National Park Service
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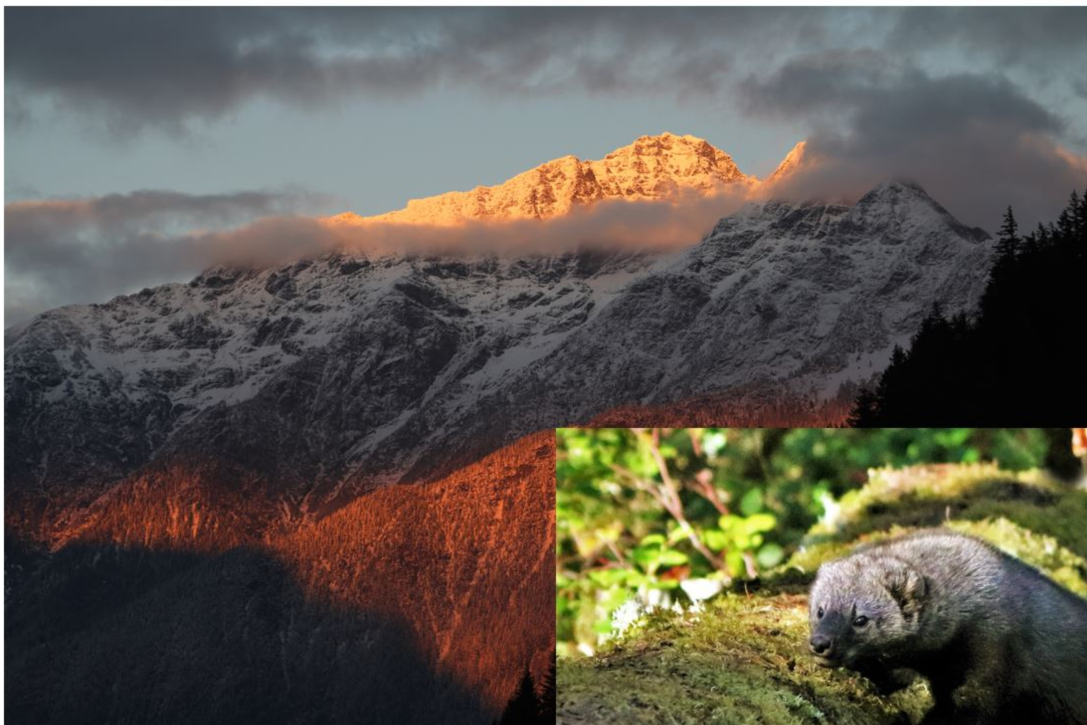
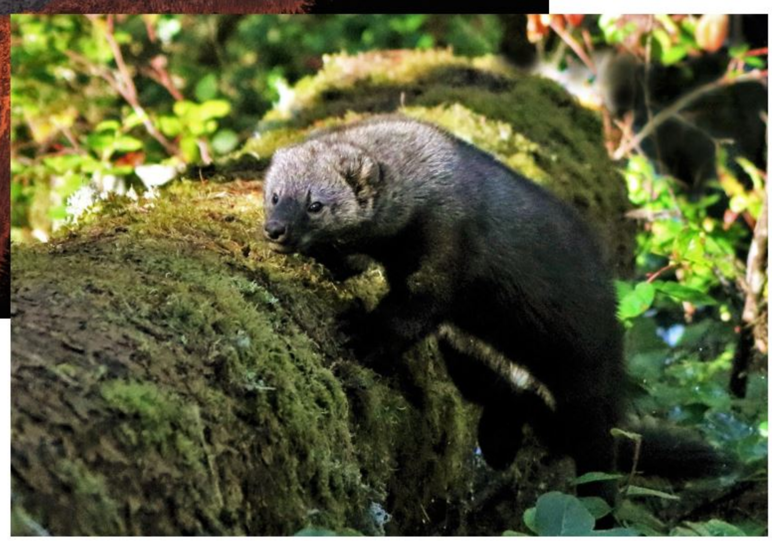
Natural Resource Stewardship and Science

Cascades Fisher Reintroduction Project

Progress Report for April 2019 to June 2020

Natural Resource Report NPS/PWR/NRR—2020/2211





ON THE COVER

Jack Mountain, North Cascades National Park Service Complex (left photo; by Jason Ransom/NPS), and male M152 at Buck Creek in the Mount Baker-Snoqualmie National Forest (right photo; by Jason Ransom/NPS)

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Prepared by:
Jeffrey C. Lewis,[1] Jason I. Ransom,[2] Tara Chestnut,[3] David O. Werntz,[4] Sandie Black,[5] Jose Luis Postigo,[5] and Axel Moehrenschlager[5]

[1]Washington Department of Fish and Wildlife
600 Capitol Way N.
Olympia, WA 98501

[2]North Cascades National Park Service Complex
810 State Route 20
Sedro-Woolley, WA 98284

[3]Mount Rainier National Park
55210 238th Avenue East
Ashford, WA 98304

[4]Conservation Northwest
1829 10th Avenue West, Suite B
Seattle, WA 98119

[5]Calgary Zoo
1300 Zoo Road NE
Calgary, AB T2E 7V6
Canada

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Contents

Contents (continued)

Page

Figures

Page

Tables

Page

Abstract

Fishers (*Pekania pennanti*) were extirpated from Washington due to over-trapping, habitat loss, and predator eradication programs. A mid-sized member of the weasel family, fishers occurred in the coniferous forests of Washington until the early and mid-1900s. We established a partnership between federal, state, and non-profit organizations with the goal of restoring fishers to their former range in Washington. This partnership reintroduced 90 fishers from British Columbia to Olympic National Park from 2008 to 2010. We are now in the fifth year of a reintroduction project to restore fishers to Mount Rainier National Park (MORA), Gifford Pinchot National Forest (GPNF) and the larger South Cascade Ecosystem, and in the second year of reintroducing them to North Cascades National Park Service Complex (NOCA), Mount Baker-Snoqualmie National Forest (MBSNF), and the larger North Cascades Ecosystem. To date, we have released 81 fishers (69 fishers (38 F, 31 M) from British Columbia, Canada, and 12 fishers (7 F, 5 M) from Alberta, Canada) into MORA and GPNF in the South Cascades Ecosystem. We have collected 1,016 locations of these fishers using radio-telemetry, and this phase of monitoring is complete. The majority of fisher locations occurred within the boundaries of the recovery area. Annual survival of reintroduced fishers has remained above 50% each year and across both sexes, and thus remains within the parameters for likely population establishment. We confirmed reproduction of fishers in the South Cascades in 2017, when female F023 was photographed with one kit at her den tree, and again in 2018, when female F082 was photographed with one kit at her den tree. We have now also translocated 89 fishers (48 F, 41 M) from Alberta into the North Cascades Ecosystem, including NOCA and MBSNF. We have collected 261 locations of these fishers using radio-telemetry, and 2020 will be the first denning season when reproduction is expected. Data are still insufficient for calculating annual survival, but 24 mortalities have been detected and several have been attributed to predation. In addition to monitoring movements, survival, and reproduction in the North Cascades, we also report on the progress of several research studies aimed at better understanding reintroduction success and improving animal welfare throughout the process.

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Fishers were reintroduced on the traditional lands of the Cowlitz Indian Tribe, Nisqually Indian Tribe, Confederated Tribes and Bands of the Yakama Nation, Puyallup Tribe of Indians, Muckleshoot Indian Tribe, Squaxin Island Tribe, Sauk-Suiattle Indian Tribe, and Upper Skagit Indian Tribe.

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Introduction

Fishers (*Pekania pennanti*) are a mid-sized member of the weasel family (Mustelidae) that historically occurred in the dense coniferous forests of Washington (Powell 1993, Lofroth et al. 2010). 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 (Lewis and Stinson 1998). Consequently, the fisher was listed as an endangered species in the state, and recovery actions were outlined to restore fishers in Washington (Lewis and Hayes 2004, Hayes and Lewis 2006).

Given the success of reintroductions for restoring fisher populations to other parts of their historical range (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). The Calgary Zoo joined WDFW, NPS, and CNW in 2018 for the reintroduction of fishers in the Cascade Range, and to help sustain the effort to restore fishers in the largest portions of their historical range in Washington (Lewis et al. 2018a).

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 (FLNRO), 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 a number of 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, Ministry (FLNRO) officials were concerned about the uncertain status of fishers in central British Columbia and discontinued our permits. Consequently, in the fall of 2017, we explored the possibility of working with Ministry officials and other potential partners in Alberta, Canada, to complete our reintroduction implementation for the Cascades Recovery Area. From 2017 to present, we have operated this project with the Alberta Ministry of Environment and Parks, the Calgary Zoo, 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 is to re-establish a self-sustaining fisher population in both the southern and northern portions of the Cascade 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). We have the following objectives to meet our goals in the southern and northern portions of the recovery area:

- **Objective 1:** Capture at least 160 fishers with a sex ratio of ≥50% females from central and northern British Columbia and/or Alberta, Canada, and release at least 80 into the southern portion of the Cascade Recovery Area over two years, and at least 80 into the northern portion of the Cascade Recovery Area over two years.
- **Objective 2:** Release fishers at few (i.e. 2–3) locations in each portion of the recovery 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.

