

Olympic National Park Mountain Goat Removal and Translocation to the North Cascades

Progress Report I

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1. Introduction

On June 18, 2018, after years of planning and extensive public review, the regional director of the U.S. National Park Service signed a Record of Decision, authorizing the beginning of a plan to remove mountain goats (*Oreamnos americanus*) from Olympic National Park (as well as adjacent portions of the Olympic National Forest). For the first few years of this work, the approved plan calls for most mountain goats to be captured live and transported to staging areas on the Olympic Peninsula where they would formally become the responsibility of the Washington Department of Fish and Wildlife (WDFW). From these staging areas, mountain goats would then be transported to pre-selected staging areas in the North Cascades, and then brought to release locations where they would be returned to the wild.

Details of the rationale and plans are contained in the Final Environmental Impact Statement and the Record of Decision (both available at <https://parkplanning.nps.gov/projectHome.cfm?projectId=49246>). This report provides an overview of the capture and translocation efforts during the first fieldwork bout in September 2018. Future progress reports will cover activities during 2019. Technical reports for the scientific literature will follow as appropriate.

2. Capture

We had originally planned to implement two capture bouts in 2018 (one in July and one in September). Each bout was to last 12 days and occur over only one weekend. We were to have 2 staging areas in operation (one in the north and one in the southeast) to minimize goat ferry time, hence increasing capture efficiency and goat survival.

In the FEIS we estimated that in a September capture bout we would catch between 5-10 goats/day, fly 8-12 days out of 12 possible capture days, and that we would fly 6-8 hours/day on days allowing capture (overall range 48-96 hours), and thus capture 40-120 goats (best estimate = 80 goats). With a projected 2 capture bouts in 2018 we estimated that we would remove approximately 188 goats total in 2018 (range 112- 264: 108 caught in July and 80 in September) (Table 1). We were not able to implement a capture bout in July 2018 due to the delayed signing of the ROD. Thus, our lone capture operation in 2018 occurred during September 10 – September 23. We were only able to use only one staging area, at Hurricane Hill, due to the additional delay in the USFS ROD.

In September 2018, we were able to fly on 10 days, but to achieve that we extended operation to 14 days. The prolonged field work was necessitated by extended periods of bad weather, which shut us out over the weekend of September 15 and 16. During those 10 days, we flew a total of only 61.1 hours (range per day 1.6 - 8.0 hours; Table 2). Shorter days were due to unfavorable weather limiting operations in the morning or in the afternoon; there were only 2 days in which we were not hampered by weather and had to cease operations early.

Table 1. Capture flights estimated in the Final Environmental Impact Statement (FEIS).

Estimated goat capture rates and flight hours for 2018 in the FEIS									
Month	Number of flyable days/ capture bout		Number of goats caught/ day		Number of goats caught (# goats/day * flyable days)			Estimated number of flight hours	
	Min	Max	Min	Max	Min	Max	Mean	Min ¹	Max ²
July	9	12	8	12	72	144	108	54	96
September	8	12	5	10	40	120	80	48	96

¹ minimum flight hours= 6 hours/ day * minimum number of flyable days

² maximum flight hours= 8 hours/day * maximum number of flyable days

Table 2. Flights and goat captured during September 2018 field work.

Actual number of goats captured and hours flown in 2018 (September)						
Flyable days in a 14 day capture bout	Number of goats caught per day		Number of goats caught	Flight hours/day		Total capture hours
	Min	Max		Min	Max	
10	4	16	115	1.6	8	61.1

A separate, complementary ROD authorizing otherwise precluded activities on U.S. Forest Service (USFS) lands was signed on December 10, 2018; thus, activities reported herein were only those authorized by the NPS ROD.

Mountain goats were caught under a full service National Park Service ACETA (Aerial Capture Eradication, and Tagging of Animals) contract with Leading Edge Aviation, Clarkston, Washington. Prior to each day’s operation, the pilot and the project lead used available information on weather, field conditions, goat distribution, and previous day’s results, to choose areas to target the operations for the day. Due to the restriction to operating from just one staging area, we focused as much of the capture operation as possible to those areas most efficiently accessed from Hurricane Hill. Consequently, most of the captures occurred near Klahhane ridge, the northern portion of the Bailey range, and on the flanks of Mount Olympus (Table 2, Figure 1).

As per a Memorandum of Understanding between WDFW and Northwest Trek Wildlife Park (NWT, an AZA-accredited arm of the Port Defiance Zoo and Aquarium, Tacoma, Washington), kids captured without their mothers were to be donated to NWT, who would care for animals until other qualified zoological parks with interest could adopt them.

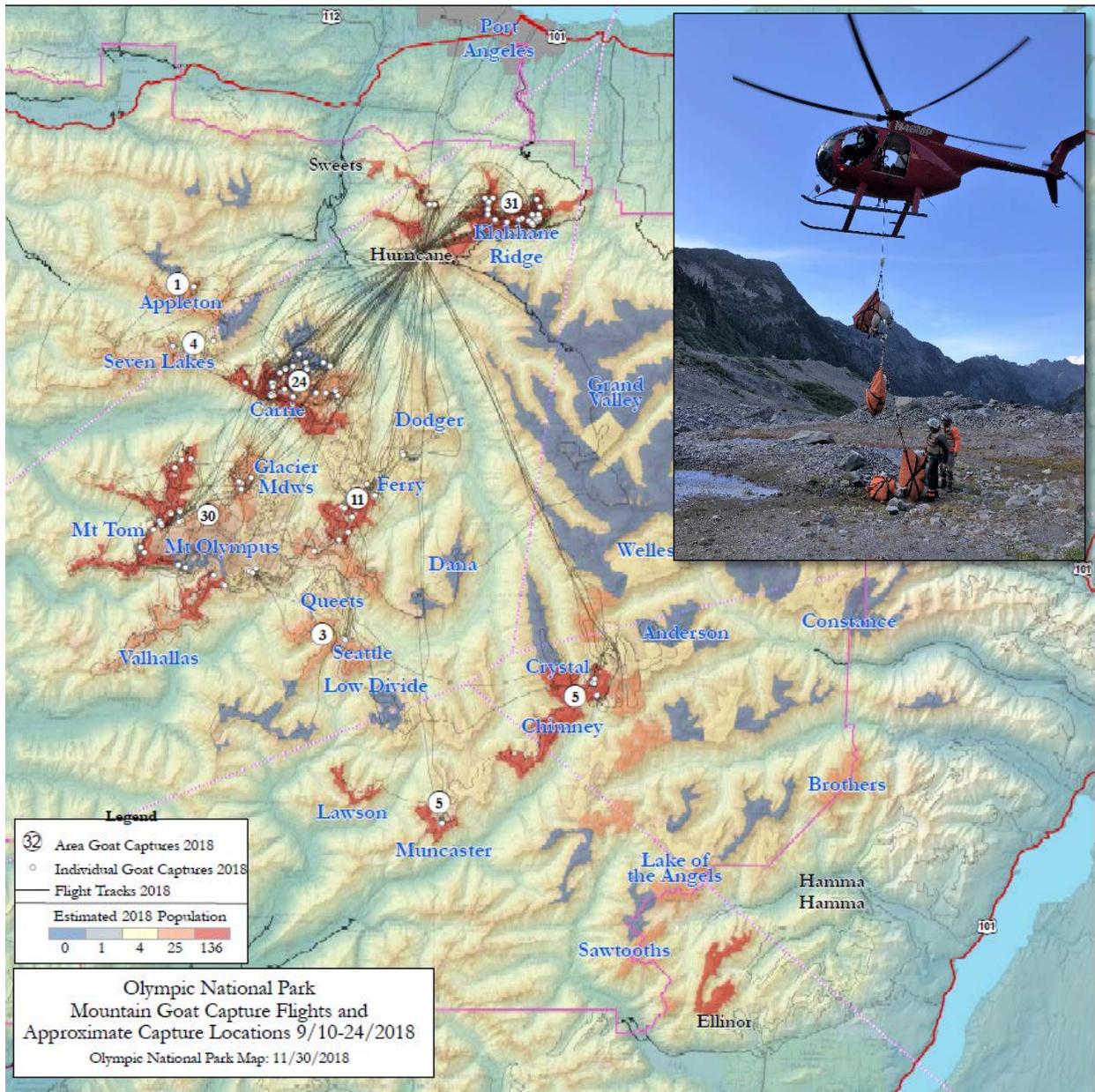


Figure 1. Goat capture locations and flight lines, Sept 10 to Sept 23, 2018. Inset shows 4 goats being prepared for a long ferry.

