatedly failed to locate all of our most dependably-located fishers (i.e., those that appeared to have established home ranges) well before the 30 months had transpired. Among 12 fishers we located consistently, the mean last-location date indicated that the average lifespan for their transmitters was only about 20.2 months. This shortened lifespan prevented us from obtaining ~10 months of data on the survival, home range characteristics, resource selection, and reproduction of many individuals, and these data were important for evaluating reintroduction success.

The Cohort 2 reintroduction season (November 2016 to February 2017) went markedly smoother, with trappers and infrastructure ready at the beginning of the season and generally slow but steady progress throughout the season. We struggled with the same balance of live capture vs. fur harvest numbers in given management units, but maintained a conservative effort. After two seasons, we still had only translocated a total of 69 fishers of the targeted ≥160 animals needed for Objective 1; a pace which threatened to extend the timing of the project beyond the funding if additional capture years were needed. We made some adjustments to transmitters specifications, but despite extensive and repeated searches inside and outside the recovery area, we did not locate 11 of 46 fishers (24%) in Cohort 2 after 12 months post-release, and this increased to 18 of 46 (39%) of Cohort 2 fishers not being located after 18 months post-release. Given the expected lifespan of 30 months for these transmitters, and the unexpectedly high number of missing fishers, we concluded that a significant number of transmitters failed and that many of these failures appeared to occur well before half of the specified lifespan had elapsed. These transmitter failures prevented us from locating 11 females (29% of the female population) and determining if they gave birth in 2018. The lack of data associated with these missing fishers continued to prevent us from evaluating their movements, survival, and home range establishment behavior using radio-telemetry.

Numerous large wildfires in the summer of 2017 burned 1.2 million hectares of forest and large expanses of occupied fisher habitat within the area of central British Columbia where we had been capturing fishers for this project (Pynn 2018). Because of a large loss of fisher habitat, the BCFLNRO did not permit us to capture additional fishers in the fall and winter of 2017 and 2018 for translocation to Washington. Ministry officials also indicated that, because of the severity of the habitat loss in this important part of the fisher's range in British Columbia, it was unlikely that they would allow additional captures of fishers for translocation to Washington in the near future. When originally assessing the feasibility and suitability of possible source populations for all Washington reintroduction areas, we determined that both British Columbia and Alberta fisher populations were suitable (Lewis and Hayes 2004). Consequently, we travelled to our British Columbia facility during the summer of 2018, and moved 16 housing units, 10 run cages, 184 traps, 68 transport boxes, and 12 trap-transport box connectors to our new staging and operations areas in Alberta. We met with new trappers, new coordinators, new animal caretakers, and new veterinarians and essentially started the program over.

The exceptional staff at Bushman, Inc. facilitated trapping and transport almost seamlessly, and Calgary Zoo constructed new housing units and modified facilities for fishers. Our biggest challenge with Cohorts 3 and 4 was the rapid pace at which fishers were caught and arriving at the zoo. We worked on communication and timing, and periodically had to pause trappers in order for the quarantine, health assessments, and transport to Washington sequence to reset without overrunning capacity. With Calgary as the operational hub, we were faced with the new challenge of a long overland transport distance to the release areas in Washington. This was solved by arranging commercial air transport for fishers and building new IATA-compliant transport boxes. Operationally, few other significant challenges arose.

Our challenges with Cohorts 1 and 2 transmitter performance led us to re-evaluate our use of that particular transmitter model and specifications for Cohorts 3 and 4. During our re-evaluation, we found that there were no appealing alternatives to this transmitter model and we decided to work with the manufacturer to design/program transmitters to perform more closely to expectations. We equipped the 26 fishers of Cohort 3 with these new transmitters, and experienced limited success. After several test flights with beacon transmitters on the landscape, experimentation with antenna and receiver configurations and models, we determined that we likely sacrificed too much signal strength in our reconfiguration of transmitters. For Cohort 4, we increased the signal strength while sacrificing a small amount of longevity. Flights for Cohort 4 fishers were largely successful soon after release (with a high of 28 fishers detected on a single flight), but there was still a marked difference between detections by different models of aircraft, including flights where no fishers were detected. That may have been an indication of antenna limitations in one aircraft, and we ceased flights in that airplane for the remainder of monitoring, in favor of the better performing airplane. Fisher detection rate still declined quite rapidly through time, and it is unknown how many fishers left the reintroduction area or had transmitters that failed.

From March to May 2020, the global SARS-CoV-2 virus pandemic caused all field work on this project to stop. Fortunately, all capture and translocation operations were complete by this time, but

Washington State shelter-in-place orders, federal government orders, and the international border closure precluded any fisher project activity (such as monitoring and travel). We did, however, continue to receive some public reports of fisher locations from vehicle collision and private trail cameras during this period. Camera stations associated with fisher research in the North Cascades remained active. Limited field work and monitoring flights began again in late May 2020 and increased through 2021.

Outreach

The project team has connected with and provided information to our partners, supporters, cooperators, stakeholders, members of the scientific and conservation communities, and the public through various outreach methods. Private landowners enrolled in a Candidate Conservation Agreement with Assurances (CCAA) throughout the course of this project, bringing the total participation to 61 landowners who provide fisher conservation measures on 3,438,728 acres of private land. These measures included working with WDFW to reintroduce and/or monitor fishers on enrolled private lands, limiting access and nuisance animal trapping in the vicinity of known den sites, covering water retention structures, and reporting fisher sightings and mortalities.

Project staff delivered over 40 presentations to the public during the course of this project (see Lewis et al. 2017, 2018b, 2019, 2020), in addition to presentations at most release events. Approximately 900 people attended the 32 release events in the Cascades, including several school and youth groups. Children released almost every fisher.

Project Publications and Theses

Chestnut, T., J. I. Ransom, D. O. Werntz, J. L. Lewis, H. Anderson, K. Palmantier, H. McCloud, M. Nuetzmann, and B. Iyall. 2018. Cultural competence in conservation biology: A case study by the Washington Cascades Fisher Restoration Team. Meeting of the Society for Northwestern Vertebrate Biology and the Wildlife Society, Portland, Oregon, 13–16 February 2018. Northwestern Naturalist 99:137–138.

Humphries, T. 2022. A reintroduction retrospective: comparative fisher (*Pekania pennanti*) survival and prey habitat use in the Cascade Mountains of Washington State. Master Thesis. University of Montana, Missoula, Montana.

Lewis. J. C., T. Chestnut, J. I. Ransom, and D. O. Werntz. 2017. Cascades fisher reintroduction project: Progress report for December 2017 to March 2017. Natural Resource Report NPS/PWR/NRR-2017/1486. National Park Service, Fort Collins, Colorado.

Lewis. J. C., T. Chestnut, J. I. Ransom, and D. O. Werntz. 2018. Cascades fisher reintroduction project: Progress report for March 2017 to February 2018. Natural Resource Report NPS/PWR/NRR-2018/1667. National Park Service, Fort Collins, Colorado.

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Media

The Cascades Fisher Reintroduction Project was featured in a social media educational project on Twitter called March Mammal Madness (#2019MMM), which reached > 250,000 students in >3,000 classrooms in all 50 states, plus 41 countries (https://libguides.asu.edu/MarchMammalMadness).

Earthfix and Oregon Public Broadcasting (OPB) worked with project biologists to produce a video, which shares information about project activities and the goals and specific objectives of the project. This video aired in February 2018 on the OPB's Oregon Field Guide television program and is available on YouTube at the following link: https://www.youtube.com/watch?v=ahuQ6d8EjMk.

The National Park Service and Silver Fox Media worked with project biologists to produce a video that captures the events and people associated with the first fisher reintroduction at Mount Rainier National Park, on 2 December 2016. This video is available on YouTube at: https://www.youtube.com/watch?v=ahuQ6d8EjMk.

The Cascades Fisher Reintroduction Project has now been featured in over 80 written, radio, and television news stories across local (e.g., Skagit Valley Herald, Yakama Herald Republic), regional

(e.g., King 5 Seattle, Oregon Public Broadcasting), national (e.g., NPR, Associated Press), and international (e.g., Canada Metro News, Calgary Herald) platforms.

Fisher Project Websites

With the assistance of project partners from the NPS, CNW, and CZS, Washington Department of Fish and Wildlife provides information on fisher conservation, updates on the Cascades Fisher Reintroduction Project, photos and videos from fisher releases, planning documents and project reports, and a list of the many project cooperators and supporters, on the agency's fisher web-page. The main fisher web page can be found at: https://wdfw.wa.gov/species-habitats/species/pekania-pennanti.