In this report we provide a detailed summary of progress of the fisher reintroduction project in the southern and northern Cascade Range in Washington made through June 2020. A detailed summary of the process and methodologies of this fisher reintroduction project are in former progress reports (Lewis et al. 2017, 2018b, 2019).

South Cascades Progress to Date

Objective 1: Capture a founder population of at least 80 fishers with a sex ratio of ≥50% females from central British Columbia and release them into the southern portion of the Cascade Recovery Area over 2–3 years.

In the first year of the project (December 2015 to November 2016), 23 fishers (11 female [F], 12 male [M]) were successfully captured in central British Columbia, transported to Washington, and released on four occasions from 3 December 2015 to 6 February 2016 near the Cispus Learning Center, Randle, WA (herein Cispus) (Figure 1, 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), 46 fishers were captured and transported to Washington (27F, 19M; Appendix A), and 16 (8F, 8M) were released at the MORA – Longmire release site and 30 (19F, 11M) 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 (7F, 5M from Alberta) without radio-transmitters at MORA and Cispus, in order to meet our objective of releasing ≥80 fishers in the southern portion of the recovery area Cascade Range (Table 1).

Table 1. The number of fishers released and fisher release sites in the southern portion of the Cascade Recovery Area 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

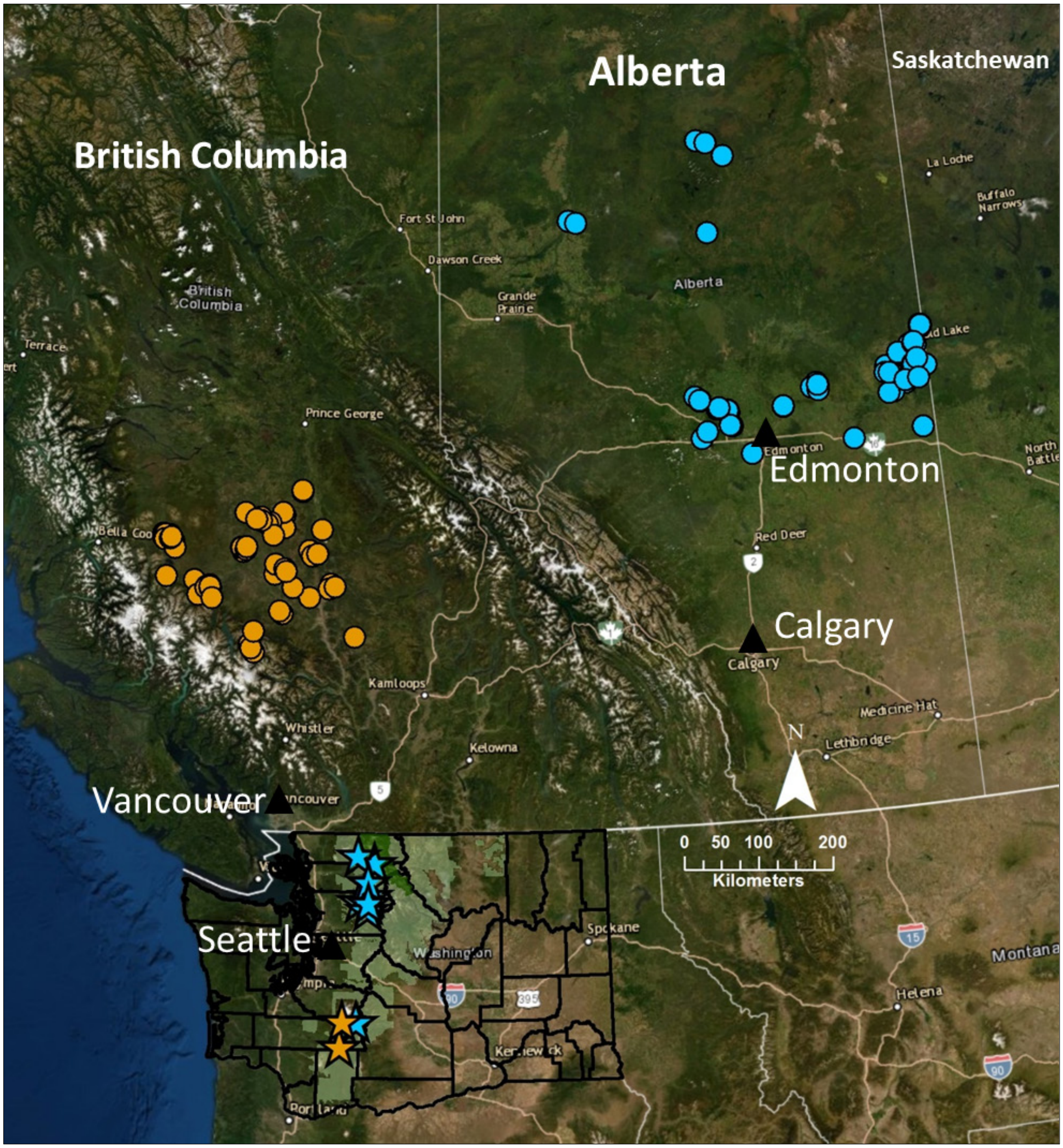

Figure 1. Locations of captures (circles) in British Columbia and Alberta, Canada, and fisher release sites (stars) in the Cascade Fisher Recovery Area. Capture locations for 69 British Columbia (orange circles) fishers correspond to releases in the South Cascades, and capture locations for 101 Alberta (blue circles) fishers correspond to releases in both the North and South Cascades.

Objective 2: Release fishers at two or three locations to increase the likelihood of fishers interacting, i.e., finding mates, and learning habitat suitability from previously released fishers.

We met this objective by releasing fishers at two primary release sites (Cispus and MORA – Longmire), and supplementing with the third release site in 2018 (MORA – Ohanapecosh; Table 1).

Objective 3: Release as many fishers as possible before January 1st to facilitate reproductive success, by conducting the reintroduction process well before the active gestation period of female fishers (Facka et al. 2016).

We met this objective by releasing 24 of 45 translocated females (53%) before January 1st (Table 1, Appendix A). 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, 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: Monitor post-release movements, survival, home range establishment, and reproduction to evaluate initial reintroduction success during the period (up to two years) when we can track fishers with functioning radio-transmitters.

Monitoring Methods

We used aerial radio-telemetry to obtain data and evaluate post-release movements, survival, home range establishment and reproduction. Our goal was to fly as many as five times per month to locate fishers; however, poor flying weather (and occasionally pilot/plane availability) prevented flying this frequently. 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; Figures 2 and 3), for an average of 2.48 locations per hour and an average cost of $186.65 per location (Figure 2). From these data, 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 49 ground telemetry locations (39 for females, 10 for males) and used them to help locate potential fisher den sites, deploy remote cameras at these sites to document reproduction, and to investigate mortality signals and recover dead fishers to determine causes of death. Supplemental data from verifiable non-telemetry detections were used to further document distribution of fishers in the recovery area (Figure 2). From August 2016 to June 2020, we received 142 non-telemetry detections that could be verified (e.g. trail camera images, photos and videos from public and partners). Collectively, these detections ranged across 7,236 km^2 of the South Cascades (Figure 2).