The capture team consisted of 5 crewmembers and the pilot; all crew member were qualified gunners. The capture team caught goats by either net gun, dart, or a combination of both methods. After securing the goat, the capture team reversed the capture drug immediately (if one was used) and all goats received the sedative Midazolam in the field. Captured goats were hobbled, blindfolded, and secured in specialty sling bags until they were ready for transport

(Figure 2). Field capture datasheets and horn guards were attached to each goat prior to transport. Goat sling load sized ranged from 1 to 5, with an average of 2 goats per load (loads with larger numbers of goats included kids accompanying their nanny). Mean time between darting or netting and delivery to the helibase was 37 minutes (range 11-84 minutes).

Table 3. Mountain goats removed from Olympic National Park during September 2018 field work by sex, age-class, and region of ONP captured.

Goat type		Capture Region								Total
Sex	Age	Hurricane	High Divide	N Bailey	S Bailey	Olympus	Anderson	Muncaster	Seattle	
Female	Adult	13	3	10	8	18	5	2		59
Female	Yearling	2		2		2		1		7
Female	Kid	1	2	1	1	3		2		10
Male	Adult	9		7		2			1	19
Male	Yearling	1		3	1	3			2	10
Male	Kid	5		2		2				9
Total		31	5	25	10	30	5	5	3	114

One hundred and fourteen goats were captured and transported to the staging area (Table 3). One additional goat died after a fall in the field and was not recoverable. Of the 114 goats transported to the processing area, 78 were adults (59 F, 19M), 17 yearlings (7F, 10M) and 19 were kids (10F, 9M) (Table 2). Of the yearling and adult goats, 35 were captured using darts, 56 nets, and 5 using a combination dart and net. (Due to the limited supply of Carfentanil, and the unavailability of an effective alternative capture drug, we used net guns as much as possible).

It took an average of 39 minutes to process each goat (range 23-59 minutes). All goats were quickly evaluated upon delivery at the helibase, given additional Midazolam if needed, and put in a sternal position to maintain their airway. Each goat was assigned a person to monitor them during the ~ 0.4 mile drive to the staging area. Upon arrival at the staging area, each goat was removed from the capture sling bag and put on a stretcher (but keeping on the blindfold, hobbles and horn guards), weighed, and then taken to one of 4 processing areas, where they were

cared for by goat processing teams. Teams were led by veterinarians, vet techs, and experienced animals handlers, with assistance from volunteers. Each animal was assigned “goat shepherd” who stayed with that animal throughout the processing operation, ensuring that capture information was attached to the processing sheet, and data on that goat was recorded throughout the process.

Each goat was evaluated by staff veterinarians for emergency medical conditions and treated if necessary. There were at least 5 people (often more) working up each goat. In addition to weight, condition score, horn dimensions, morphometric measurements, sex, age and lactation status were recorded. Samples taken included: nasal swab, tissue for DNA analysis, blood, hair, and fecal samples. Photographs were taken of the horns and teeth of each animal. All animals were given BoSe (selenium and Vitamin E to reduce muscle damage leading to capture myopathy), Fluxinin (a nonsteroidal anti-inflammatory and analgesic), Ivermectin (an anti-parasitic), Oxytetracycline (antibiotic), and Vitamin E. All adults and yearlings were also given Haloperidol to aid animals in maintain tranquility. In addition, most received 1 L fluids subcutaneously. Temperature, respiration and CRT was monitored throughout the process. Each animal was equipped with an ear tag, with the unique ear tag number corresponding to the animal number in the records. All adults were equipped with a radio-collar; all but 3 received GPS collars. Kids that were released also received breakaway VHF collars.

After processing, goats were moved into individual transport crates (Figure 3). The crates were kept in a secluded and shaded area until they were ready to be loaded into the transport trucks. Due to the time of year (September) and prevailing weather during the operation (cool and cloudy) overheating was not a concern. Mean time between darting in the field and placement in the crate was 1:16 hours (range 0:38–2:34).

A full report on veterinary aspects of captured goats is pending. Preliminary results indicate that all goats sampled were negative for infection with the bacteria *Mycoplasma ovipneumoniae*. Captured kids were prioritized for parasite examinations because they were more likely than adults to be shedding them (i.e., showing evidence of infection). All kids examined were negative for Cryptosporidium, Giardia, and Johne’s Disease. Two kids were assessed as likely to have contagious ecthyma (also known as orf), a common, non-fatal disease in Caprinae, and were euthanized on site rather than translocated.



Figure 2. Map of the Hurracaine staging area, including location of helibase and processing area. Insets show a) goats delivered to the helibase, b) transported to processing area, and 3) unloaded by handlers at the processing area.

Overall, goats were in good condition (Table 4); only one goat was evaluated to have a condition score of < 2. Average weight of adult females was 74.1 kg (range 59-87.5 kg) and adult males 117.6 kg (range 74.5 kg [for a 3 year-old male] to 147.5 kg [for a male estimated to be 7-8 years old]).

Table 4. Mean body mass and condition score for mountain goats captured in Olympic National Park, September, 2018.

Sex	Age	Mean Body Mass		Condition Score		Mean Age	
		(kg)	<i>n</i>	(1-5)	<i>n</i>	Age	<i>n</i>
Female	Adult	74.1	59	2.7	48	4.8	34
Female	Yearling	48.1	7	2.9	4		
Female	Kid	26.5	10	2.8	5		
Male	Adult	117.6	19	3.4	12	6.2	15
Male	Yearling	50.0	10	2.7	9		
Male	Kid	28.83	8	2.7	3		

Of the 115 goats removed from the park, 6 died in capture-related mortalities; these either died in the field (4) or were euthanized following an examination of their injuries (2). All of the goats that died during or as a result of the capture were caught by darting, or darting and netting. The factor that contributed to mortalities were dart wounds (2) or excessive induction time leading to falls (4). A factor that may have contributed to the long induction time was our attempt to stretch out the limited Carfentanil supply by trying a lower dose, or leaving drugs in darts for greater than 2 days. In 2019 we expect to be able to use Thiafentanil; thus minimizing drug use will no longer be a constraint, and we expect this to help reduce capture mortalities.



Figure 3. Goats in the processing area a) goat being weighed, b) overview of processing area, c) a processing team, and d) goat being loaded into a crate.

Three more goats were euthanized because they were unsuitable for transport; in addition to the 2 suspected to be infected with orf, one large billy was known to have exhibited aggressive behaviors and hence was not a candidate for transport.