Mount Rainier National Park, North Cascades National Park Service Complex, Conservation Northwest, and the Wilder Institute also host project websites that provide general and agency specific project information and provide links to the main project website hosted by WDFW. These websites are found at:

https://www.nps.gov/articles/washington-fisher-restoration.htm,

https://www.nps.gov/noca/learn/nature/washington-fisher-restoration.htm,

https://www.conservationnw.org/our-work/wildlife/fisher/, and

https://wilderinstitute.org/conservation-programs/

Project Cost

Total project cost from 2014–2021 was approximately $3,039,428, for all planning and compliance, implementation and monitoring, research, and outreach, including in-kind services such as personnel time and equipment from other agencies and organizations. The National Park Service provided 18% of these project costs through Natural Resource Stewardship and Science Directorate (WASO-NRSS) Project 195423 and Pacific West Region funding, with MORA funding 11% of total project costs through staff time and in-kind contributions and NOCA funding 15% through staff time and in-kind contributions. State and other agencies contributed 18% of overall funding, with non-governmental organizations contributing the remaining 38%. Total collaboration included four federal agencies, three state and provincial agencies, eight Tribes and First Nations, two universities, and 22 non-government organizations.

Conclusions

The Cascades Fisher Reintroduction Project was a successful conservation action: we achieved our stated objectives and met most benchmarks of success for reintroduction and animal welfare. We were able to translocate 170 fishers from Canada to the Washington Cascades that met all optimal health criteria and represented a young founder population with a slightly female-biased sex ratio. We managed to move fishers efficiently, reduced their time in captivity throughout the project, and met high standards of animal care and welfare. We released fishers at a few centralized locations in each portion of the recovery area, hopefully facilitating interaction and reducing the tendency for animals to wander far, in search of conspecifics. We also released most fishers before January 1 of each year, which allowed animals to settle and begin establishing a home range before the onset of breeding season. Reproduction was documented in both the North and South Cascades within two years of release, and survival through a breeding season was relatively high in both areas. Survival one year after reintroduction was high in the South Cascades, but lower than expected in the North Cascades. As of the end of 2021, fishers were well distributed across much of the Cascades Fisher Recovery Area (Figure 22). Some animals were located enough times to determine that a home range had likely been established; and based on the consistent distribution within the recovery area through time, we can assume that many other fishers have settled into a home range that includes the west slope of the Washington Cascades.

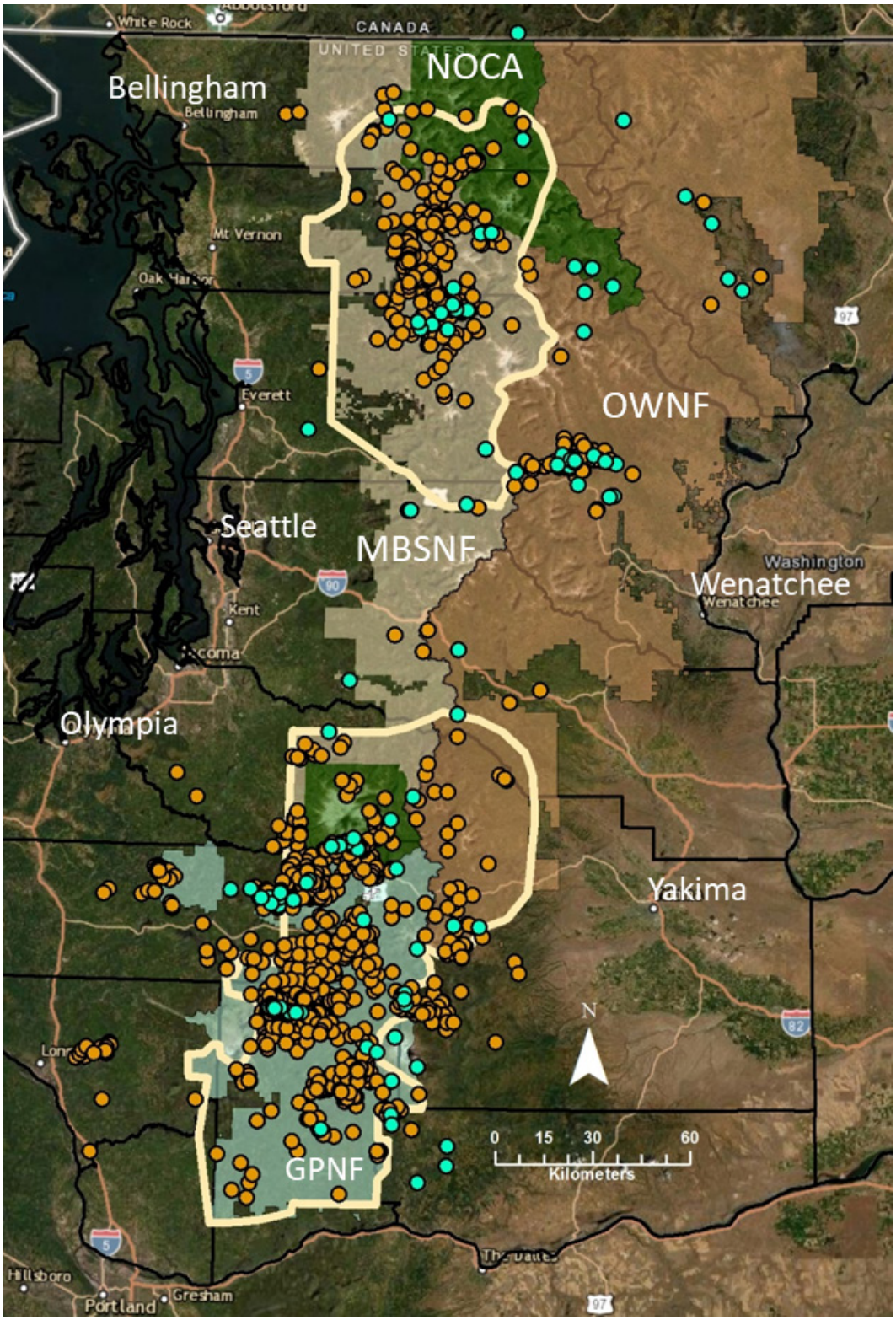

Figure 22. All fisher locations 2015–2021, across the Washington Cascades, with the North Cascades and South Cascades reintroduction areas outlined. Orange markers represent radio-telemetry locations, and green circles represent confirmed non-telemetry detections.

Throughout the project, we were able to collect new data on stress, behavior, allometry, resource selection, genetics, veterinary care of fishers, toxicology, and other fields that we hope will advance the state of wildlife reintroduction science and animal welfare. We will continue to analyze these data and publish results in the coming years. We also reached local, regional, national, and international audiences throughout the course of the project, to educate people about fishers, the importance of biodiversity, and the ecological and cultural significance of projects like this. We demonstrated the power of broad collaboration across private and public sectors, toward a common goal that benefits the public and the natural places we steward.

Cumulatively, we are encouraged about the sustainability and ultimate recovery of fishers in the Washington Cascades. We will continue to monitor fishers across the entire Cascades Fisher Recovery Area using a carefully designed occupancy study, as well as genetic analyses of hair samples to determine reproduction and survival through time (NPS Project 307416).

Lastly, this project could not have succeeded without the amazing fortitude of 170 unwitting individual fishers who endured the ordeal of translocation and colonization that we asked of them, in order to rebuild a lost population. It was not an easy journey. To the best of our knowledge, fisher F001, aka “Ainsley” (Figure 23), who was the first founder for the Cascades Fisher Reintroduction Project, is living her best life somewhere in the South Cascades. Long may she run.

Figure 23. Fisher F001, awaiting her health assessment in Williams Lake, British Columbia, 2015.

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Appendix A. Individual Fishers Released in the Cascades Fisher Recovery Area, Washington, 2015–2020.

Lists of individual fishers released in the Cascades Fisher Recovery Area, with capture and release dates, weight, age, number of telemetry locations, and last known status are presented in Tables A1 and A2.

Table A1. List of individual fishers released in the South Cascades with capture and release dates, and last known status.