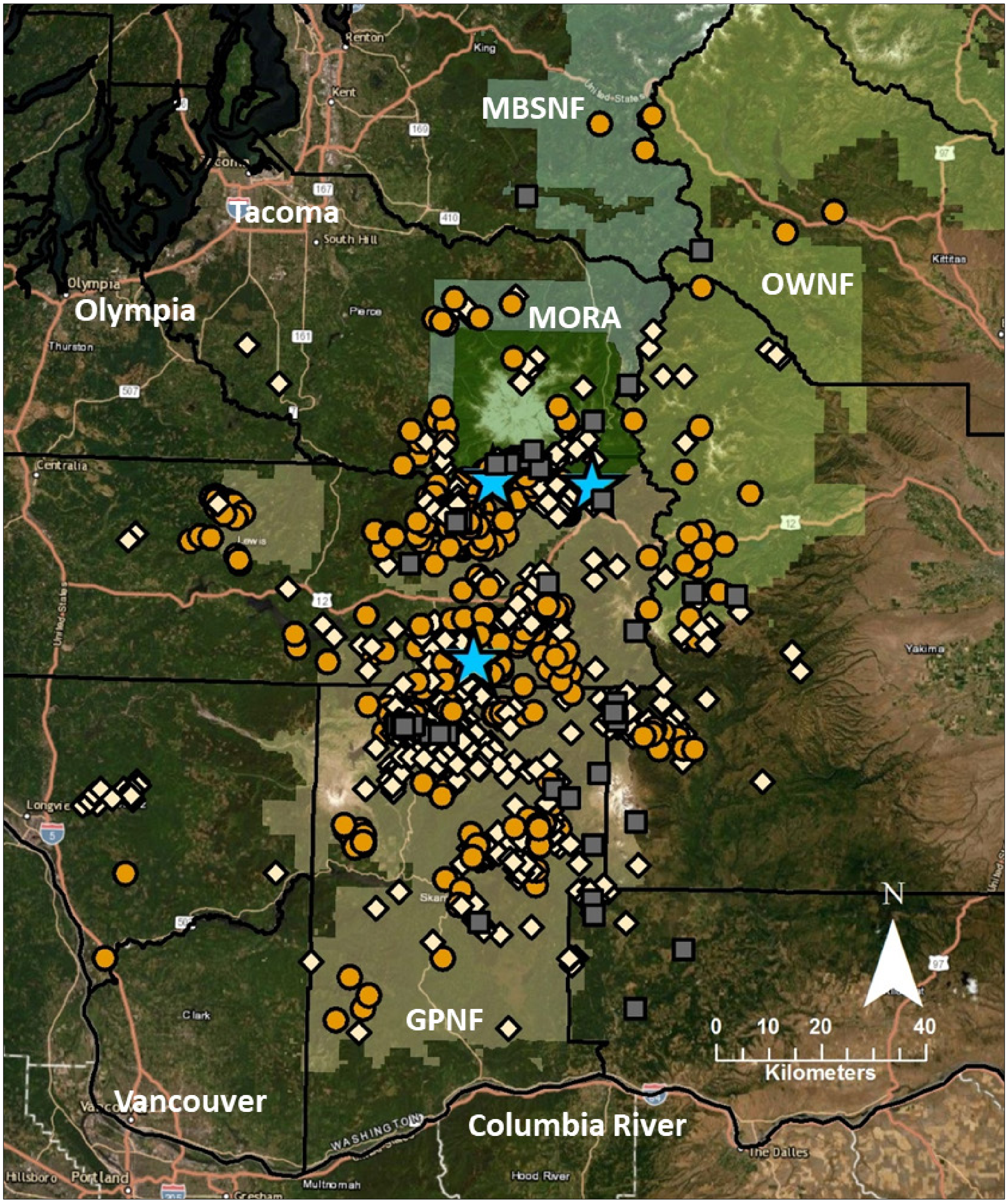

Figure 2. Aerial and ground telemetry locations (*n*=910; 572 female [white diamonds], 338 male [orange circles]) obtained from December of 2015 to September of 2018 for 69 fishers released in the southern portion of the Cascade Fisher Recovery Area in Washington (see Table 1). Blue stars indicate the 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=142) from August 2016 to March 2020 are depicted as black squares.

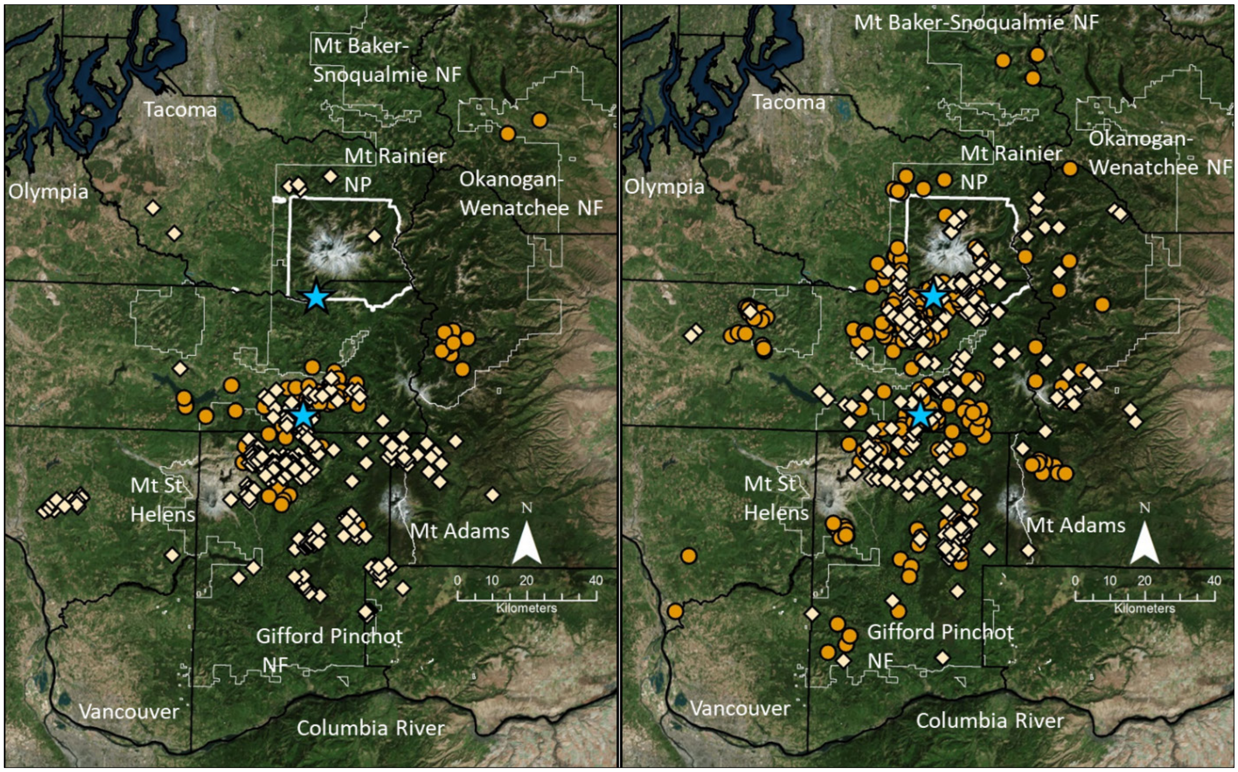

Figure 3. Locations of male (orange circles) and female (white diamonds) fishers from Cohort 1 (those released fall/winter of 2015/2016; all at one release site, the Cispus Learning Center; left graphic) and from Cohort 2 (released at two release sites, fall/winter of 2016/2017; right graphic). The two blue stars indicate the Mount Rainier National Park - Longmire (northern star) and Cispus Learning Center (southern star) release sites.

Movements and Home Range Establishment

Post-release movements and home range establishment by released individuals are indicators of how individuals perceive the suitability of the habitat within and outside the recovery area. Specifically, we presumed that proximity of the aerial telemetry locations of fishers to their release site, and the proximity of established home ranges to release sites, in the year following release, were indications of the occupancy/suitability of the recovery area.

Our initial analysis of movements indicated that the mean distance to all telemetry locations for Cohort 1 fishers was approximately 25 km from the Cispus release site (Table 2). This mean distance indicates that many fishers used landscapes relatively close to the Cispus release site and the center of the recovery area, avoiding extended movements away from a release site that may pose greater mortality risks. The mean distance to telemetry locations appeared to be less for Cohort 2 females and substantially smaller for Cohort 2 males as compared to Cohort 1 fishers (Table 2). This shorter distance may 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 (Table 2). The suitability of the recovery area is also supported by the majority of telemetry locations being located within the boundaries of the recovery area (i.e., National Forest and National Park lands; Figures 2 and 3).

Table 2. Mean distances between telemetry locations and release sites (Cispus Learning Center and Mount Rainier National Park – Longmire, MORA) and between established home ranges and release sites for fishers during their first year following release, by cohort and sex.

Fishers by Cohort and Sex	Data (n)	Mean distance ± SE from release site
Cohort 1 All Females (Cispus release)	Telemetry Locations (210)	26.8 ± 1.4 km
Cohort 1 All Males (Cispus release)	Telemetry Locations (129)	24.7 ± 1.9 km
Cohort 2 All Females	Telemetry Locations (173)	23.7 ± 1.3 km
Cohort 2 Females (Cispus released)	Telemetry Locations (68)	18.8 ± 1.9 km
Cohort 2 Females (MORA released)	Telemetry Locations (105)	26.9 ± 1.7 km
Cohort 2 All Males	Telemetry Locations (133)	19.6 ± 1.4 km
Cohort 2 Males (Cispus released)	Telemetry Locations (66)	15.2 ± 1.2 km
Cohort 2 Males (MORA released)	Telemetry Locations (67)	23.8 ± 2.4 km
Cohort 1 All Females	Home Range Centers (9)	33.0 ± 6.8 km
Cohort 1 All Males	Home Range Centers (5)	30.1 ± 8.4 km
Cohort 2 All Females	Home Range Centers (8)	19.7 ± 3.7 km
Cohort 2 Females (Cispus released)	Home Range Centers (5)	24.7 ± 4.7 km
Cohort 2 Females (MORA released)	Home Range Centers (3)	11.4 ± 0.5 km
Cohort 2 All Males	Home Range Centers (8)	20.2 ± 4.8 km
Cohort 2 Males (Cispus released)	Home Range Centers (4)	30.2 ± 6.2 km
Cohort 2 Males (MORA released)	Home Range Centers (4)	10.3 ± 2.5 km

While telemetry locations are informative of general movement patterns, home range establishment provides an additional indication of habitat suitability for reintroduced fishers, and we used this as one measure of reintroduction success. For example, home range establishment by ≥50% of individuals following release, and home range establishment relatively close to the release site, are positive indicators of habitat suitability (Lewis and Hayes 2004). For Cohort 1 fishers, we identified nine of 11 females (82%) and five of 12 males (42%), with ≥10 clustered location points indicative of home range establishment. Eight of these nine females (88%) appeared to establish home ranges within or partly within the recovery area; whereas all five males appear to have established home ranges within or partly within the recovery area. We also identified eight of the 27 Cohort 2 females (30%) and eight of 19 Cohort 2 males (42%) that appeared to establish a home range in their first year. All eight females and seven of the eight males appeared to establish their home ranges within the recovery area. Even though a smaller percentage of Cohort 2 fishers appeared to establish home ranges in their first year (in part because nine Cohort 2 females died in their first year), this finding is likely an underestimate given the difficulty in getting enough data for each of the 46 Cohort 2 fishers to indicate home range establishment of some individuals (See Appendix A). For context, among the fishers released during the Olympic fisher reintroduction project, 27 of 50 females (54%) and 21 of 40 males (46%) established home ranges in their first year (Lewis 2014).