A total of 106 live goats were removed from the park; 6 orphaned kids went to the zoos and 100 were transported to the Cascades.

3. Transportation and Release

3. a. Methods

3 a.1. Transportation

Because we knew from previous experience (Harris and Steele 2016) that mountain goats cannot be safely moved *en masse*, each animal to be translocated was placed in its own, specially-built crate (Fig. 4). When ambient temperatures were cool, goats awaiting transport were placed in a shady area near the processing area until ready to be transported. If temperatures rose to a point where over-heating was a concern, goats were placed in refrigerator trucks where the ambient temperature could be adjusted to approximately 10°C (50° F).



Figure 4. Crates with goats. Shown is a crate with "howdy door" allowing mother and kid to see and smell each other during transport.

Over 70 volunteer drivers participating in the translocation effort were responsible for transporting goats to release sites following pre-determined routes. Goats were transported in fridge trucks, up to nine goats in each truck, or by pick-up trucks carrying up to two goats. Pick-

up trucks were only used to move goats when ambient temperatures were cool enough to allow safe transport without the use of additional controlled cooling. Each vehicle transporting goats had a team of two volunteers, which took turns driving, or navigating and in communication with other transport vehicles and WDFW or ONP staff. Additionally, volunteers in personal vehicles accompanied the goat transport vehicles to provide any support needed. Communication was accomplished with personal cellular and satellite phones. Each fridge truck also carried a satellite phone and cell phone, which allowed WDFW and ONP staff to track their progress via the internet and some communication by text message.

During transport, drivers were instructed to drive at safe speeds, and stop at regular intervals (about hourly) to open the rear door for 5-10 minutes allowing additional ventilation in the back of fridge trucks. Most routes to release sites included the Kingston-Edmonds ferry. Thus, transport from capture to release sites typically took 4-5 hours.

3. a. 2. Releases

Plans called for all releases to occur at sites that could be accessed only by helicopter but were not in Federally-designated wilderness areas: Stillaguamish Peak, Vesper-Sperry, Mt. Index, Goat Mountain, and Tower Mountain (See Fig 5). However, weather conditions in September 2018 were such that Olympic National Park crews were frequently able to capture animals but Cascade crews were unable to use helicopters to access the release sites. Anticipating this possibility, we identified a number of sites accessible by road, that while suboptimal, still provided the goats terrain that would allow them to travel close, if not exactly to, the desired release sites.

For releases that occurred at the planned (helicopter-accessed) sites, we first flew to the release site to confirm that it was safe to land. We then flew to the staging area to confirm plans with the crews who had been tending the goats overnight. We ferried the release crews (always numbering 6 individuals) along with snow-fencing materials and other gear to and from the release-staging areas to the release sites in 2 separate hops (the Bell Jet Ranger used in 2018 can safely accommodate 3 passengers).

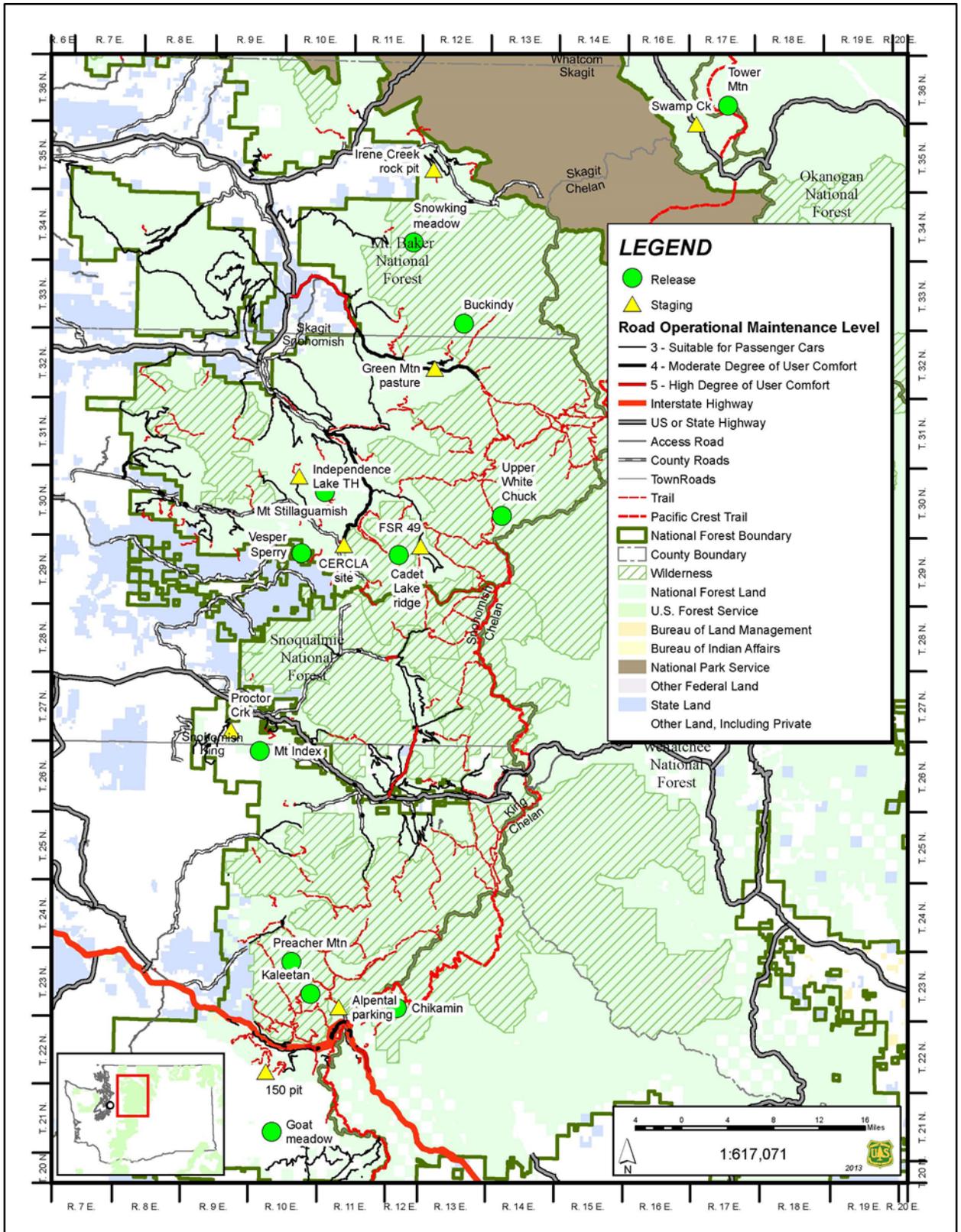


Figure 5. Staging (yellow triangles) and release (green circles) as planned in the FEIS.

After crews arrived, they set up the snow-fencing in 2 roughly parallel rows, forming a chute that would encourage goats to run off in the desired direction immediately following release (Fig. 6). Crates containing goats were then delivered 2 at a time (except the larger ‘billy crates’, see below, which were delivered individually) to the release site. Crates were arranged in a side-by-side row, and doors were only opened once all crates had arrived. When we had known nanny-kid pairs, we always situated the 2 crates containing them adjacent to each other, releasing the kid shortly after the nanny (to increase the probability it would follow its mother). Otherwise, doors were opened as close to simultaneously as possible.



Figure 6. “Chute” created by temporary placement of snow fencing to direct goats toward preferred areas upon leaving the crates. Shown is the release area near Stillaguamish Peak.