Fisher ID	Sex	Age at Release (y)[a]	Weight (kg)	Capture Date	Release Date	Days in Captivity	No. of Telemetry Locations	Status: Last Date Found
F001	F	1	2.71	5-Nov-2015	3-Dec-2015	28	49	Alive: Oct 2017
F002	F	4	3.12	17-Nov-2015	3-Dec-2015	16	26	Dead: Mar 2018
M003	M	0	4.36	19-Nov-2015	3-Dec-2015	14	9	Dead: Jul 2017
F004	F	2	2.71	20-Nov-2015	3-Dec-2015	13	10	Dead: May 2016
M005	M	<1	3.70	28-Nov-2015	3-Dec-2015	5	10	Dead: Mar 2016
F006	F	2	2.42	30-Nov-2015	3-Dec-2015	3	13	Dead: May 2016
M007	M	3	4.78	30-Nov-2015	3-Dec-2015	3	14	Dead: Feb 2017
M008	M	2	5.09	2-Dec-2015	23-Dec-2015	21	18	Alive: Jul 2017
M009	M	<1	2.85	7-Dec-2015	23-Dec-2015	16	8	Dead: Mar 2016
M010	M	2	4.46	9-Dec-2015	16-Jan-2016	38	5	Alive: May 2016
F011	F	<1	2.08	9-Dec-2015	23-Dec-2015	14	43	Alive: Oct 2017
M012	M	<1	3.34	12-Dec-2015	23-Dec-2015	11	29	Alive: Oct 2017
F013	F	4	2.68	12-Dec-2015	16-Jan-2016	35	18	Alive: Jun 2017
M016	M	6	4.97	24-Dec-2015	16-Jan-2016	23	7	Dead: Mar 2016
F017	F	<1	2.32	24-Dec-2015	16-Jan-2016	23	51	Alive: Dec 2017
M019	M	2	4.90	8-Jan-2016	16-Jan-2016	8	22	Alive: May 2017
M020	M	<1	3.68	11-Jan-2016	16-Jan-2016	5	10	Alive: Jul 2016
F021	F	2	3.19	14-Jan-2016	6-Feb-2016	23	3	Dead: Mar 2017
F023	F	<1	2.43	17-Jan-2016	6-Feb-2016	20	46	Alive: Sep 2017
M024	M	unknown	4.02	22-Jan-2016	6-Feb-2016	15	28	Alive: Oct 2017
F025	F	<1	2.61	23-Jan-2016	6-Feb-2016	14	34	Alive: Oct 2017
M026	M	<1	3.98	28-Jan-2016	6-Feb-2016	9	7	Dead: Jun 2017
F028	F	unknown	2.76	31-Jan-2016	6-Feb-2016	6	30	Alive: Oct 2017
M029	M	<1	3.68	13-Nov-2016	2-Dec-2016	19	11	Dead: Jul 2018
M030	M	1	4.55	14-Nov-2016	2-Dec-2016	18	5	Alive: Dec 2017

[a] Age as determined by dental cementum analysis

[b] Veterinary assessment of age class, no dental analysis performed

[c] Date of release: no radio-transmitter implanted.

Table A1 (continued). List of individual fishers released in the South Cascades with capture and release dates, and last known status.

Fisher ID	Sex	Age at Release (y)[a]	Weight (kg)	Capture Date	Release Date	Days in Captivity	No. of Telemetry Locations	Status: Last Date Found
F031	F	2	2.87	5-Nov-2016	2-Dec-2016	27	18	Alive: Oct 2017
F032	F	1	2.38	17-Nov-2016	2-Dec-2016	15	5	Dead: Sep 2017
F034	F	2	3.22	17-Nov-2016	2-Dec-2016	15	12	Alive: Aug 2017
M035	M	<1	3.83	21-Nov-2016	2-Dec-2016	11	10	Dead: Oct 2017
M036	M	<1	3.63	24-Nov-2016	2-Dec-2016	8	9	Dead: Sep 2017
M037	M	<1	3.50	25-Nov-2016	2-Dec-2016	7	22	Alive: Jul 2018
F038	F	<1	2.23	25-Nov-2016	2-Dec-2016	7	5	Alive: Jul 2018
M039	M	5	5.02	27-Nov-2016	2-Dec-2016	5	4	Alive: Dec 2016
M040	M	<1	3.79	27-Nov-2016	10-Dec-2016	13	8	Alive: Jul 2018
F041	F	2	2.69	27-Nov-2016	10-Dec-2016	13	7	Alive: Oct 2017
F042	F	<1	2.55	28-Nov-2016	10-Dec-2016	12	43	Alive: Sep 2018
M043	M	<1	3.58	30-Nov-2016	10-Dec-2016	10	14	Alive: Jul 2018
M044	M	<1	3.06	1-Dec-2016	10-Dec-2016	9	12	Alive: Oct 2017
F045	F	<1	2.54	3-Dec-2016	10-Dec-2016	7	7	Dead: Apr 2017
M046	M	4	5.08	5-Dec-2016	10-Dec-2016	5	5	Dead: Sep 2017
F047	F	2	2.47	6-Dec-2016	10-Dec-2016	4	8	Dead: Jun 2017
M048	M	<1	3.76	6-Dec-2016	17-Dec-2016	11	12	Alive: Jul 2018
F049	F	1	2.53	7-Dec-2016	17-Dec-2016	10	11	Dead: Dec 2018
F050	F	1	2.38	7-Dec-2016	17-Dec-2016	10	9	Alive: Jul 2017
F051	F	1	2.74	7-Dec-2016	17-Dec-2016	10	21	Dead: May 2018
F052	F	unknown	2.56	10-Dec-2016	17-Dec-2016	7	16	Dead: Oct 2017
M054	M	1	3.76	11-Dec-2016	17-Dec-2016	6	15	Alive: Sep 2018
M056	M	<1	3.17	22-Dec-2016	31-Dec-2016	9	20	Alive: Sep 2018
F057	M	<1	2.22	22-Dec-2016	31-Dec-2016	9	7	Alive: Dec 2017
M058	M	<1	3.70	22-Dec-2016	31-Dec-2016	9	8	Alive: Sep 2018
F059	F	<1	1.95	23-Dec-2016	31-Dec-2016	8	15	Alive: Jul 2018
F060	F	2	2.66	24-Dec-2016	13-Jan-2017	20	9	Alive: Feb 2018
M061	M	<1	3.93	24-Dec-2016	13-Jan-2017	20	12	Alive: Jul 2018
M062	M	<1	3.82	24-Dec-2016	13-Jan-2017	20	6	Alive: Apr 2018
M063	M	<1	3.81	26-Dec-2016	31-Dec-2016	5	7	Alive: Feb 2018
M064	M	<1	3.46	26-Dec-2016	31-Dec-2016	5	26	Alive: Sep 2018
F065	F	3	2.71	1-Jan-2017	13-Jan-2017	12	12	Dead: Jun 2017

[a] Age as determined by dental cementum analysis

[b] Veterinary assessment of age class, no dental analysis performed

[c] Date of release: no radio-transmitter implanted.

Table A1 (continued). List of individual fishers released in the South Cascades with capture and release dates, and last known status.

Fisher ID	Sex	Age at Release (y)[a]	Weight (kg)	Capture Date	Release Date	Days in Captivity	No. of Telemetry Locations	Status: Last Date Found
M066	M	<1	3.70	1-Jan-2017	13-Jan-2017	12	5	Alive: Oct 2017
F067	F	<1	2.94	4-Jan-2017	13-Jan-2017	9	15	Dead: Jun 2018
F070	F	<1	2.58	6-Jan-2017	13-Jan-2017	7	6	Dead: Jul 2017
F072	F	<1	2.40	11-Jan-2017	3-Feb-2017	23	4	Alive: May 2017
F073	F	1	2.83	14-Jan-2017	3-Feb-2017	20	9	Alive: Sep 2018
F075	F	<1	2.25	17-Jan-2017	3-Feb-2017	17	15	Alive: Jul 2018
F080	F	1	2.44	30-Jan-2017	3-Feb-2017	4	13	Alive: May 2018
F082	F	<1	2.79	2-Feb-2017	20-Feb-2017	18	27	Alive: Sep 2018
F084	F	<1	3.22	4-Feb-2017	20-Feb-2017	16	4	Alive: Sep 2017
F085	F	<1	2.19	6-Feb-2017	20-Feb-2017	14	5	Dead: Sep 2017
F086	F	2	2.61	13-Feb-2017	20-Feb-2017	7	4	Dead: Oct 2017
F088	F	3	2.90	15-Feb-2017	20-Feb-2017	5	8	Dead: Jun 2017
M089	M	Juvenile[b]	4.35	15-Oct-2018	27-Oct-2018	12	NA	Alive: Oct 2018[c]
F090	F	Adult[b]	3.03	15-Oct-2018	27-Oct-2018	12	NA	Alive: Oct 2018[c]
F091	F	Subadult[b]	2.96	17-Oct-2018	27-Oct-2018	10	NA	Alive: Oct 2018[c]
F092	F	Juvenile[b]	2.58	21-Oct-2018	27-Oct-2018	6	NA	Alive: Oct 2018[c]
M149	M	<1	4.28	19-Oct-2019	8-Nov-2019	20	NA	Alive: Nov 2019[c]
F150	F	<1	3.10	20-Oct-2019	8-Nov-2019	19	NA	Alive: Nov 2019[c]
F154	F	<1	2.74	21-Oct-2019	8-Nov-2019	18	NA	Alive: Nov 2019[c]
M155	M	<1	5.02	21-Oct-2019	8-Nov-2019	18	NA	Alive: Nov 2019[c]
M173	M	<1	3.34	18-Nov-2019	10-Jan-2020	53	NA	Alive: Jan 2020[c]
F189	F	<1	2.74	19-Dec-2019	10-Jan-2020	22	NA	Alive: Jan 2020[c]
F190	F	<1	2.74	21-Dec-2019	10-Jan-2020	20	NA	Alive: Jan 2020[c]
M192	M	<1	4.54	22-Dec-2019	10-Jan-2020	19	NA	Alive: Jan 2020[c]

[a] Age as determined by dental cementum analysis

[b] Veterinary assessment of age class, no dental analysis performed

[c] Date of release: no radio-transmitter implanted.