Among the 11 Cohort 1 fishers (9F, 5M) that appeared to establish a home range in the southern Cascade Range, the mean distance from the Cispus release site to the center of a home range was 33.0 km for females and 30.1 km for males, and there was considerable variance among these distances (Table 2). The mean distance to home ranges was shorter for the 17 Cohort 2 fishers (23.1 km for nine females, 20.2 km for eight males; Table 2) that appeared to establish a home range in their first year as compared to Cohort 1 fishers. The mean distances to home ranges observed for fishers released in the southern Cascades tended to be smaller than those observed for fishers released on the Olympic Peninsula (i.e., 30.1 km^2 for females; 44.5 km^2 for males [Lewis 2014]), which may be explained in part by the difference in release strategies between the two recovery areas (i.e., fishers were released at 21 dispersed release sites in the Olympic project but at only three in the southern Cascades (MORA – Longmire and Cispus)). Other explanations for differences in distance to home ranges may include prey distribution and availability, as well as differences in habitat types between the Olympic Peninsula and the southern Washington Cascade Range. Location data from Cohort 1 and Cohort 2 fishers 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 3).

Survival and Mortality

We set our objective for total number of fishers to release (160 total, 80 each in the southern and northern part of the Cascades recovery area) based on annual survival rates of 50% or greater (Lewis and Hayes 2004). For Cohort 1 fishers, we observed five mortalities (2F, 3M) the first year; estimated survival rates averaged 80% for females and 75% for males (Table 3). In Cohort 1's second year, we observed four mortalities (1F, 3M), with female survival higher (88%) than as reported in most established populations, and male survival moderate (45%) (Lewis and Hayes 2004). Overall, survival rates for Cohort 1 fishers were above our initial estimated survival goal needed to establish a self-sustaining population.

For Cohort 2 fishers, we observed a greater number of female mortalities in their first year (n = 9F). The survival rate for Cohort 2 females was 58%. We documented three male mortalities in year 1 and estimated 80% annual survival for Cohort 1 males. In year 2, we obtained location and survival status data until September 2018, for 10 months of survival data before the remaining functional radio-transmitters failed. With these data, we calculated 10-month survival estimates (rather than annual survival estimates) for Cohort 2 males and females (Table 2). These estimates indicated a high overall survival rate for all fishers (81%), a moderate survival rate for females (60%; as a result of two of nine females dying), and 100% survival of 12 males. Similar to Cohort 1, overall survival rates for Cohort 2 fisher were also above our estimated annual survival goal of ≥50.

Table 3. Annual survival rates and number of mortalities for fishers released in the southern portion of the Cascades Fisher Recovery Area from December 2015 to September 2018, by cohort and sex. Survival estimates for year 2 of Cohort 2 (bottom three estimates) are 10-month survival rates. Survival rates were estimated based on Kaplan-Meier methods modified for staggered entry of radio-collared animals (Pollock et al. 1989).

Cohort[a]	Population segment	Observation period	Number of fishers	Number of mortalities	Annual survival rate (95% CI)
1	Females	Year 1 (Dec 2015–Nov 2016)	11	2	0.80 (0.34–1.00)
1	Males	Year 1 (Dec 2015–Nov 2016)	12	3	0.75 (0.38–1.00)
1	All fishers	Year 1 (Dec 2015–Nov 2016)	23	5	0.77 (0.59–0.95)
1	Females	Year 2 (Dec 2016–Nov 2017)	9	1	0.88 (0.45–1.00)
1	Males	Year 2 (Dec 2016–Nov 2017)	9	3	0.45 (0.00–0.91)
1	All fishers	Year 2 (Dec 2016–Nov 2017)	18	4	0.67 (0.38–0.96)
2	Females	Year 1 (Dec 2016–Nov 2017)	27	9	0.58 (0.28–0.88)
2	Males	Year 1 (Dec 2016–Nov 2017)	19	3	0.80 (0.57–1.00)
2	All fishers	Year 1 (Dec 2016–Nov 2017)	46	12	0.67 (0.48–0.86)
2	Females	10 months in Year 2 (Dec 2017–Sep 2018)	11	3	0.60 (0.17–1.00)
2	Males	10 months in Year 2 (Dec 2017–Sep 2018)	12	0	1.00 (N/A)[a]
2	All fishers	10 months in Year 2 (Dec 2017–Sep 2018)	23	3	0.81 (0.55–1.00)

[a] Confidence intervals cannot be calculated for survival estimates that equal 1.00 (i.e., no mortalities observed).

Overall, we observed moderate to high survival rates for males and females for both release cohorts, as compared to survival in established fisher populations (Lewis and Hayes 2004). Although the precision of our estimates is low, we did not detect survival rates declining from year 1 to year 2 for males or females in either release cohort. Unexpectedly, we could not detect the signal from a large number of fishers within one year after being released. We suspect that a greater than expected number of radio-transmitter failures may explain the majority of these missing fishers. While we lack data for these missing fishers, and the lack of data for these fishers results in survival estimates with low precision, some of these missing fishers may still be contributing to the establishment of a self-sustaining population within the recovery area.

To date, we have documented a total of 23 fisher mortalities and we have recovered the remains, or a transmitter (or both), for 19 fishers. Of these 19 mortalities, we have determined the cause of death for six, which included predation (females F047 and F052), vehicle collision (female F021), injury/broken-back (female F045), starvation following an injury (female F006), and infection of wound following a fight (male M005). Of the remaining 13 fishers, we considered the cause of death unknown for seven fishers and unknown/possible predation for six fishers. Our ability to determine the cause of death has been hindered by the difficulty in locating and recovering fishers shortly after they die and before they are scavenged or decompose, especially in summer. Analyses are in progress to determine the carnivore species associated with predation-related mortalities.

Reproduction

We were not able to confirm any reproduction among Cohort 1 females during the spring of 2016. Most Cohort 1 females were too young to reproduce in the spring of 2016, and it is also unknown if reproduction occurred in older females, due to insufficient aerial telemetry locations. We did document reproduction by female F023 in May/June of 2017. Female F023 was released on 6 February 2016 at 10 months of age, and mated with a reintroduced male fisher in April of 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 (i.e., behavior consistent with denning), 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 was released in the recovery area 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).

In the spring of 2018, we documented female F082 using a localized area on 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 (i.e., a squirrel and a mountain beaver) on 16 and 18 June 2018 (Figure 4). While we did not detect a kit at this time, F082's behavior is consistent with a female provisioning kits.

Figure 4. 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 a number of photos of F082 interacting with a single kit on the ground by the den tree (Figure 4). 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.

We achieved an initial reintroduction goal by confirming reproduction by at least one female from each cohort. Although we suspected denning by several females based on localized behavior documented through aerial and ground-based radio-telemetry, our field teams could not confirm denning by documenting a female attending kits at these other locations. 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.

North Cascades Progress to Date

Objective 1: Capture a founder population of at least 80 fishers with a sex ratio of ≥50% females from central Alberta, and release them into the northern portion of the Cascade Recovery Area over two years.

We have met this objective by releasing a total of 89 fishers (48F, 41M) in the North Cascades Recovery Area. From October 2018 to March 2019, 26 fishers (15F, 11M) were successfully captured in a 125,664 km^2 area in central and north-central Alberta (Table 4, Appendix B): in this report, these 26 fishers are referred to collectively as Cohort 3. From October 2019 to March 2020, 63 fishers (34F, 29M) were captured across the same area: in this report, these fishers are referred to collectively as Cohort 4 (Table 4, Appendix B). Following veterinary evaluation at Calgary Zoo, Cohort 3 fishers were transported to Washington and released on five occasions from 5 December 2018 to 7 March 2019, and Cohort 4 fishers were transported to Washington and released on 13 occasions from 12 October 2019 to 27 February 2020 (Table 4). Releases took place at seven locations within the North Cascades National Park Service Complex and Mount Baker-Snoqualmie National Forest (Figure 5).