After the goats were released, the helicopter was called back from the staging area to ferry the crates and equipment back to the release areas, while the crew monitored the goats as long as they remained observable with binoculars and spotting scopes. Because of their lighter weight, empty crates were ferried 3-at-a-time (except the larger ‘billy-crates’). Finally, release crews were ferried back to the release-staging areas using 2 round-trips. The total time spent in releases, from arrival of the helicopter to the last ferry of crew, varied from about 2.5 to 4.5 hours. When helicopters could not be used, we drove all vehicles to the best possible release site, and followed the same procedures as above (but without the helicopter).

3.b. Results

3.b.1. Transportation

We transported mountain goats captured on 10 days to 6 sites within 5 different release areas (Table 5). Three sites (Sutton Lake, Independence Lake Trailhead, and Box Canyon Trailhead) were chosen because preferred release sites were either inaccessible to the helicopter because of weather, or within Federally-designated wilderness (Sutton Lake in place of Goat Mountain; Independence Lake trailhead in place of Stillaguamish Peak, and Box Canyon in place of Chikamin Ridge). Three sites were accessed via helicopter (Stillaguamish Peak, Vesper-Sperry, and Nugget Lakes near Golden Horn Mountain). Except in one case, goats stayed overnight in their crates at the release-staging area, awaiting the next morning when they could be transported to release sites. On September 12, capture operations ceased early because of weather issues, with only 2 goats having been captured. Crates containing these animals were transported in volunteers' pickup trucks, and released in early evening of the same day.

Table 5. Mountain goats transported and released from Olympic National Park to sites in the North Cascades, September 2018. Shown are dates captured, dates released, release site, general area (as shown in the FEIS), method of release, and number of goats.

Capture Date	Release Date	Release Site	Translocation Area	Released by	Goats released
9/10/2018	9/11/2018	Sutton Lake	Cedar River Drainage	Vehicle	13
9/11/2013	9/12/2018	Stillaguamish Peak	Stillaguamish Peak	Helicopter	5
9/11/2013	9/12/2018	Independence Lake TH	Stillaguamish Peak	Vehicle	5
9/12/2018	9/12/2018	Independence Lake TH	Stillaguamish Peak	Vehicle	2
9/13/2018	9/14/2018	Sutton Lake	Cedar River Drainage	Vehicle	8
9/14/2018	9/15/2018	Box Canyon (Kachess Lake)	Chikamin Ridge	Vehicle	9
9/17/2018	9/18/2018	Vesper-Sperry	Vesper-Sperry	Helicopter	12
9/18/2018	9/19/2018	Vesper-Sperry	Vesper-Sperry	Helicopter	14
9/19/2018	9/20/2018	Nugget Lakes	Tower Mountain	Helicopter	14
9/20/2018	9/21/2018	Stillaguamish Peak	Stillaguamish Peak	Helicopter	8
9/23/2018	9/24/2018	Nugget Lakes	Tower Mountain	Helicopter	8
Total					98

We transported a total of 100 mountain goats. Two large adult males died in transit, evidently from capture myopathy exacerbated by the stress of being confined in the crate that was judged to be too small. (The capture crew subsequently ceased capturing adult males until we obtained use of 2 larger crates – which we termed “billy crates”; adult males captured subsequently were transported in these crates [see Fig. 7] which were designed for transporting bighorn sheep rams and were generously loaned to the project by Dr. Tom Stephenson, California Department of Fish and Game).



Figure 7. Crates designed for bighorn sheep used during September 2018 to transport adult male mountain goats. Photograph courtesy J. Sevigny, Stillaguamish Tribe.

Thus, we released 98 mountain goats (Table 6). Because of the problems transporting adult males, the gender ratio of released animals was more heavily skewed toward females than initially planned (55 adult nannies compared with 14 adult billies). The juvenile sex ratio was closer to parity (13 females compared with 16 males). Of the 98 animals, 70 animals were equipped with collars providing both transmission of GPS positions to satellites (at least daily) as well as VHF transmitters allowing location in the field and notification of mortality events (Table 7). An additional 15 animals, most of them too small to wear GPS collars, were equipped with elastic, drop-off VHF-only transmitters (Table 8). Thirteen animals, all yearlings, were released without tracking devices.

Table 6. Mountain goats transported from Olympic National Park to five translocation areas, by sex and age. See Table 5 for specific sites and dates of release.

	Nanny	Billy	Nanny yearling	Billy yearling	Nanny Kid	Billy Kid	Total
Translocation area							
Cedar River	11	5	0	2	0	1	19
Stillaguamish Peak	12	2	3	1	2	1	21
Vesper-Sperry	13	3	2	6	0	2	26
Chikamin Ridge	6	1	0	2	0	0	9
Tower Mtn	13	3	2	0	4	1	23
Total	55	14	7	11	6	5	98

3. b. 2. Releases

Most animals left the crates immediately upon doors being opened. A few animals exhibited stiffness and mild limping, which we interpreted as resulting from up to ~ 24 hours of confinement in the crate; others showed no evident effects of confinement. Three animals appeared rigid and unwilling to move upon release, although all were clearly aware of their surroundings and appeared responsive. In all 3 cases, we pulled the animal from its crate, encouraging it to move via gentle prodding and lifting it up off the ground. In all 3 cases, after 2-3 minutes of seeming immobility, the goat suddenly sprang to its feet and bounded off in the direction that most previously released goats had selected.

Table 7. Mountain goats transported from Olympic National Park to five translocation areas wearing GPS/VHF collars, by sex and age. See Table 5 for actual release sites and dates of release.

GPS collars	Nanny	Billy	Nanny yearling	Billy yearling	Nanny Kid	Billy Kid	Total
Translocation area							
Cedar River	10	5	0	1	0	0	15
Stillaguamish Peak	10	2	1	0	0	0	13
Vesper-Sperry	13	3	0	0	0	0	16
Chikamin Ridge	6	1	0	0	0	0	7
Tower Mtn	13	3	2	0	0	0	18
Total	52	14	3	1	0	0	70

Table 8. Mountain goats transported from Olympic National Park to 5 translocation areas wearing VHF only collars, by sex and age. See Table 5 for actual release sites and dates of release.

VHF only	Nanny	Billy	Nanny yearling	Billy yearling	Nanny Kid	Billy Kid	Total
Translocation area							
Cedar River	1	0	0	0	0	1	2
Stillaguamish Peak	2	0	1	0	2	1	6
Vesper-Sperry	0	0	0	0	0	2	2
Chikamin Ridge	0	0	0	0	0	0	0
Tower Mtn	0	0	0	0	4	1	5
Total	3	0	1	0	6	5	15

In all but a few cases, goats left the crates in the intended direction, as indicated by the presence of the “chute” created by the temporary snow fencing. Occasionally, we observed animals leap over the snow-fencing, and 2-3 found spaces between the crates and fencing to head off in other directions. Based on our observations at the release sites, most females and young appeared to leave the crates together; most adult males headed in directions other than majority of females.

c. Discussion

Poor weather compromised our ability to place goats in the best possible locations and complicated our planning. We experienced no days during which weather conditions were not concerns. On September 12, 2018 we were forced to release only a subset of goats from the helicopter-release site before being forced to retreat to the staging area due to the unexpectedly rapid onset of low clouds. We released the remaining animals relatively nearby via vehicle. On September 19, 2018 we released animals in 2 bouts from the helicopter, separated by a retreat to the release-staging area while weather deteriorated and then improved again. That said, goats released via vehicle all headed uphill in the direction we generally had intended. Time between capture and release was generally > 24 hours, but in 1 case (9/12/18) was < 12 hours.