Table A2. List of individual fishers released in the North Cascades and associated morphology, age, and release data.

Fisher ID	Sex	Age at Release (y)[a]	Weight (kg)	Capture Date	Release Date	Days in Captivity	No. of Telemetry Locations	Status: Last Date Found
F093	F	1	2.90	26-Oct-2018	5-Dec-2018	40	7	Dead: Jan 2019
M095	M	1	5.08	28-Oct-2018	5-Dec-2018	38	5	Dead: Sep 2019
F096	F	<1	3.04	18-Nov-2018	5-Dec-2018	17	29	Dead: Oct 2020
F097	F	<1	2.40	18-Nov-2018	5-Dec-2018	17	9	Alive: Mar 2019
F098	F	1	2.86	20-Nov-2018	5-Dec-2018	15	11	Alive: Apr 2019
F101	F	<1	2.80	26-Nov-2018	5-Dec-2018	9	5	Alive: Mar 2019
M102	M	<1	4.46	27-Nov-2018	13-Dec-2018	16	5	Alive: Mar 2019
M103	M	<1	3.93	23-Nov-2018	13-Dec-2018	20	5	Dead: Feb 2019
M104	M	1	4.03	24-Nov-2018	13-Dec-2018	19	2	Alive: Dec 2018
F105	F	2	3.15	29-Nov-2018	13-Dec-2018	14	59	Alive: Jun 2021
F106	F	5	2.80	30-Nov-2018	13-Dec-2018	13	5	Dead: Sep 2019
M107	M	1	4.52	1-Dec-2018	13-Dec-2018	12	3	Dead: Mar 2019
F109	F	<1	2.51	15-Dec-2018	17-Jan-2019	33	3	Alive: Mar 2019
F110	F	<1	2.07	15-Dec-2018	17-Jan-2019	33	2	Alive: Jan 2019
F111	F	<1	2.59	16-Dec-2018	17-Jan-2019	32	4	Alive: Apr 2019
M112	M	<1	4.27	18-Dec-2018	17-Jan-2019	30	3	Dead: Jan 2019
M113	M	1	4.88	20-Dec-2018	17-Jan-2019	28	4	Dead: Aug 2020
F116	F	<1	2.35	22-Dec-2018	17-Jan-2019	26	7	Dead: Mar 2019
F118	F	<1	2.56	10-Jan-2019	6-Feb-2019	27	4	Dead: Apr 2019
M119	M	<1	4.36	14-Jan-2019	6-Feb-2019	23	2	Alive: Feb 2019
M120	M	1	4.86	15-Jan-2019	6-Feb-2019	22	1	Alive: Feb 2019
M121	M	<1	4.56	18-Jan-2019	6-Feb-2019	19	3	Dead: Feb 2019
F122	F	<1	2.88	19-Jan-2019	6-Feb-2019	18	3	Dead: Oct 2019
M123	M	1	5.00	23-Jan-2019	6-Feb-2019	14	5	Dead: Oct 2019
M124	M	<1	4.80	14-Feb-2019	7-Mar-2019	21	4	Dead: Oct 2020
F125	F	<1	2.50	17-Feb-2019	7-Mar-2019	18	3	Alive: May 2021
M126	M	<1	4.42	2-Oct-2019	12-Oct-2019	10	2	Alive: Nov 2019
M127	M	4	5.10	2-Oct-2019	12-Oct-2019	10	6	Alive: Jul 2021
M128	M	1	5.24	2-Oct-2019	12-Oct-2019	10	5	Alive: Nov 2019
M129	M	<1	3.99	2-Oct-2019	12-Oct-2019	10	7	Alive: Feb 2020
F130	F	<1	3.00	2-Oct-2019	12-Oct-2019	10	3	Dead: Feb 2020
F131	F	<1	2.85	3-Oct-2019	12-Oct-2019	9	6	Alive: Jan 2020

[a] Age as determined by dental cementum analysis

[b] Veterinary assessment of age class, no dental analysis performed

[c] Date of release: no radio-transmitter implanted.

Table A2 (continued). List of individual fishers released in the North Cascades and associated morphology, age, and release data.

Fisher ID	Sex	Age at Release (y)[a]	Weight (kg)	Capture Date	Release Date	Days in Captivity	No. of Telemetry Locations	Status: Last Date Found
F132	F	1	2.93	3-Oct-2019	17-Oct-2019	14	5	Alive: Nov 2019
M133	M	<1	4.51	4-Oct-2019	17-Oct-2019	13	11	Alive: Jul 2021
F134	F	2	2.97	4-Oct-2019	17-Oct-2019	13	8	Dead: Apr 2020
F135	F	2	2.88	5-Oct-2019	31-Oct-2019	26	5	Dead: Jan 2020
M136	M	<1	4.47	7-Oct-2019	17-Oct-2019	10	6	Alive: Feb 2020
F137	F	2	2.83	6-Oct-2019	24-Oct-2019	18	16	Dead: Jun 2021
M138	M	1	5.30	8-Oct-2019	24-Oct-2019	16	7	Alive: Feb 2020
F139	F	<1	2.84	8-Oct-2019	24-Oct-2019	16	20	Alive: Jun 2021
M140	M	1	4.98	10-Oct-2019	24-Oct-2019	14	5	Alive: Feb 2020
F141	F	1	2.54	10-Oct-2019	24-Oct-2019	14	1	Alive: Oct 2019
M142	M	<1	4.48	11-Oct-2019	24-Oct-2019	13	18	Alive: Mar 2021
M143	M	<1	4.55	11-Oct-2019	24-Oct-2019	13	5	Alive: Nov 2019
F144	F	1	2.65	16-Oct-2019	24-Oct-2019	8	10	Alive: Jun 2021
F145	F	1	2.58	16-Oct-2019	31-Oct-2019	15	3	Alive: Nov 2019
F146	F	<1	2.96	16-Oct-2019	31-Oct-2019	15	17	Alive: Feb 2021
M147	M	1	4.60	19-Oct-2019	31-Oct-2019	12	5	Alive: Feb 2020
F148	F	<1	2.72	19-Oct-2019	31-Oct-2019	12	5	Dead: Feb 2020
F151	F	1	3.02	22-Oct-2019	7-Nov-2019	16	4	Dead: Oct 2020
M152	M	1	4.58	22-Oct-2019	7-Nov-2019	16	10	Alive: Apr 2021
M153	M	<1	4.80	22-Oct-2019	7-Nov-2019	16	5	Dead: Jan 2020
M156	M	<1	4.88	30-Oct-2019	14-Nov-2019	15	2	Alive: Nov 2019
F157	F	<1	2.94	31-Oct-2019	14-Nov-2019	14	1	Alive: Nov 2019
M158	M	<1	4.70	1-Nov-2019	14-Nov-2019	13	5	Dead: Feb 2020
M159	M	2	5.54	31-Oct-2019	14-Nov-2019	14	2	Alive: Nov 2019
M160	M	1	4.96	31-Oct-2019	14-Nov-2019	14	3	Alive: Feb 2020
M161	M	2	5.22	2-Nov-2019	21-Nov-2019	19	3	Alive: Feb 2020
F162	F	2	3.26	2-Nov-2019	14-Nov-2019	12	8	Alive: Aug 2021
M163	M	<1	4.60	4-Nov-2019	21-Nov-2019	17	2	Dead: May 2021
M164	M	1	4.04	3-Nov-2019	21-Nov-2019	18	3	Alive: Jan 2021
M165	M	<1	4.82	4-Nov-2019	21-Nov-2019	17	1	Alive: Nov 2019
F168	F	1	2.69	4-Nov-2019	21-Nov-2019	17	2	Alive: May 2021
F169	F	1	3.42	4-Nov-2019	29-Nov-2019	25	2	Alive: Sep 2021

[a] Age as determined by dental cementum analysis

[b] Veterinary assessment of age class, no dental analysis performed

[c] Date of release: no radio-transmitter implanted.