Table 4. The number of fishers released and their release sites in the northern portion of the Cascades Recovery Area 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

Table 4 (continued). The number of fishers released and their release sites in the northern portion of the Cascades Recovery Area 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
Bedal Campground (MBSNF)	February 27, 2020	0	1	1
Totals	–	48	41	89

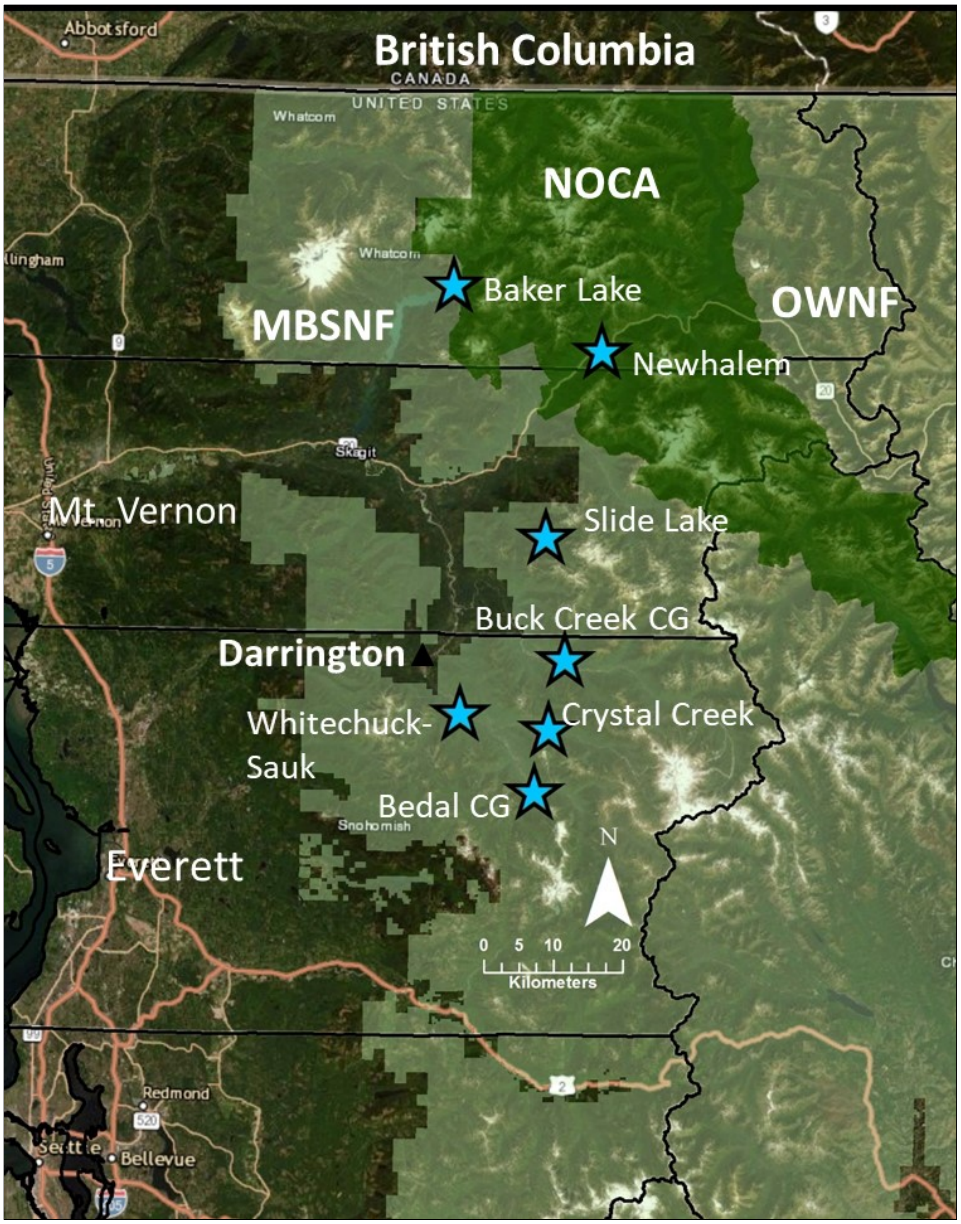

Figure 5. Locations (blue stars) of the seven sites where fishers were released from December 2018 to February 2020 in the northern portion of the Cascades Recovery Area. MBSNF= Mount Baker - Snoqualmie National Forest, OWNF = Okanogan-Wenatchee National Forest, and NOCA = North Cascades National Park Service Complex.

Objective 2: Release fishers at few (i.e. 2–3) locations in each portion of the recovery area to increase the likelihood of fishers interacting (i.e., finding mates and obtaining social cues from previously released fishers).

We met this objective with Cohort 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 in few localities, to facilitate social interaction (Figure 5).

Objective 3: Release as many fishers as possible before January 1st to facilitate reproductive success, by conducting the reintroduction process well before the active gestation period of female fishers (Facka et al. 2016).

We released 74% of fishers (35 of 48 females [73%] and 31 of 41 males [76%]) in the northern portion of the Cascades Recovery Area prior to January 1 (Table 4). The 73% success rate for females is much higher than achieved in the southern portion of the recovery area (54%, Table 1) or during the Olympic reintroduction project (30%; Lewis 2014). This is primarily due to an earlier trapping start date in Alberta operations (Oct 1, instead of Nov 1 in British Columbia), as well as more efficient spatial and temporal coordination of trappers.

Objective 4: Monitor post-release movements, survival, home range establishment, and reproduction to evaluate initial reintroduction success during the period when we can track fishers with functioning radio-transmitters (up to two years).

Monitoring Methods

We used the same methods as described for the southern portion of the Cascades Recovery Area to monitor fishers in the northern portion: aerial telemetry supplemented with ground-based telemetry. To date, we have conducted 32 aerial telemetry flights from 15 January 2019 to 23 Jun 2020, which included 142.2 hours of flight time, at a total cost of $65,439. During these flights we obtained 194 locations (121 for females, 73 for males; Figure 6), for an average of 1.48 locations per hour and an average cost of $460.19 per location. To date, we have obtained 67 ground telemetry locations (46 for females, 21 for males), including 10 mortality recovery locations. Of the 89 fishers, 44 (49%) have not yet been located after their release, including 25 of 48 females (52%) and 19 of 41 males (46%); however, 63 of these fishers were only recently released (Table 5, Appendix B). Required maintenance of our primary airplane and flight restrictions due to the SARS-CoV-2 virus pandemic have constrained our ability to locate fishers since January of 2020; however, aircraft availability and the lifting of restrictions in May 2020 allowed us to us to resume data collection and begin locating missing fishers and reproductive females. A number of incidental detections in the Steven's Pass area in early 2020 suggests that some released fishers may have moved southeast from the main reintroduction area, which indicates an area for us to focus telemetry flights in the near future.

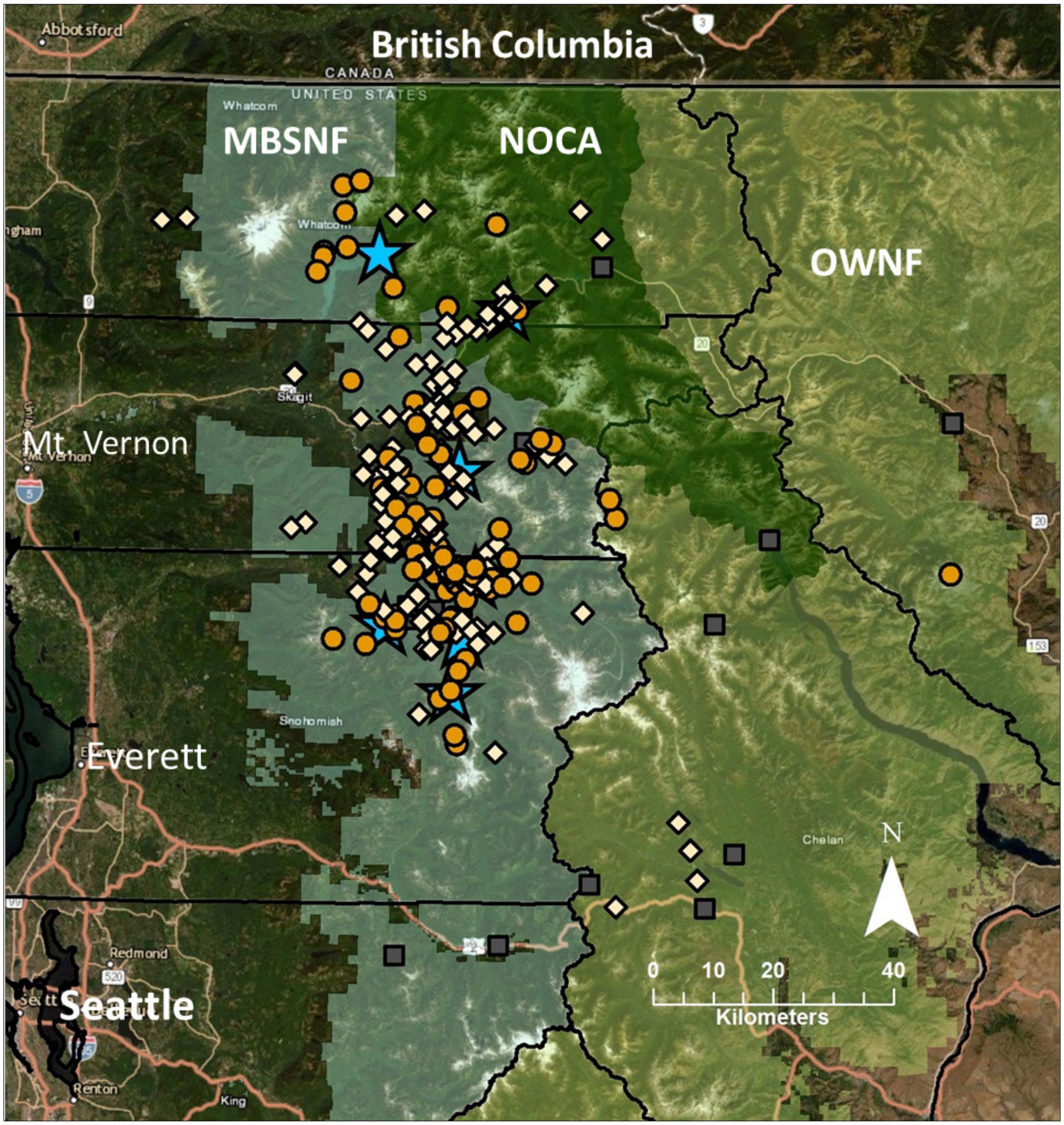

Figure 6. Aerial and ground telemetry locations (*n*=261; 167 female [white diamonds], 94 male [orange circles]) obtained from December 2018 to June 2020 for 89 fishers released in the northern portion of the Cascade Fisher Recovery Area in Washington (see Table 4). Blue stars indicate the locations of release sites. Additional confirmed non-telemetry detections (n=33) are depicted as black squares.