4. Initial Response of Translocated Goats

4. a. Methods

We monitored survival and movements of 70 of the 98 goats released via GPS data downloaded from the Globalstar (and, for a few collars, the Iridium) satellite systems. Fifteen animals (mostly kids) wore only VHF-transmitting systems; we used occasional ground-based telemetry, as well as helicopter flights on October 4 and October 21 to confirm the status of these animals. (We were able to confirm whether the animal was alive without observing it based on the pulse-rate of the collar). We also received about half-dozen reports of goats from WDFW's existing Mountain Goat Incident web-based reporting system in which we were able to determine that the goats in question were those recently translocated. We also received occasional photographs from the general public and from game cameras operated by WDFW (Fig. 8). Assistance was also provided by project partners with monitoring and mortality investigation.



Figure 8. Photograph of adult nanny provided by a game camera operated by WDFW enforcement, near Darrington, WA.

4. b. Results

As suggested by Harris and Steele (2014), assessing the success of mountain goat translocations requires many years. Results reported in this progress report are limited to data

obtained during the 1st ~ 3 months post-release, and thus should not be used as a basis for evaluating success, or as a predictor of future outcomes.

4.b.1. Initial survival of translocated mountain goats

As of December 20, 2018, we have documented mortality of 9 of the released mountain goats (7 adult females, 2 adult males, Table 9). One additional collar near Stillaguamish Peak went on mortality mode shortly after the animal was released, but based on 2 helicopter searches and notes taken at the time of capture indicating that the collar was loose, we suspect this represents a dropped collar.

Table 9. Summary of known mortalities of mountain goats translocated from Olympic National Park to selected sites in the North Cascades in September, 2018.

Goat	Gender	Age	Wt (kg)	Release Location	Release Date	Mortality Date	Days alive
4906	female	adult	76.0	Vesper-Sperry	9/18/2018	9/23/2018	5
4953	female	adult	85.5	Tower Mtn	9/24/2018	9/25/2018	1
4948	female	adult	86.5	Stillaguamish Peak	9/12/2018	10/21/2018	39
4867	male	adult	92.5	Stillaguamish Peak	9/21/2018	10/22/2018	31
4938	male	adult	110.5	Cedar - Sutton Lake	9/11/2018	10/25/2018	44
4872	female	adult	60.0	Stillaguamish Peak	9/20/2018	11/8/2018	49
4871	female	adult	75.0	Vesper-Sperry	9/19/2018	11/22/2018	64
4945	female	adult	69.5	Cedar - Sutton Lake	9/14/2018	12/6/2018	83
4889	female	adult	69.0	Vesper-Sperry	9/17/2018	12/9/2018	83

Two of the 9 mortalities occurred within only a few days of release; it seems most likely both were either injured or compromised by the capture or transport. Adult female 4906 released at Vesper-Sperry on September 18 died 5 days later; Mike Sevigny of the Tulalip Tribe examined her carcass on October 8, and judged her to have fallen down a steep escarpment. Adult female 4953 released at Nugget Lake on September 24 died shortly after release; students at Western Washington University were able to photograph the carcass on October 15, 2108 but could not determine the cause of death.

Seven of the 9 mortalities occurred > 30 days following release. Although their lack of familiarity with the new surroundings and/or lack of existing social groupings may have

contributed to these deaths, they were unlikely to be direct consequences of capture or transportation. Adult female 4948 released at Stillaguamish Peak on 9/12/18 sent a mortality mode message on 10/21/18 (39 days post-release). The carcass was inspected by Sauk-Suiattle biologists 2 days later; little of the carcass was intact as it had evidently been scavenged (and perhaps killed) by a bear. Marrow of a femur was white and waxy. Adult male 4867 released 9/21/18 at the Stillaguamish Peak site sent a mortality mode message on 10/22/18 (31 days post-release). Students from Western Washington University photographed the carcass on 11/11/18 (Fig. 9). Cause of death remains unknown.



Figure 9. Adult male released at Stillaguamish Peak 9/21/18 that died around 10/22/18, photographed on 11/11/18. Photograph courtesy of Western Washington University.

Adult male 4938 released at Sutton Lake on 9/11/18 sent a mortality mode message on 10/25/18 (44 days post-release) and was investigated by Muckleshoot Tribe biologists the subsequent day. Bite marks, burial of the carcass, and other evidence pointed to cougar predation as the cause of death. Adult female 4872 released at Stillaguamish Peak on 9/20/18 sent a mortality mode message on 11/8/18 (49 days post-release) from a location near Mt. Jumbo. Students from Western Washington University made an unsuccessful attempt to examine the carcass on 11/10/18. Adult female 4871 released on 9/19/2018 at Vesper Sperry sent a mortality

message on 11/22/18 (64 days post-release), although the death may have occurred a few days earlier, from a location near Sunset Lake in the Wild Sky Wilderness on the Skykomish Range District. Staff have thus far been unable to get the site to examine the carcass. Adult female 4945 released on 9/14/2018 at Sutton Lake sent a mortality message on 12/6/18 (83 days post-release). Examination by MIT biologists on 12/10/18 implicated cougar predation. Adult female 4889 released on 9/17/2018 at Vesper-Sperry sent a mortality message on 12/9/2018 (83 days post-release). To date, staff have been unable to examine the carcass.

As of December 2018, we have been able to monitor or observe 8 of the 11 kids, as well as the 3 adults and 1 yearling animal equipped only with VHF telemetry systems. No mortalities of these have been documented. Thus, as of mid-December 2018, our best information suggests that 76 of the 85 animals that were released with transmitters and are still providing data remain alive.

4. b. 2. Initial movement patterns of translocated mountain goats

Here, we provide a qualitative summary of patterns exhibited by released goats in the first ~ 3 months post-release, based on mapping of GPS-instrumented animals. Detailed, quantitative analyses of movement patterns will be reported in subsequent reports.

Figures 10, 11, and 12 provide overviews of areas used by GPS-instrumented mountain goats during the 30 days October 11-November 10, 2018. It appears that most goats explored their surroundings, presumably to understand where forage and escape terrain resources could be found. Most movements during the 1st week or so following release radiated outward from the release site in all directions, albeit at differing speeds.