Table A2 (continued). List of individual fishers released in the North Cascades and associated morphology, age, and release data.

Fisher ID	Sex	Age at Release (y)[a]	Weight (kg)	Capture Date	Release Date	Days in Captivity	No. of Telemetry Locations	Status: Last Date Found
F170	F	<1	2.46	14-Nov-2019	29-Nov-2019	15	NA	Alive: Nov 2019[c]
M171	M	1	5.26	14-Nov-2019	29-Nov-2019	15	1	Dead: Aug 2020
M172	M	2	5.68	17-Nov-2019	29-Nov-2019	12	1	Dead: Apr 2019
F174	F	<1	2.56	17-Nov-2019	29-Nov-2019	12	NA	Alive: Nov 2019[c]
F175	F	2	2.74	21-Nov-2019	29-Nov-2019	8	1	Alive: Nov 2019
F176	F	1	2.86	22-Nov-2019	29-Nov-2019	7	6	Alive: Jul 2021
F177	F	2	3.18	24-Nov-2019	5-Dec-2019	11	4	Dead: Jun 2020
F178	F	1	3.20	25-Nov-2019	5-Dec-2019	10	4	Dead: Feb 2020
M179	M	2	4.48	26-Nov-2019	5-Dec-2019	9	1	Alive: Dec 2019
F180	F	3	3.09	26-Nov-2019	5-Dec-2019	9	1	Alive: Dec 2019
F181	F	1	2.65	28-Nov-2019	5-Dec-2019	7	4	Dead: Jan 2020
M182	M	2	5.30	29-Nov-2019	12-Dec-2019	13	NA	Alive: Dec 2019[c]
F183	F	<1	2.64	30-Nov-2019	12-Dec-2019	12	NA	Alive: Dec 2019[c]
F184	F	2	2.94	30-Nov-2019	12-Dec-2019	12	2	Dead: Feb 2020
M185	M	1	4.38	3-Dec-2019	12-Dec-2019	9	NA	Alive: Dec 2019[c]
F186	F	Subadult[b]	2.88	3-Dec-2019	12-Dec-2019	9	2	Dead: Feb 2020
M187	M	6	5.52	7-Dec-2019	13-Feb-2020	68	3	Dead: May 2020
F188	F	Subadult[b]	2.94	19-Dec-2019	9-Jan-2020	21	NA	Alive: Jan 2020[c]
F191	F	<1	2.48	21-Dec-2019	9-Jan-2020	19	1	Alive: Jan 2020
F193	F	<1	2.80	31-Dec-2019	9-Jan-2020	9	3	Dead: Feb 2020
F194	F	<1	2.72	31-Dec-2019	9-Jan-2020	9	3	Alive: Feb 2020
F195	F	<1	2.66	22-Jan-2020	13-Feb-2020	22	3	Dead: May 2021
M196	M	<1	4.38	28-Jan-2020	13-Feb-2020	16	3	Dead: Jun 2021
F197	F	<1	2.65	7-Feb-2020	13-Feb-2020	6	NA	Alive: Feb 2020[c]
M198	M	Juvenile[b]	3.78	7-Feb-2020	27-Feb-2020	20	1	Alive: Feb 2020

[a] Age as determined by dental cementum analysis

[b] Veterinary assessment of age class, no dental analysis performed

[c] Date of release: no radio-transmitter implanted.

Appendix B. Mortality Data for Fishers Recovered in the Cascades Fisher Recovery Area, Washington 2015–2021.

Table B1. List of dead fishers recovered in the Washington Cascade Range.

Fisher ID	Sex	Age at Death	Carcass Recovery Date	Cause of Death	Comments
F002	Female	7	3-Mar-2018	Human-caused	Illegally killed by a trapper
F004	Female	3	31-May-2016	Human-caused	Only transmitter found, at a developed human location
F006	Female	3	3-Jun-2016	Depredation	Head trauma - broken zygomatic arch
F021	Female	4	21-Mar-2017	Human-caused	Road kill
F045	Female	1	24-Apr-2017	Depredation	Broken back, puncture wounds. Predator DNA sequenced positive for bobcat.
F047	Female	3	5-Jun-2017	Depredation	Likely depredation; advanced desiccation (scavenged, skin turned inside out)
F049	Female	3	20-Dec-2018	Human-caused	Road kill
F051	Female	3	24-May-2018	Unknown	Scavenged: interruption of integument in predated area over dorsal thorax
F052	Female	1	31-Oct-2017	Depredation	Likely depredation. Predator DNA failed to sequence.
F065	Female	4	17-Jun-2018	Depredation	Depredation: Animal was scavenged, many entry holes. Tissues in poor condition, advanced autolysis, freezing precludes histopathology. Predator DNA failed to sequence.
F067	Female	2	18-Jun-2018	Depredation	Likely depredation (note inverted front limb), heavily scavenged.
F070	Female	1	31-Jul-2017	Unknown	No necropsy possible
F075	Female	2	14-Jul-2018	Depredation	Scavenged, many entry holes. Tissues in poor condition, advanced autolysis, freezing precludes histopathology.
F085	Female	1	27-Oct-2017	Depredation	Carcass decayed and desiccated. Possible puncture wounds on left shoulder. Transmitter found next to carcass.
F086	Female	3	25-Oct-2017	Unknown	Scavenged, many entry holes.
F088	Female	4	26-Jun-2017	Unknown	Only transmitter and clumps of fur recovered. Predator DNA failed to sequence.
F096	Female	2	19-Oct-2020	Depredation	Evidence of predation. DNA swab not yet analyzed.
F116	Female	1	20-Mar-2019	Depredation	Apparent depredation by felid (cougar tracks near site), bitten off front paws, puncture wounds. Predator DNA sequence positive for both bobcat and mountain lion.

Table B1 (continued). List of dead fishers recovered in the Washington Cascade Range.

Fisher ID	Sex	Age at Death	Carcass Recovery Date	Cause of Death	Comments
F118	Female	1	3-May-2019	Depredation	Depredation (consistent with large felid), Predator DNA sequenced positive for a Felid (no species identified, bobcat suspected)
F130	Female	1	5-Mar-2020	Unknown	No obvious external trauma; yellowish color in mouth; blood dripped from nose on movement of carcass. DNA swab not yet analyzed.
F134	Female	3	27-Apr-2020	Human-caused	Road kill
F137	Female	4	16-Jun-2021	Unknown	No remains, old mortality, few bone fragments
F148	Female	1	10-Mar-2020	Accident	Tangled up in woody debris from high water flow - possible drowning.
F181	Female	2	30-Jan-2020	Unknown	Only skeleton and transmitter and hair found. DNA swab not yet analyzed.
F193	Female	1	21-Feb-2020	Depredation	Predation: Transmitter with bite marks; small amount of hair, one skin fragment and one bone fragment. DNA swab not yet analyzed.
M003	Male	2	21-Aug-2017	Unknown	–
M005	Male	1	30-Mar-2016	Intraspecific Aggression	Intraspecific aggression
M007	Male	5	16-Feb-2017	Unknown	Only transmitter and hair/blood found. Predator DNA failed to sequence.
M009	Male	1	29-Jun-2017	Unknown	–
M016	Male	7	–	Accident	Carcass underwater in debris pile when investigated on 3/18/2016 and not recovered
M026	Male	2	22-Jun-2017	Unknown	–
M103	Male	1	2-Apr-2019	Unknown	Two small bone fragments, hair, and transmitter: putative bobcat scat on site
M112	Male	0	30-Jan-2019	Human-caused	Suspected human involvement: cracked skull consistent with hammer, cut marks made by knife blade. Predator DNA failed to sequence.
M121	Male	0	6-Mar-2019	Depredation	Depredation. Predator DNA sequenced positive for mountain lion.
M124	Male	0	6-Nov-2020	Human-caused	Road kill
M158	Male	1	19-Mar-2020	Unknown	Only transmitter and hair found. DNA swab not yet analyzed.
M163	Male	2	11-May-2021	Unknown	Only hair left.
M172	Male	3	14-Apr-2020	Human-caused	Road kill
M187	Male	6	27-May-2020	Unknown	Only hair and a few pieces of autolyzed skin

Appendix C. Morphometric Measures for British Columbia and Alberta Fishers.