Table 5. Summary counts of fishers released and detected in the northern portion of the Cascades Recovery Area, through March 2020.

Fisher Cohort	Sex	Released	Died (%)	Missing (%)	Not yet located following release (%)
Cohort 3: Released Dec 2018 - Mar 2019	F	14	5 (36)	8 (57)	0 (0)
	M	12	6 (50)	6 (50)	1 (8)
Cohort 4: Released Oct 2019 - Feb 2020	F	34	8 (24)	≥12	12 (35)
	M	29	2 (7)	≥7	7 (24)

Movements and Home Range Establishment

Flight restrictions and scheduled aircraft maintenance prevented us from locating a number of cohort 4 fishers in 2019/2020 (Table 5). Despite our limited success in tracking fishers via telemetry flights, we have obtained a number of detections of released fishers via ground telemetry, incidental detections at camera stations, and roadkill recoveries on Highway 2 (Figure 6). Many of these locations indicate a substantial movement from a release site and they could indicate that these areas are suitable for home range establishment. Future telemetry flights will place an added emphasis on tracking fishers in these areas.

Because of our small number of telemetry flights and the limited data for Cohort 3 fishers, we have yet to determine home range establishment for fishers other than female F096. Flights throughout 2020 will enable us to gain more insights into post-release movements and home range establishment among fishers in both release cohorts.

Survival and Mortality

Given the short time that fishers have occupied the North Cascades, as well as the constraints on aerial telemetry during the pandemic, we lack sufficient data to calculate annual survival estimates. To date, we have documented a total of 24 fisher mortalities (15 F / 9 M), and we have recovered the remains, or a transmitter (or both), for 12 fishers in the North Cascades. Of these 12 mortalities, the suspected cause of death for seven recovered fishers include: predation (male M112 [confirmed cougar DNA], female F118 [putative bobcat DNA], male M121 [both cougar and bobcat DNA on site], female F193 [samples to be tested]); vehicle collision (male M172 and F134); drowning/debris flow (female F148). Of the remaining five recovered fishers, potential predator DNA samples were collected from four carcasses for genetic analyses, and one fisher had insufficient remains to test. All other mortalities could not be recovered due to their remote location and lack of accessibility.

Reproduction

We did not observe denning behavior among Cohort 3 females in 2019, and have not yet monitored during the denning season in 2020. In Cohort 3, only two females were of potential breeding age at the time of release, and in Cohort 4, eight females were of potential breeding age at the time of release. We expect that some of the Cohort 3 females would be breeding in 2020, along with the eight Cohort 4 females, but our lack of telemetry flights due to the SARS-CoV-2 virus pandemic has limited our ability to detect potentially denning females to date in 2020. Flight restrictions began easing in May 2020, and we began searching for reproductive females within the study area. Two females from Cohort 3 in the North Cascades, F096 and F105, appear to have limited their movements and are exhibiting activity patterns consistent with denning behavior.

Project Status and Plans for 2020/21

Since winter 2015/2016, we have released 170 fishers in the Washington Cascades Fisher Recovery Area, and have exceeded our goal of releasing at least 160 founders. We have completed radio telemetry monitoring of fishers released in the southern portion of the recovery area and are now in year two of three for radio telemetry monitoring in the northern portion of the recovery area. To reach our target goals, we plan to continue aerial telemetry flights through the summer of 2021, with supplemental ground-based telemetry, to obtain location data and determine the survival status of released fishers in the north. During the spring of 2020 and 2021, our flights will focus on obtaining locations for females in an effort to document denning and reproductive success. As in previous years, if reproduction occurs, our goal is to document kit(s) from at least one den site. We will continue to collect data points in an effort to estimate minimum home ranges for all released fishers. Our field efforts will also include recovering any additional mortalities that occur. Additionally, we will continue outreach and education to local communities to facilitate an understanding of project goals and outcomes and as a means to protect fishers that interact or come into close contact with humans (e.g., as non-target captures by trappers in the region, visiting residences, seen near roads). We will also begin analysis of the complete capture, handling, stress, and behavior data from the associated fisher studies (as described below), as well as continue our support of two current graduate student research projects that are focused on fisher prey and competition in the northern portion of the Cascades Recovery Area.

Challenges/Difficulties Encountered

In the spring and summer of 2018, we had difficulty locating many of our radio-transmittered fishers in the southern portion of the recovery area, and this was most noticeable for females because we focused our monitoring efforts on females during the denning season. Despite extensive and repeated searches inside and outside the recovery area, we did not locate 11 of 46 fishers (24%; 7F, 4M) in Cohort 2 within the first 12 months after release, and we did not locate 18 of 46 (39%; 11F, 7M) within 18 months after 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 also prevented us from evaluating their movements, survival, and home range establishment behavior using radio-telemetry.

Our findings regarding transmitter performance led us to re-evaluate our use of this particular transmitter model, and specifications for future fisher reintroductions. 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 (released in the northern portion of the recovery area) 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 (with a high of 28 fishers detected on a single flight), but there is still a marked difference between detections by aircraft, including flights where no fishers were detected. This may be an indication of antenna limitations in one aircraft, and we have ceased flights in that airplane for the remainder of monitoring, in favor of the better performing ship.

From March to May 2020, the global SARS-CoV-2 virus pandemic caused all field work on this project to stop. Washington State shelter-in-place orders, federal government orders, and international border closure precluded any fisher project activity. 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 northern portion of the Cascades Recovery Area remained active. Limited field work and monitoring flights began again in late May 2020.

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 related to reintroduction success (e.g., shorter post-release movements, high survival, quick establishment of a home range, large number of females giving birth). Many of these studies will utilize telemetry data collected as we monitor released fishers. Other research investigations involving reintroduced fishers 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 are 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 southern portion of the Cascade Recovery Area. 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/Thesis below). The second study is similarly focused on pre-reintroduction predator and prey densities in the northern portion of the Cascades Recovery Area, paired with post-reintroduction habitat selection by fishers. Methods are comparable to those employed in the southern area in order to facilitate long-term analysis and modeling of the entire reintroduction effort. The northern area study is being conducted in collaboration with University of Montana (UM) graduate student Tanner Humphries and his Advisor at UM, Dr. Jedediah Brodie. Dr. Jason Ransom is serving on the graduate student committee. 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 southern portion of the Cascades Recovery Area, and while no active mountain beaver poisoning is known to occur in the recovery area, it is a common practice in regional timber management. The graduate student, Kayla Dreher, will begin work in summer 2020, with Dr. Laura Prugh advising and Dr. Jason Ransom serving on the graduate committee.

Behavior/Personality and Stress of Fishers in Captivity

Research efforts at the Centre for Conservation Research of the 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 also related with personality (Koolhaas et al. 1999), so we are investigating this relationship and 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.

Personality

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 7). 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 syndromes. Most of the tests were replicated at least once, spaced at least 24 hours apart, with the order of novel objects randomized.