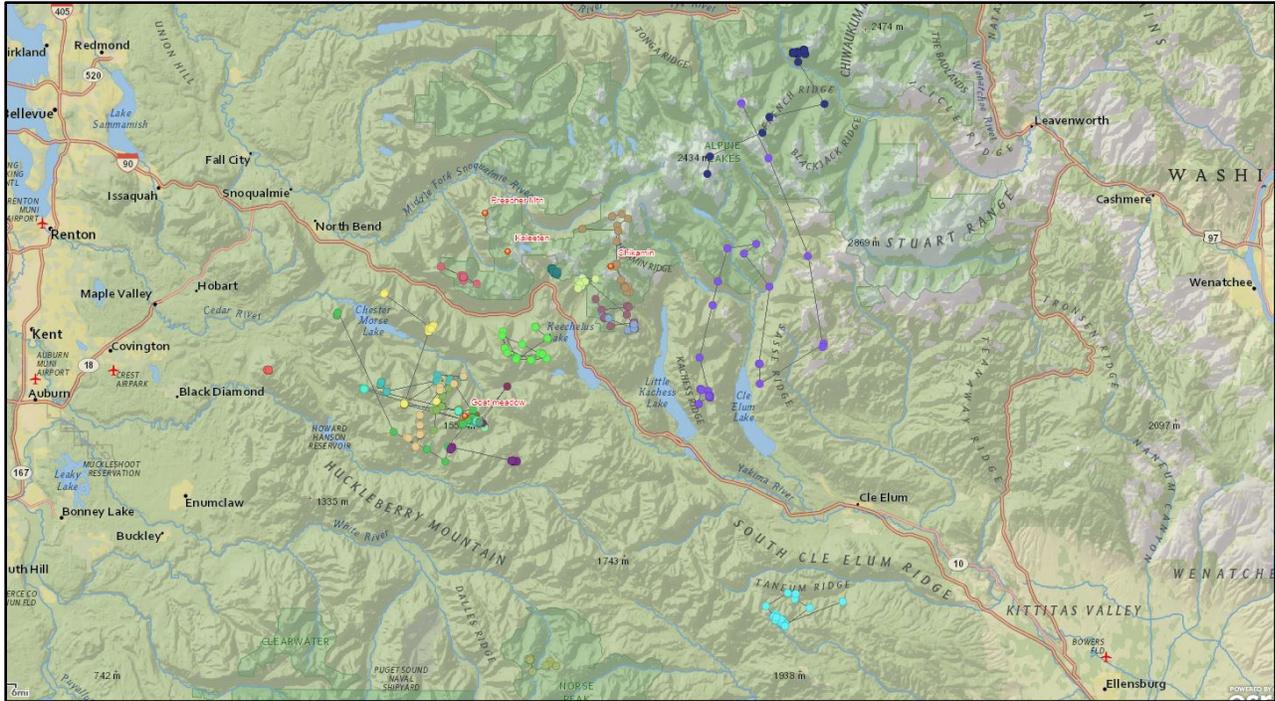


Figure 10. Area map, showing general locations during October 10-November 10, 2018 of GPS-instrumented mountain goats released at the Sutton Lake (Cedar River Drainage) and Box Canyon (near Kachess Lake) release sites in September 2018.

Figure 10 displays locations of animals released at the 2 southern-most sites (Sutton Lake, Box Canyon). Although a long-term objective for goats in these areas is to increase density to the point where occasional movements will occur across Interstate Highway 90, no such highway crossings have been observed to date. Some goats released at Sutton Lake, where extensive areas of alpine terrain are lacking, moved to lower-elevation sites. Most of the animals released at Box Canyon moved into the Alpine Lakes Wilderness Area.

Figure 11 displays locations of goats released on either side of the Mountain Loop Highway, south of Darrington. We noted considerable movements among most of these animals, with some exploring areas as far west as the hills above Arlington (not shown in this map), and others moved as far east as Glacier Peak. The Mountain Loop Highway did not appear to act as a barrier to movement, although most animals stayed on the side they had been released. One animal released at the Vesper Sperry site travelled south almost to Interstate Highway 90, and as of late November 2018 had evidently settled on Kachess Ridge (and thus appears on Figure 10).

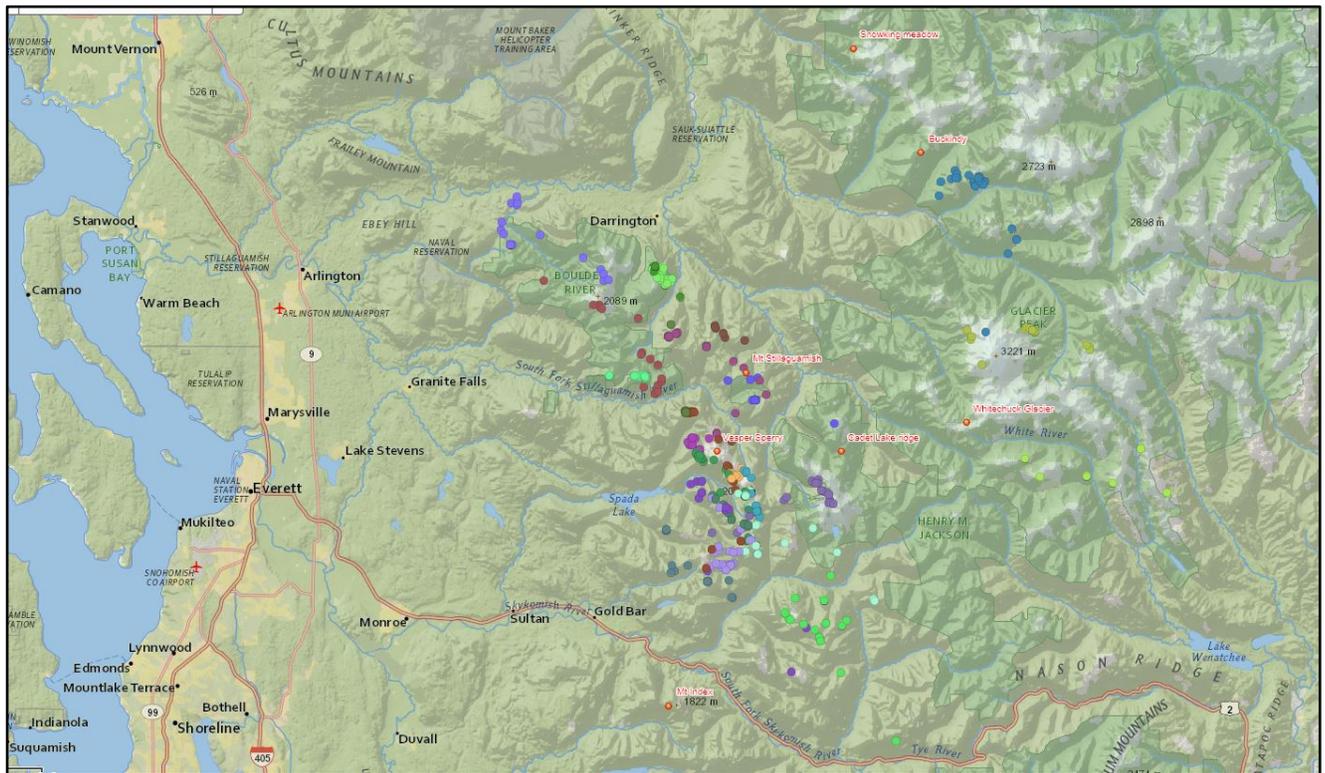


Figure 11. Area map, showing general locations during October 10-November 10, 2018 of GPS-instrumented mountain goats released at the Stillaguamish Peak, Independence Lake Trailhead, and Vesper-Sperry release sites in September 2018.

Figure 12 displays locations of goats released at the Nugget Lakes site near Golden Horn and Tower Mountains on the Okanogan-Wenatchee National Forest. Most movements were in a north-south direction. A few animals crossed south or west across Highway 20, but subsequently moved back closer to their site of release. One animal moved north to the Canadian border on Hozomeen Mountain.