Table C1. Mean ± Standard Error for body measurement of fishers, by age class, captured in central British Columbia and central Alberta, Canada, 2015–2020.

Measure	*N*	Weight (kg)	Total Length (cm)	Tail Length (cm)	Neck Circumference (cm)	Chest Circumference (cm)	Sagittal Crest Height (mm)	Hind Foot Length (cm)	Ear Length (mm)	Teat Width (mm)	Teat Height (mm)	Baculum Length (cm)
Juvenile Female (BC)	21	2.4 ± 0.07	92.8 ± 0.86	34.5 ± 0.58	16.8 ± 0.23	21.9 ± 0.31	0.5 ± 0.08	11.6 ± 0.21	36.7 ± 0.91	2.1 ± 0.11	2.2 ± 0.18	–
Juvenile Female (AB)	32	2.7 ± 0.04	89.3 ± 0.66	34.8 ± 0.43	16.3 ± 0.18	21.1 ± 0.27	1.0 ± 0.17	11.3 ± 0.05	48.6 ± 0.61	2.1 ± 0.05	2.0 ± 0.07	–
Juvenile Male (BC)	25	3.6 ± 0.07	101.2 ± 0.73	35.9 ± 0.11	19.4 ± 0.29	25.8 ± 0.32	0.7 ± 0.18	13.1 ± 0.11	41.6 ± 0.95	–	–	11.0 ± 0.31
Juvenile Male (AB)	26	4.4 ± 0.07	101.5 ± 1.17	38.7 ± 0.38	19.5 ± 0.43	26.0 ± 0.27	1.6 ± 0.23	12.8 ± 0.10	53.4 ± 0.53	–	–	9.6 ± 0.01
Subadult Female (BC)	7	2.6 ± 0.07	93.3 ± 0.79	34.4 ± 0.99	17.8 ± 0.23	23.1 ± 0.62	1.1 ± 0.40	11.3 ± 0.13	37.7 ± 1.81	2.4 ± 0.10	2.8 ± 0.16	–
Subadult Female (AB)	13	2.9 ± 0.07	90.7 ± 1.11	36.3 ± 0.49	17.0 ± 0.30	22.8 ± 0.74	2.6 ± 0.52	11.3 ± 0.19	48.1 ± 0.60	2.4 ± 0.13	2.9 ± 0.07	–
Subadult Male (BC)	6	4.0 ± 0.12	111.8 ± 7.03	37.6 ± 0.55	20.1 ± 0.33	27.5 ± 0.69	2.4 ± 1.02	13.4 ± 0.17	39.3 ± 1.02	–	–	11.2 ± 0.44
Subadult Male (AB)	15	4.8 ± 0.11	100.7 ± 1.83	35.8 ± 2.11	20.9 ± 0.31	26.5 ± 0.39	4.7 ± 0.88	12.9 ± 0.13	55.1 ± 0.59	–	–	10.7 ± 0.17
Adult Female (BC)	16	2.7 ± 0.08	92.5 ± 1.09	34.2 ± 0.57	18.2 ± 0.25	23.4 ± 0.32	2.9 ± 0.53	10.7 ± 0.66	38.6 ± 1.34	3.2 ± 0.17	4.2 ± 0.25	–
Adult Female (AB)	14	3.0 ± 0.04	91.5 ± 1.06	35.7 ± 0.70	17.0 ± 0.29	21.9 ± 0.49	4.0 ± 0.33	11.4 ± 0.10	48.4 ± 0.49	4.1 ± 0.60	5.0 ± 0.66	–
Adult Male (BC)	12	4.8 ± 0.14	104.4 ± 0.85	34.7 ± 0.97	23.6 ± 0.51	29.8 ± 0.55	7.4 ± 0.95	13.1 ± 0.33	44.7 ± 1.37	–	–	12.4 ± 0.45
Adult Male (AB)	8	5.2 ± 0.14	105.2 ± 1.28	40.3 ± 0.69	22.3 ± 0.37	27.5 ± 0.67	10.4 ± 0.93	13.3 ± 0.11	55.3 ± 0.56	–	–	10.9 ± 0.17

Appendix D. Genetic Data for Fishers Captured in British Columbia and Alberta, Canada.

Mitochondrial DNA haplotypes and measure of genetic diversity for fishers captured in British Columbia and Alberta, Canada are presented in Tables D1 and D2.

Table D1. List of mitochondrial DNA (mtDNA) haplotypes for individual fishers captured in British Columbia and Alberta, Canada, 2015–2020.

Fisher ID	Capture Date	Sex	Sample Type	Capture Location	mtDNA Haplotype	Reintroduction Location
F001	5-Nov-2015	Female	ear punch	British Columbia	Drew-Hap6	South Cascades
F002	17-Nov-2015	Female	ear punch	British Columbia	Drew-Hap7	South Cascades
F004	20-Nov-2015	Female	ear punch	British Columbia	Drew-Hap7	South Cascades
F006	30-Nov-2015	Female	ear punch	British Columbia	Drew-Hap4	South Cascades
F011	9-Dec-2015	Female	ear punch	British Columbia	Drew-Hap7	South Cascades
F013	12-Dec-2015	Female	ear punch	British Columbia	Drew-Hap9	South Cascades
F017	24-Dec-2015	Female	ear punch	British Columbia	Drew-Hap9	South Cascades
F021	14-Jan-2016	Female	ear punch	British Columbia	Drew-Hap9	South Cascades
F023	17-Jan-2016	Female	ear punch	British Columbia	Drew-Hap9	South Cascades
F025	23-Jan-2016	Female	ear punch	British Columbia	Drew-Hap4	South Cascades
F028	31-Jan-2016	Female	ear punch	British Columbia	Drew-Hap6	South Cascades
F031	5-Nov-2016	Female	hair	British Columbia	Drew-Hap6	South Cascades
F032	17-Nov-2016	Female	hair	British Columbia	Drew-Hap9	South Cascades
F034	17-Nov-2016	Female	hair	British Columbia	Drew-Hap9	South Cascades
F038	25-Nov-2016	Female	hair	British Columbia	Drew-Hap6	South Cascades
F041	27-Nov-2016	Female	hair	British Columbia	Drew-Hap6	South Cascades
F042	28-Nov-2016	Female	hair	British Columbia	Drew-Hap7	South Cascades
F045	3-Dec-2016	Female	hair	British Columbia	Drew-Hap6	South Cascades
F047	6-Dec-2016	Female	hair	British Columbia	Drew-Hap6	South Cascades
F049	7-Dec-2016	Female	hair	British Columbia	Drew-Hap4	South Cascades
F050	28-Nov-2016	Female	hair	British Columbia	Drew-Hap9	South Cascades
F051	7-Dec-2016	Female	hair	British Columbia	Drew-Hap9	South Cascades
F052	10-Dec-2016	Female	hair	British Columbia	Drew-Hap4	South Cascades
F057	22-Dec-2016	Male	hair	British Columbia	Drew-Hap7	South Cascades
F059	23-Dec-2016	Female	hair	British Columbia	Drew-Hap9	South Cascades
F060	24-Dec-2016	Female	hair	British Columbia	Drew-Hap9	South Cascades
F065	1-Jan-2017	Female	hair	British Columbia	Drew-Hap6	South Cascades
F067	4-Jan-2017	Female	hair	British Columbia	Drew-Hap9	South Cascades
F070	6-Jan-2017	Female	hair	British Columbia	Drew-Hap9	South Cascades

Table D1 (continued). List of mitochondrial DNA (mtDNA) haplotypes for individual fishers captured in British Columbia and Alberta, Canada, 2015–2020.