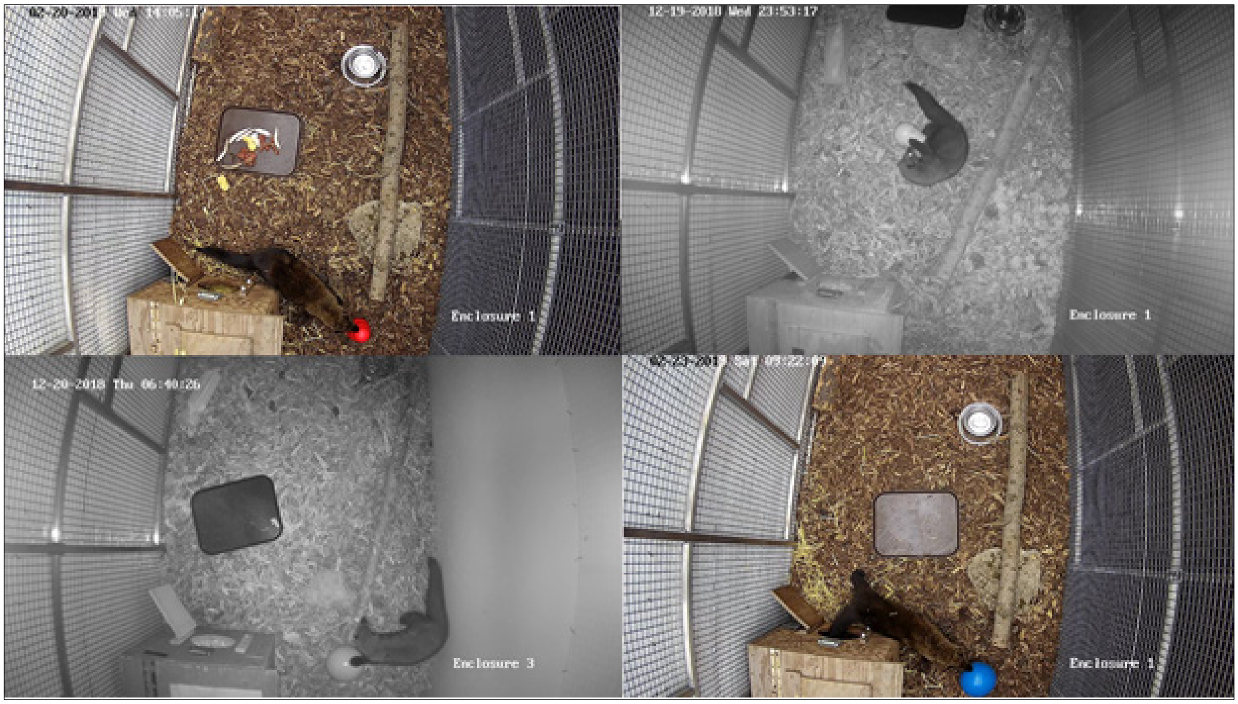

Figure 7. Fishers investigating novel objects (balls and plastic toys) as a test of fearfulness while in temporary holding facilities at Calgary Zoo. Fisher pens routinely included a den box, substrate, water bowl and a food tray.

In Fall 2019, we distributed 40 trail cameras (Reconyx PC800 HyperFire Professional) to the fisher trappers with the help of Bushman, Inc., in order to monitor the behavior of the 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 8). We are still gathering the trail cameras from the close of the 2019/2020 season, and analysis is planned in 2020.

Figure 8. Fisher M142 investigating the live trap in Alberta, Canada, and getting caught.

Stress characteristics

Improved efficiencies toward minimizing stress in captured fishers included 1) minimizing time in captivity, 2) using plastic 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 6 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. All fisher capture and handling procedures were approved by the Calgary Zoo's Committee for Welfare, Ethics, and Research (CZWERC 2018-15) and Alberta Environment and Parks (Permits 19-014 and 20-014).

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 overnights in transport box	1.2	0	6
Number of hours in a box in motion, travelling by truck	12.9	5.9	30.9
Number of hours in a box in motion, travelling by ATV / Snowmobile	0.20	0	4
Number of hours in a box in motion, travelling by airplane	1.4	0	1.9
Number of hours in a box that is not moving	25.1	2.6	74.3
Total hours in a transport box	39.7	14.8	93.5
Total nights in captivity (including medical holds[a])	17.4	6	88
Total nights in captivity (excluding medical holds[a])	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 for fishers captured in Alberta and translocated to Washington (Table 6). This was only slightly greater than mean time in captivity of 13 days for the 69 British Columbia fishers released in the southern portion of the recovery area from 2015 to 2017, and both are less than the mean time in captivity for fishers reintroduced to the Olympic Peninsula (21 days). This was accomplished through improved efficiencies in capture and ground transport strategies in Alberta, 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 (1F, 5M) 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 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 corticosteroids. To date, we have 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 corticosteroid analysis. We will compare both approaches and test if stress levels are correlated with capture and handling, time in captivity, and behavioral traits.

Veterinary Assessments

During the 2018/2019 and 2019/2020 fisher translocation seasons, the Veterinary Services department of the Calgary Zoo received and cared for 110 wild fishers obtained by Alberta trappers. One hundred and one of these fishers (46M, 55F) were found to be suitable for release. On arrival at the zoo, each animal was visually assessed (without handling) for body condition, obvious injuries and behavior. Fishers were then housed in individual enclosures and received a diet of ground horse meat, herring or smelt, whole mice, and whole chicks. While most animals ate within the first 24 hours, some took two or three days to settle in and begin eating well. Fishers were not handled for 48 hours or more to allow recovery from trapping and transfer. When ready for a full assessment, each animal was moved into a transfer box, and from there into a handling cone for injection in the epaxial muscle with a mixture of dexmedetomidine (0.015–0.025 mg/kg), midazolam (0.08–0.1 mg/kg) and ketamine (2–3.5 mg/kg). Induction was rapid, and most animals 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. All animals received a detailed physical exam and assessment for potential release. Eighty of 101 animals that met the health criteria for release were prepared for abdominal midline celiotomy surgery to implant an abdominal radio-transmitter. Following surgery, each animal was treated with a long acting antibiotic, a non-steroidal anti-inflammatory (meloxicam 0.1 mg/kg), and an analgesic (buprenorphine). Recovery from surgery was uncomplicated in all 80 animals.

Four animals (1M, 3F) did not meet the requirements for translocation due to dental fractures, and 1 male did not meet requirements due to a chronically dislocated femur: all five animals were found to be in very good body and coat condition, and were returned to their original capture locations. In Cohort 3, three animals were found to have significant damage to the facial area and jaws, including skin loss, bony infection and abscessation, likely due to self-inflicted injuries in the live trap. One animal with a draining wound and associated cellulitis was treated with flushing, and local and systemic antibiotics, recovering in approximately one week. Damage was so significant in the other two animals that euthanasia was elected. One additional animal required significant dental reconstruction work due to historic dental fractures, and was accepted by 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 Cohort 3 season to alleviate injuries from trapping by increasing trapper education and including the use of plastic-lined traps that prevented animals from accessing metal wire to chew on (the likely source of 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.

All animals received a full physical 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 nerve block, a mandibular premolar was extracted from each animal for aging. Hair samples were collected for genetic analysis and banking. Each fisher was vaccinated for rabies and canine distemper and was treated with a topical parasiticide. Whole body digital radiographs were taken in lateral and ventrodorsal views. The lateral cranial radiograph provides the ability to measure the height of the caudal sagittal crest (Figure 9) and length of baculum (in males); these measurements were previously collected by palpation and measurement through the skin. These more accurate sagittal crest and baculum measurements will be incorporated into analyses of age as a function of allometry, where age data from dental cementum analysis are available. If correlation is sufficiently high, this measure could provide a less painful and invasive aging technique than tooth extraction in future years.