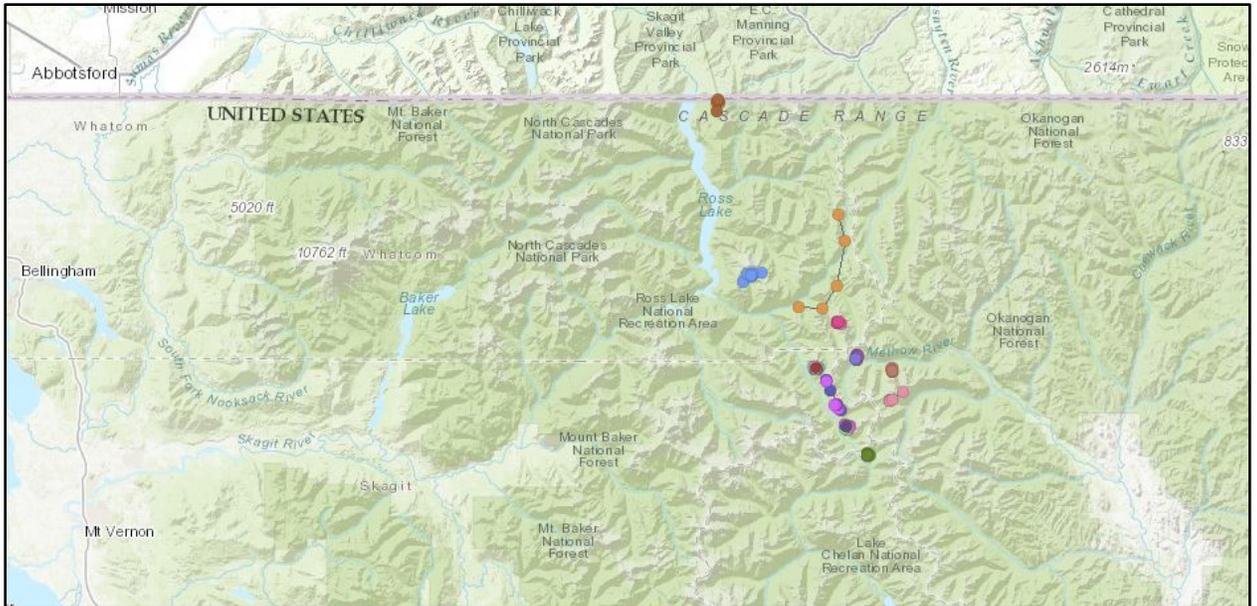


Figure 12. Area map, showing general locations during October 10-November 10, 2018 of GPS-instrumented mountain goats released at the Nugget Lake release site (near Golden Horn and Tower Peak, September 2018).

1. Initial exploratory phase. We noted two distinct types of movement patterns among goats within the first few weeks of release. Some goats evidently found a spot to their liking, and remained sedentary (for example, nanny 4935, Figure 13, right-hand panel). Other animals moved extensively, at least until mid-November (for example, female 4870, mid-November 2018 movements shown, Figure 13 left-hand panel). The longest distance between release and late November locations appears to be the ~ 52 miles of female 4889, released at Vesper-Sperry, which had travelled to near I90 at Kachess Ridge. Although quantitative analyses are pending, we noted no obvious differences between males and females in movement patterns through the end of October. We also noted no evident directional tendencies (e.g., no obvious preference for traveling in the direction of Olympic National Park). By mid-October, it appeared that most exploration behavior had ceased and movements tended to slow at this time, and some goats that

had radiated away from their release sites turned around, moving back in the direction of their release.

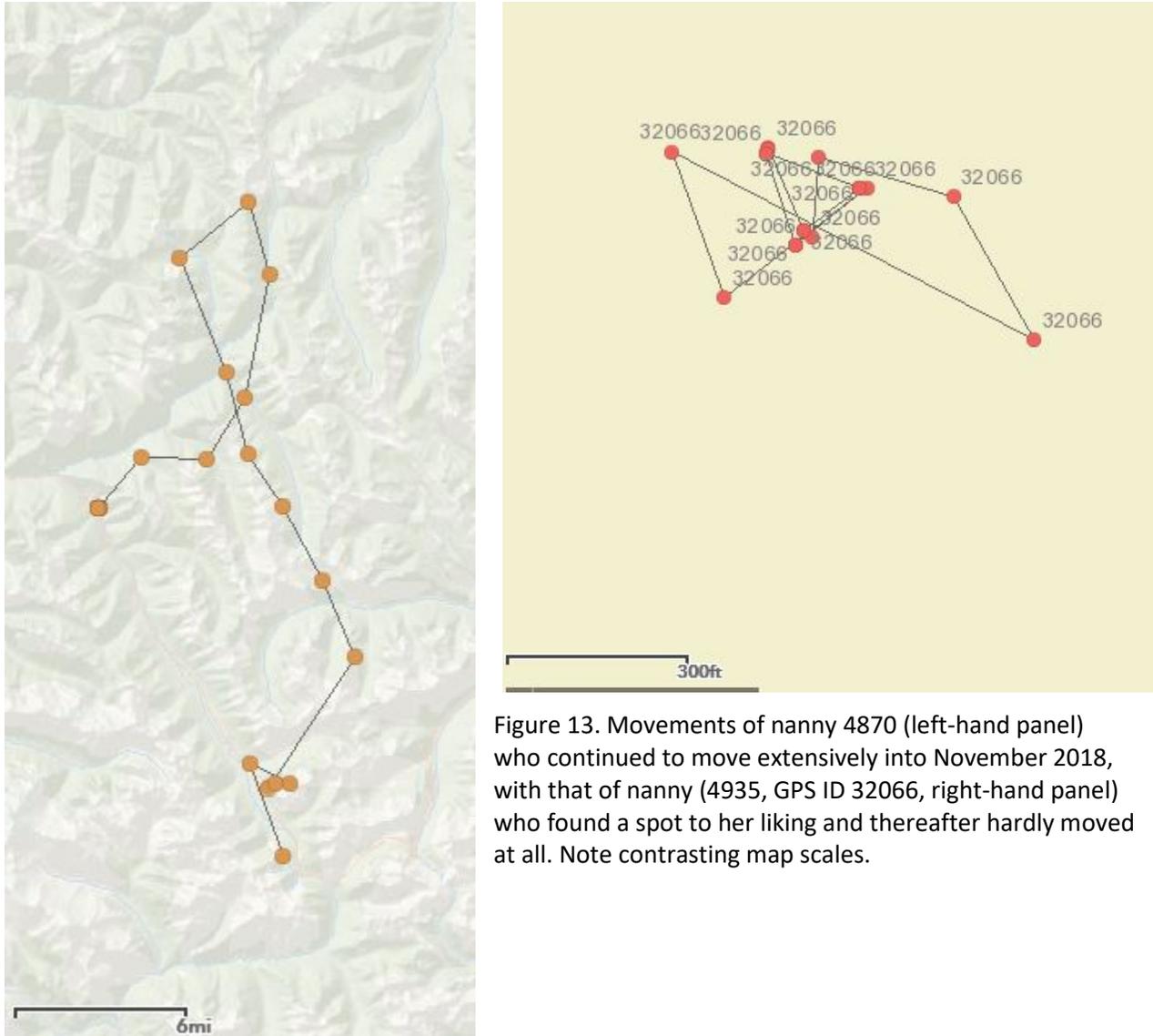


Figure 13. Movements of nanny 4870 (left-hand panel) who continued to move extensively into November 2018, with that of nanny (4935, GPS ID 32066, right-hand panel) who found a spot to her liking and thereafter hardly moved at all. Note contrasting map scales.

2. *Mating season.* We lack sufficient detail to document whether breeding has occurred, either among translocated animals, or between translocated and remnant resident animals. Some males appear to have remained sedentary through November, suggesting they may not have searched for females (or had found resident females). However, at least some billies have exhibited movement patterns suggesting that they have searched for, and found, translocated nannies (see, for example, Figure 14). In some cases, the billy and nanny were documented as

being together for only 1 or 2 consecutive GPS transmissions (minimum inter-transmission time of 23 hours). In some cases, a billy appeared to move with a nanny over a few days (for example, Figure 15).