Fisher ID	Capture Date	Sex	Sample Type	Capture Location	mtDNA Haplotype	Reintroduction Location
F072	11-Jan-2017	Female	hair	British Columbia	Drew-Hap4	South Cascades
F073	14-Jan-2017	Female	hair	British Columbia	Drew-Hap6	South Cascades
F075	17-Jan-2017	Female	hair	British Columbia	Drew-Hap9	South Cascades
F080	30-Jan-2017	Female	hair	British Columbia	Drew-Hap9	South Cascades
F082	2-Feb-2017	Female	hair	British Columbia	Drew-Hap9	South Cascades
F084	4-Feb-2017	Female	hair	British Columbia	Drew-Hap4	South Cascades
F085	6-Feb-2017	Female	hair	British Columbia	Drew-Hap6	South Cascades
F086	13-Feb-2017	Female	hair	British Columbia	Drew-Hap6	South Cascades
F088	15-Feb-2017	Female	hair	British Columbia	Drew-Hap9	South Cascades
F090	15-Oct-2018	Female	hair	Alberta	Drew-Hap7	South Cascades
F091	17-Oct-2018	Female	hair	Alberta	Drew-Hap7	South Cascades
F092	21-Oct-2018	Female	hair	Alberta	Drew-Hap11	South Cascades
F093	26-Oct-2018	Female	hair	Alberta	Drew-Hap11	North Cascades
F094	26-Oct-2018	Female	hair	Alberta	Drew-Hap3	not translocated
F096	18-Nov-2018	Female	hair	Alberta	Drew-Hap11	North Cascades
F097	18-Nov-2018	Female	hair	Alberta	Drew-Hap3	North Cascades
F098	20-Nov-2018	Female	hair	Alberta	Drew-Hap7	North Cascades
F099	23-Nov-2018	Female	hair	Alberta	Drew-Hap7	not translocated
F101	26-Nov-2018	Female	hair	Alberta	Drew-Hap7	North Cascades
F105	29-Nov-2018	Female	hair	Alberta	Drew-Hap7	North Cascades
F106	30-Nov-2018	Female	hair	Alberta	Hap 14	North Cascades
F109	15-Dec-2018	Female	hair	Alberta	Drew-Hap3	North Cascades
F110	15-Dec-2018	Female	hair	Alberta	Hap 13	North Cascades
F111	16-Dec-2018	Female	hair	Alberta	Drew-Hap3	North Cascades
F114	20-Dec-2018	Female	hair	Alberta	Drew-Hap3	not translocated
F115	22-Dec-2018	Female	hair	Alberta	Drew-Hap3	not translocated
F116	22-Dec-2018	Female	hair	Alberta	Drew-Hap3	North Cascades
F117	27-Dec-2018	Female	hair	Alberta	Drew-Hap3	not translocated
F118	10-Jan-2019	Female	hair	Alberta	Drew-Hap3	North Cascades
F122	19-Jan-2019	Female	hair	Alberta	Hap 13	North Cascades
F125	17-Feb-2019	Female	hair	Alberta	Drew-Hap7	North Cascades
F130	2-Oct-2019	Female	hair	Alberta	Drew-Hap3	North Cascades
F131	3-Oct-2019	Female	hair	Alberta	Drew-Hap7	North Cascades
F132	3-Oct-2019	Female	hair	Alberta	Drew-Hap3	North Cascades
F134	4-Oct-2019	Female	hair	Alberta	Hap 13	North Cascades

Table D1 (continued). List of mitochondrial DNA (mtDNA) haplotypes for individual fishers captured in British Columbia and Alberta, Canada, 2015–2020.

Fisher ID	Capture Date	Sex	Sample Type	Capture Location	mtDNA Haplotype	Reintroduction Location
F135	5-Oct-2019	Female	hair	Alberta	Drew-Hap3	North Cascades
F137	6-Oct-2019	Female	hair	Alberta	Drew-Hap7	North Cascades
F139	8-Oct-2019	Female	hair	Alberta	Drew-Hap7	North Cascades
F141	10-Oct-2019	Female	hair	Alberta	Drew-Hap3	North Cascades
F144	16-Oct-2019	Female	hair	Alberta	Hap 14	North Cascades
F145	16-Oct-2019	Female	hair	Alberta	Drew-Hap3	North Cascades
F146	16-Oct-2019	Female	hair	Alberta	Hap 13	North Cascades
F148	19-Oct-2019	Female	hair	Alberta	Drew-Hap3	North Cascades
F150	20-Oct-2019	Female	hair	Alberta	Drew-Hap3	South Cascades
F151	22-Oct-2019	Female	hair	Alberta	Drew-Hap3	North Cascades
F154	21-Oct-2019	Female	hair	Alberta	Hap 13	South Cascades
F157	31-Oct-2019	Female	hair	Alberta	Drew-Hap3	North Cascades
F162	2-Nov-2019	Female	hair	Alberta	Drew-Hap3	North Cascades
F168	4-Nov-2019	Female	hair	Alberta	Drew-Hap3	North Cascades
F169	4-Nov-2019	Female	hair	Alberta	Drew-Hap7	North Cascades
F170	14-Nov-2019	Female	hair	Alberta	Drew-Hap3	North Cascades
F174	17-Nov-2019	Female	hair	Alberta	Drew-Hap3	North Cascades
F175	21-Nov-2019	Female	hair	Alberta	Drew-Hap7	North Cascades
F176	22-Nov-2019	Female	hair	Alberta	Drew-Hap3	North Cascades
F177	24-Nov-2019	Female	hair	Alberta	Drew-Hap3	North Cascades
F178	25-Nov-2019	Female	hair	Alberta	Drew-Hap7	North Cascades
F180	26-Nov-2019	Female	hair	Alberta	Drew-Hap11	North Cascades
F181	28-Nov-2019	Female	hair	Alberta	Drew-Hap7	North Cascades
F183	30-Nov-2019	Female	hair	Alberta	Drew-Hap3	North Cascades
F184	30-Nov-2019	Female	hair	Alberta	Drew-Hap7	North Cascades
F186	3-Dec-2019	Female	hair	Alberta	Hap 13	North Cascades
F188	19-Dec-2019	Female	hair	Alberta	Drew-Hap3	North Cascades
F189	19-Dec-2019	Female	hair	Alberta	Drew-Hap3	South Cascades
F190	21-Dec-2019	Female	hair	Alberta	Drew-Hap7	South Cascades
F191	21-Dec-2019	Female	hair	Alberta	Drew-Hap3	North Cascades
F193	31-Dec-2019	Female	hair	Alberta	Drew-Hap7	North Cascades
F194	31-Dec-2019	Female	hair	Alberta	Drew-Hap7	North Cascades
F195	22-Jan-2020	Female	hair	Alberta	Drew-Hap3	North Cascades
F197	7-Feb-2020	Female	hair	Alberta	Drew-Hap11	North Cascades
M003	19-Nov-2015	Male	ear punch	British Columbia	Drew-Hap9	South Cascades

Table D1 (continued). List of mitochondrial DNA (mtDNA) haplotypes for individual fishers captured in British Columbia and Alberta, Canada, 2015–2020.

Fisher ID	Capture Date	Sex	Sample Type	Capture Location	mtDNA Haplotype	Reintroduction Location
M005	28-Nov-2015	Male	ear punch	British Columbia	Drew-Hap7	South Cascades
M007	30-Nov-2015	Male	ear punch	British Columbia	Drew-Hap6	South Cascades
M008	2-Dec-2015	Male	ear punch	British Columbia	Drew-Hap6	South Cascades
M009	7-Dec-2015	Male	ear punch	British Columbia	Drew-Hap4	South Cascades
M010	9-Dec-2015	Male	ear punch	British Columbia	Drew-Hap7	South Cascades
M012	12-Dec-2015	Male	ear punch	British Columbia	Drew-Hap6	South Cascades
M016	24-Dec-2015	Male	ear punch	British Columbia	Drew-Hap4	South Cascades
M019	8-Jan-2016	Male	ear punch	British Columbia	Drew-Hap9	South Cascades
M020	11-Jan-2016	Male	ear punch	British Columbia	Drew-Hap7	South Cascades
M024	22-Jan-2016	Male	ear punch	British Columbia	Drew-Hap6	South Cascades
M026	28-Jan-2016	Male	ear punch	British Columbia	Drew-Hap4	South Cascades
M029	13-Nov-2016	Male	hair	British Columbia	Drew-Hap6	South Cascades
M030	14-Nov-2016	Male	hair	British Columbia	Drew-Hap4	South Cascades
M035	21-Nov-2016	Male	hair	British Columbia	Drew-Hap6	South Cascades
M036	24-Nov-2016	Male	hair	British Columbia	Drew-Hap7	South Cascades
M037	25-Nov-2016	Male	hair	British Columbia	Drew-Hap7	South Cascades
M039	27-Nov-2016	Male	hair	British Columbia	Drew-Hap4	South Cascades
M040	27-Nov-2016	Male	hair	British Columbia	Drew-Hap7	South Cascades
M043	30-Nov-2016	Male	hair	British Columbia	Drew-Hap7	South Cascades
M044	1-Dec-2016	Male	hair	British Columbia	Drew-Hap9	South Cascades
M046	5-Dec-2016	Male	hair	British Columbia	Drew-Hap9	South Cascades
M048	6-Dec-2016	Male	hair	British Columbia	Drew-Hap4	South Cascades
M054	10-Dec-2016	Male	hair	British Columbia	Drew-Hap6	South Cascades
M056	22-Dec-2016	Male	hair	British Columbia	Drew-Hap6	South Cascades
M058	22-Dec-2016	Male	hair	British Columbia	Drew-Hap4	South Cascades
M061	24-Dec-2016	Male	hair	British Columbia	Drew-Hap6	South Cascades
M062	24-Dec-2016	Male	hair	British Columbia	Drew-Hap9	South Cascades
M063	26-Dec-2016	Male	hair	British Columbia	Drew-Hap4	South Cascades
M064	26-Dec-2016	Male	hair	British Columbia	Drew-Hap6	South Cascades
M066	1-Jan-2017	Male	hair	British Columbia	Drew-Hap9	South Cascades
M089	15-Oct-2018	Male	hair	Alberta	Drew-Hap3	South Cascades
M095	28-Oct-2018	Male	hair	Alberta	Drew-Hap7	North Cascades
M100	25-Nov-2018	Male	hair	Alberta	Drew-Hap7	not translocated
M102	27-Nov-2018	Male	hair	Alberta	Drew-Hap7	North Cascades
M103	23-Nov-2018	Male	hair	Alberta	Drew-Hap11	North Cascades