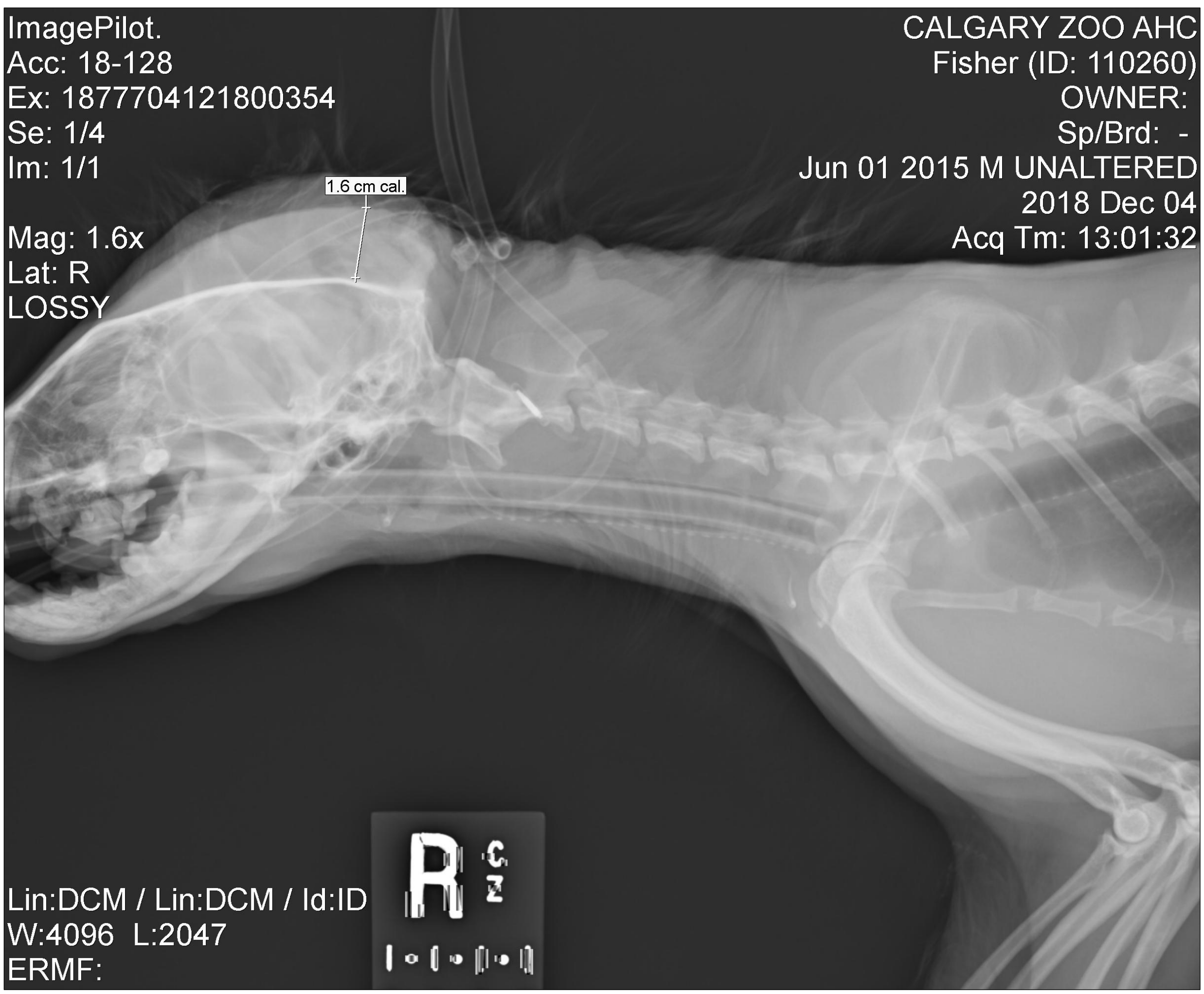

Figure 9. Lateral cranial radiograph of male fisher M104 showing 1.6 cm sagittal crest measurement.

Laboratory Samples and Associated Studies

Endoparasites

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 distemper virus. We also considered vaccinating against parvo virus but decided against it, as there was no evidence that the available vaccinations (for cats and dogs) were effective in protecting mustelids against parvo virus, 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. While we did not 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 (2M, 5F) 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 (1M, 1F) 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 carried out on 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.

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 private or public 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 performed toxicology screening on liver samples from seven fishers (5F, 2M) 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. Three of these fishers (F051, F052 and M112) did not test positive for any AR compounds. Toxicology screening was negative for all screened organic compounds (pesticides, environmental contaminants, drugs and natural products). 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 area in Alberta. 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 due to their hunting and foraging behaviors (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, Alberta-only, 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.

We will continue screening fishers for AR exposure when carcasses with sufficient tissue can be collected. Evaluation of AR exposure will also be investigated through the mountain beaver and AR exposure study commencing in 2020.

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. Six new landowners enrolled in a Candidate Conservation Agreement with Assurances (CCAA) in the last year, bringing the total participation to 60 landowners who provide fisher conservation measures on 3,318,377 acres of private land. Approximately 900 people have attended release events in the Cascades, including several school and youth groups. Children have released almost every fisher to date.

Recent Presentations

- March 31, 2020: Jose Luis Postigo presented a video entitled "Your Daily Dose: Fishers" on the Youtube channel of the Calgary Zoo. https://www.youtube.com/watch?v=2hzOSkOOruQ&t=32s
- March 2, 2020, Jason Ransom gave a presentation "Cascades Fisher Reintroduction Project" to Seattle City Light staff in Newhalem, WA.
- February 19, 2020, Tara Chestnut gave webinar "Restoring fishers to Washington State: science and culture" to University of Maine–Farmington wildlife management students.
- January 24, 2020, Jeff Lewis and Tara Chestnut gave a presentation "The Cascade Fisher Reintroduction Project: Progress in the South Cascades and North Cascades Reintroduction Areas" to Point Defiance Zoo and Aquarium and Northwest Trek leadership at Northwest Trek Wildlife Park.
- January 13, 2020: Jose Luis Postigo gave a presentation "International Fisher Reintroduction Project at the Calgary Zoo" to the staff of the Calgary Zoo Education Department.
- November 19, 2019: Jose Luis Postigo gave a presentation "Fish'ing for success: Fisher conservation and the Calgary Zoo" to the members of the Calgary Zoo.
- November 18, 2019, Tara Chestnut provided a project update to the Nisqually Indian Tribe Tribal Council members and Youth Programs leadership.
- Sept 18–20, 2019. Dave Werntz gave a presentation "Cascades Fisher Reintroduction Project" to Conservation Northwest Board members and staff.
- May 23–26, 2019. Jason Ransom gave a presentation "Mesocarnivore research, monitoring, and restoration in North Cascades National Park" at the Mesocarnivore Community of Practice Meeting, coordinated by the British Columbia Ministry of Environment, at Cowichan Lake Research Station, British Columbia.
- May 23–26, 2019. Jeff Lewis and Jason Ransom gave a presentation "Cascades Fisher Reintroduction Project: Progress in the South Cascades and North Cascades Reintroduction Areas" at the Mesocarnivore Community of Practice Meeting, coordinated by the British Columbia Ministry of Environment, at Cowichan Lake Research Station, British Columbia.

- April 22, 2019 Tara Chestnut gave a presentation “Cultural competence in conservation biology: A case study by the Cascades Fisher Reintroduction Team” at the University of Washington, multi-departmental Fish and Wildlife Ecology seminar series.
- April 16, 2019, Alyssa Friesen, Conservation Linkage Associate with the Calgary Zoological Foundation (CZF), gave a presentation “Conserving Fishers in Washington” embedded in the school program of the Calgary Zoological Society (CZS)
- April 13, 2019 and March 19, 2019, Jose Luis Postigo, Conservation Research Population Ecologist (CZF) gave a presentation “Reintroducing Fishers from Alberta to Washington” to CZS staff
- April 4, 2019 Roger Christophersen gave a presentation “Room to Roam: Current wildlife studies in the North Cascades” to staff at the North Cascades Institute Environmental Learning Center.

Publications/Thesis

Parsons, M. A., Lewis, J. C., Pauli, J. N., Chestnut, T., Ransom, J. I., Werntz, D., and L. R. Prugh. 2020. Prey of reintroduced fishers and their habitat relationships in the Cascades Range, Washington. Forest Ecology and Management 460: 117888.

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Lewis. J. C., J. I. Ransom, T. Chestnut, D. O. Werntz, S. Black, J. L. Postigo, and A. Moehrenschlager. 2019. Cascades fisher reintroduction project: Progress report for March 2018 to March 2019. Natural Resource Report NPS/PWR/NRR-2019/1982. 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 Website

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 Calgary Zoo 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://www.calgaryzoo.com/why-we-matter/conservation-programs.

Project Cost

Total project cost from 2014-2020 was approximately $2,779,800, for all planning and compliance, implementation and monitoring, research, and outreach, and including in-kind services such as personnel time and equipment from other agencies and organizations. The National Park Service provided 17% of these project costs through Natural Resource Stewardship and Science Directorate (WASO-NRSS) Project 195423, with MORA funding 13% 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 19% of overall funding, with non-governmental organizations contributing the remaining 36%. Total collaboration included 4 federal agencies, 3 state and provincial agencies, 8 Tribes and First Nations, 2 universities, and 22 non-government organizations.

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Appendix A. Individual Fishers Released in the Southern Cascade Recovery Area

Table A1. List of individual fishers released in the southern portion of the Cascade Recovery Area 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
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

[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 southern portion of the Cascade Recovery Area 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
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
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

[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 southern portion of the Cascade Recovery Area 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
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.

Appendix B. Individual Fishers Released in the Northern Cascade Recovery Area

Table B1. List of individual fishers released in the northern portion of the Cascade Recovery Area 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	26	Alive: Jun 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	17	Alive: Jun 2020
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	3	Alive: Aug 2019
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	2	Alive: Mar 2019
F125	F	<1	2.50	17-Feb-2019	7-Mar-2019	18	2	Alive: Mar 2019
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	5	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.

Table B1 (continued). List of individual fishers released in the northern portion of the Cascade Recovery Area 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
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
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	8	Alive: Feb 2020
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	5	Alive: Feb 2020
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	5	Alive: Jun 2020
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	5	Alive: Nov 2019
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	6	Alive: Feb 2020
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	12	Alive: Jun 2020
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	3	Alive: Feb 2020
M152	M	1	4.58	22-Oct-2019	7-Nov-2019	16	2	Alive: Nov 2019
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	5	Alive: Feb 2020
M163	M	<1	4.60	4-Nov-2019	21-Nov-2019	17	2	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.

Table B1 (continued). List of individual fishers released in the northern portion of the Cascade Recovery Area 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
M164	M	1	4.04	3-Nov-2019	21-Nov-2019	18	2	Alive: Feb 2020
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	1	Alive: Nov 2019
F169	F	1	3.42	4-Nov-2019	29-Nov-2019	25	1	Alive: Nov 2019
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	Alive: Nov 2019
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	3	Alive: Jan 2020
F177	F	2	3.18	24-Nov-2019	5-Dec-2019	11	4	Alive: 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	2	Alive: Feb 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	2	Alive: Feb 2020
M196	M	<1	4.38	28-Jan-2020	13-Feb-2020	16	2	Alive: Feb 2020
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.

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National Park Service
U.S. Department of the Interior

Natural Resource Stewardship and Science
1201 Oakridge Drive, Suite 150
Fort Collins, CO 80525