Table D1 (continued). List of mitochondrial DNA (mtDNA) haplotypes for individual fishers captured in British Columbia and Alberta, Canada, 2015–2020.

Fisher ID	Capture Date	Sex	Sample Type	Capture Location	mtDNA Haplotype	Reintroduction Location
M104	24-Nov-2018	Male	hair	Alberta	Drew-Hap7	North Cascades
M107	1-Dec-2018	Male	hair	Alberta	Drew-Hap7	North Cascades
M108	12-Dec-2018	Male	hair	Alberta	Drew-Hap11	not translocated
M112	18-Dec-2018	Male	hair	Alberta	Drew-Hap11	North Cascades
M113	20-Dec-2018	Male	hair	Alberta	Drew-Hap7	North Cascades
M119	14-Jan-2019	Male	hair	Alberta	Drew-Hap3	North Cascades
M120	15-Jan-2019	Male	hair	Alberta	Drew-Hap7	North Cascades
M121	18-Jan-2019	Male	hair	Alberta	Drew-Hap3	North Cascades
M123	23-Jan-2019	Male	hair	Alberta	Drew-Hap7	North Cascades
M124	14-Feb-2019	Male	hair	Alberta	Drew-Hap3	North Cascades
M126	2-Oct-2019	Male	hair	Alberta	Drew-Hap3	North Cascades
M127	2-Oct-2019	Male	hair	Alberta	Drew-Hap3	North Cascades
M128	2-Oct-2019	Male	hair	Alberta	Drew-Hap3	North Cascades
M129	2-Oct-2019	Male	hair	Alberta	Drew-Hap7	North Cascades
M133	4-Oct-2019	Male	hair	Alberta	Drew-Hap3	North Cascades
M136	7-Oct-2019	Male	hair	Alberta	Drew-Hap3	North Cascades
M138	8-Oct-2019	Male	hair	Alberta	Drew-Hap3	North Cascades
M140	10-Oct-2019	Male	hair	Alberta	Drew-Hap3	North Cascades
M142	11-Oct-2019	Male	hair	Alberta	Drew-Hap3	North Cascades
M143	11-Oct-2019	Male	hair	Alberta	Drew-Hap11	North Cascades
M147	19-Oct-2019	Male	hair	Alberta	Drew-Hap3	North Cascades
M149	19-Oct-2019	Male	hair	Alberta	Drew-Hap3	South Cascades
M152	22-Oct-2019	Male	hair	Alberta	Hap 13	North Cascades
M153	22-Oct-2019	Male	hair	Alberta	Drew-Hap3	North Cascades
M155	21-Oct-2019	Male	hair	Alberta	Drew-Hap11	South Cascades
M156	30-Oct-2019	Male	hair	Alberta	Drew-Hap11	North Cascades
M158	1-Nov-2019	Male	hair	Alberta	Drew-Hap11	North Cascades
M159	31-Oct-2019	Male	hair	Alberta	Drew-Hap7	North Cascades
M160	31-Oct-2019	Male	hair	Alberta	Drew-Hap3	North Cascades
M161	2-Nov-2019	Male	hair	Alberta	Drew-Hap3	North Cascades
M163	4-Nov-2019	Male	hair	Alberta	Drew-Hap3	North Cascades
M164	3-Nov-2019	Male	hair	Alberta	Drew-Hap3	North Cascades
M165	4-Nov-2019	Male	hair	Alberta	Drew-Hap7	North Cascades
M166	4-Nov-2019	Male	hair	Alberta	Drew-Hap3	not translocated
M171	14-Nov-2019	Male	hair	Alberta	Drew-Hap11	North Cascades

Table D1 (continued). List of mitochondrial DNA (mtDNA) haplotypes for individual fishers captured in British Columbia and Alberta, Canada, 2015–2020.

Fisher ID	Capture Date	Sex	Sample Type	Capture Location	mtDNA Haplotype	Reintroduction Location
M172	17-Nov-2019	Male	hair	Alberta	Drew-Hap7	North Cascades
M173	18-Nov-2019	Male	hair	Alberta	Drew-Hap3	South Cascades
M179	26-Nov-2019	Male	hair	Alberta	Drew-Hap3	North Cascades
M182	29-Nov-2019	Male	hair	Alberta	Hap 14	North Cascades
M185	3-Dec-2019	Male	hair	Alberta	Hap 14	North Cascades
M187	7-Dec-2019	Male	hair	Alberta	Drew-Hap3	North Cascades
M192	22-Dec-2019	Male	hair	Alberta	Drew-Hap3	South Cascades
M196	28-Jan-2020	Male	hair	Alberta	Drew-Hap11	North Cascades
M198	7-Feb-2020	Male	hair	Alberta	Drew-Hap3	North Cascades

Table D2. List of loci and measures of genetic diversity for individual fishers captured in British Columbia and Alberta, Canada, 2015–2020. *N* is the number of samples that produced a genotype at each locus, N_e is the effective number of alleles, H_o is observed heterozygosity, and H_e is expected heterozygosity.

Source Population	Locus	*N*	Number of Alleles	N_e	H_o	H_e
British Columbia	Ma1	69	5	4.01	0.74	0.75
British Columbia	Ggu234	69	5	3.96	0.72	0.75
British Columbia	Ggu216	69	5	3.59	0.68	0.72
British Columbia	Ggu101	69	5	2.85	0.61	0.65
British Columbia	Lut604	69	5	3.4	0.59	0.71
British Columbia	Gg4	69	4	3.22	0.68	0.69
British Columbia	Pv9	69	4	2.41	0.55	0.58
British Columbia	Mer022	69	6	3.05	0.67	0.67
British Columbia	Mvis72	69	6	2.75	0.55	0.64
British Columbia	Mvis020	69	5	1.14	0.01	0.13
British Columbia	Mp144	69	11	8.08	0.91	0.88
British Columbia	Mp247	69	6	4.11	0.72	0.76
British Columbia	Mp59	69	3	2.15	0.46	0.53
British Columbia	MP0175	69	5	2.07	0.46	0.52
British Columbia	MP0197	69	4	1.87	0.43	0.46
British Columbia	MP0200	69	8	5.1	0.58	0.8
British Columbia	Lut733	69	2	1.9	0.51	0.47
Alberta	Ma1	109	5	3.79	0.66	0.74
Alberta	Ggu234	101	6	1.88	0.5	0.47
Alberta	Ggu216	107	9	4.04	0.7	0.75
Alberta	Ggu101	109	6	3.86	0.71	0.74
Alberta	Lut604	107	5	3.75	0.67	0.73
Alberta	Gg4	109	5	3.14	0.71	0.68
Alberta	Pv9	87	4	3.64	0.7	0.73
Alberta	Mer022	102	6	3.25	0.66	0.69
Alberta	Mvis72	108	8	4.44	0.76	0.77
Alberta	Mvis020	109	5	2.1	0.22	0.52
Alberta	Mp144	108	9	4.88	0.74	0.79
Alberta	Mp247	109	7	3.9	0.75	0.74
Alberta	Mp59	108	3	1.86	0.44	0.46
Alberta	MP0175	109	6	3.79	0.62	0.74
Alberta	MP0197	109	2	1.36	0.22	0.26
Alberta	MP0200	109	11	4.05	0.71	0.75
Alberta	Lut733	91	2	1.96	0.51	0.49

Male fisher M124, near the White Chuck River in the Mount Baker-Snoqualmie National Forest, Washington, 2019. NPS / JASON RANSOM

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