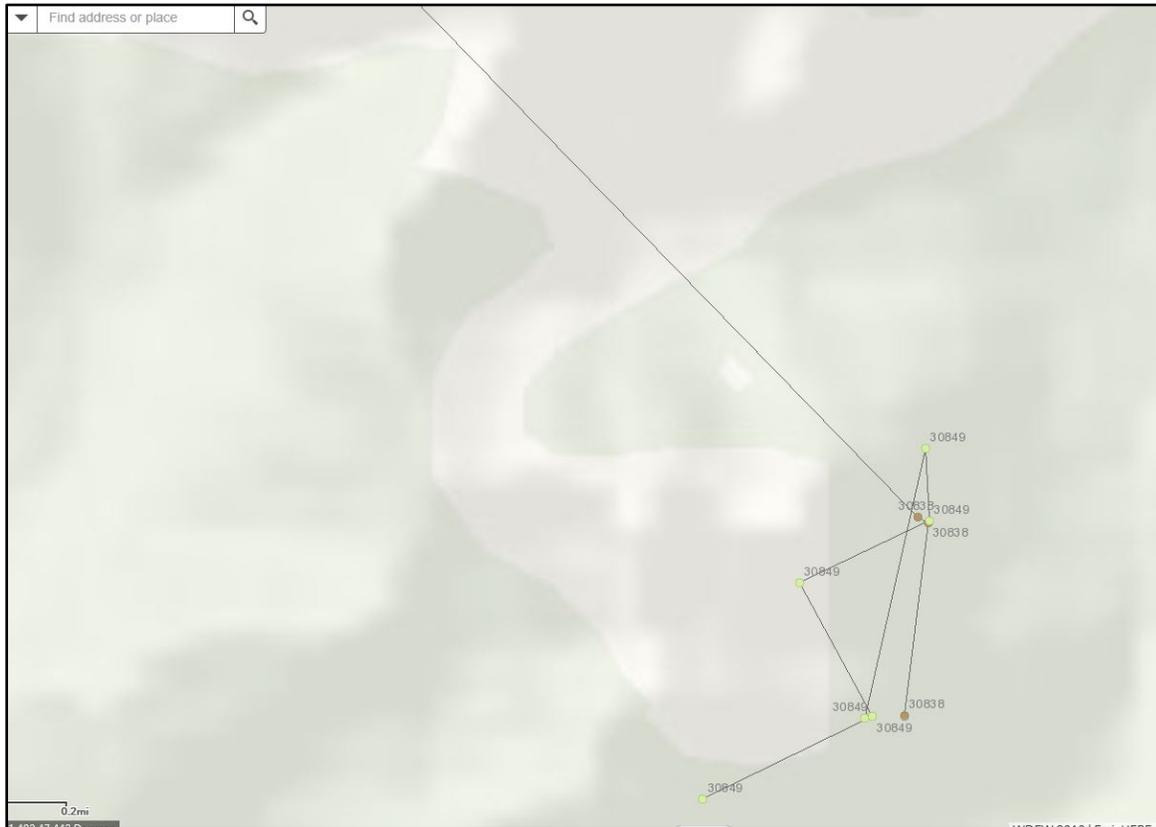


Figure 14: An example of an adult male (billy) evidently traveling in search of, and then finding and temporarily traveling with, an adult female (nanny). In this case, male 4911 (brown circles, 30838) arrived from the northwest and spent 2 days travelling with female 4892 (green circles, 30849) on approximately November 19, 2018.

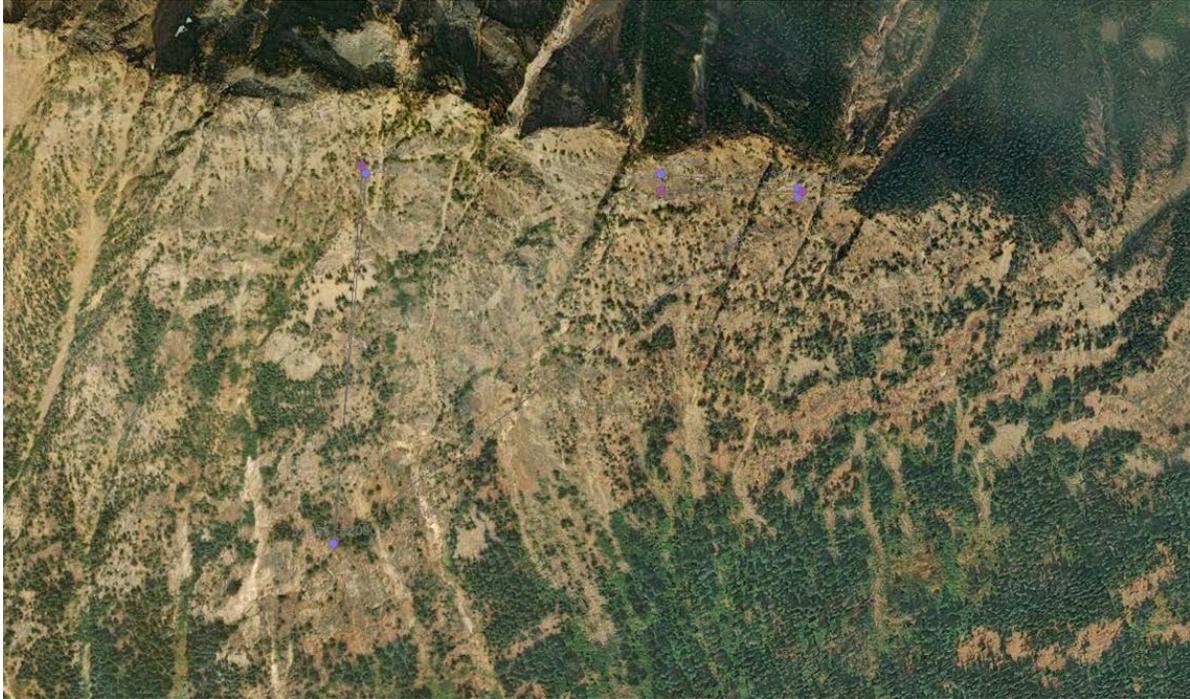


Figure 15. Male mountain goat 4874 (magenta) travelling with female 4863 (purple), both released at Nugget Lakes, traveling together in the 7 days ending November 26, 2018.

3. Grouping behavior of GPS-instrumented animals. As of late November 2018, a majority of GPS-instrumented animals appear to be solitary. However, there are examples of groups of females having formed. For example, two nannies released at Box Canyon travelled together for a number of days in early November 2018 (Figure 16), and 3 nannies released at Nugget Lakes have consistently travelled together in November (Figure 17).



Figure 16. Two nannies released at Box Canyon travelling together, early November 2018.



Figure 17. Three nannies released at Nugget Lake in September 2018, travelling together in mid-November 2018.

Any estimate of the proportion of animals having formed groups would necessarily be biased low at this time, because we have extensive information only on animals equipped with GPS collars. For example, during our VHF telemetry flight of October 17, 2018, we found that although 3 of the kids released at Stillaguamish Peak were no longer travelling with their mothers, they had evidently found each other, and were travelling together. The first appreciable snow storms of winter 2018-19 occurred in mid-November. As expected, movements appeared to slow at this time (Figure 18).

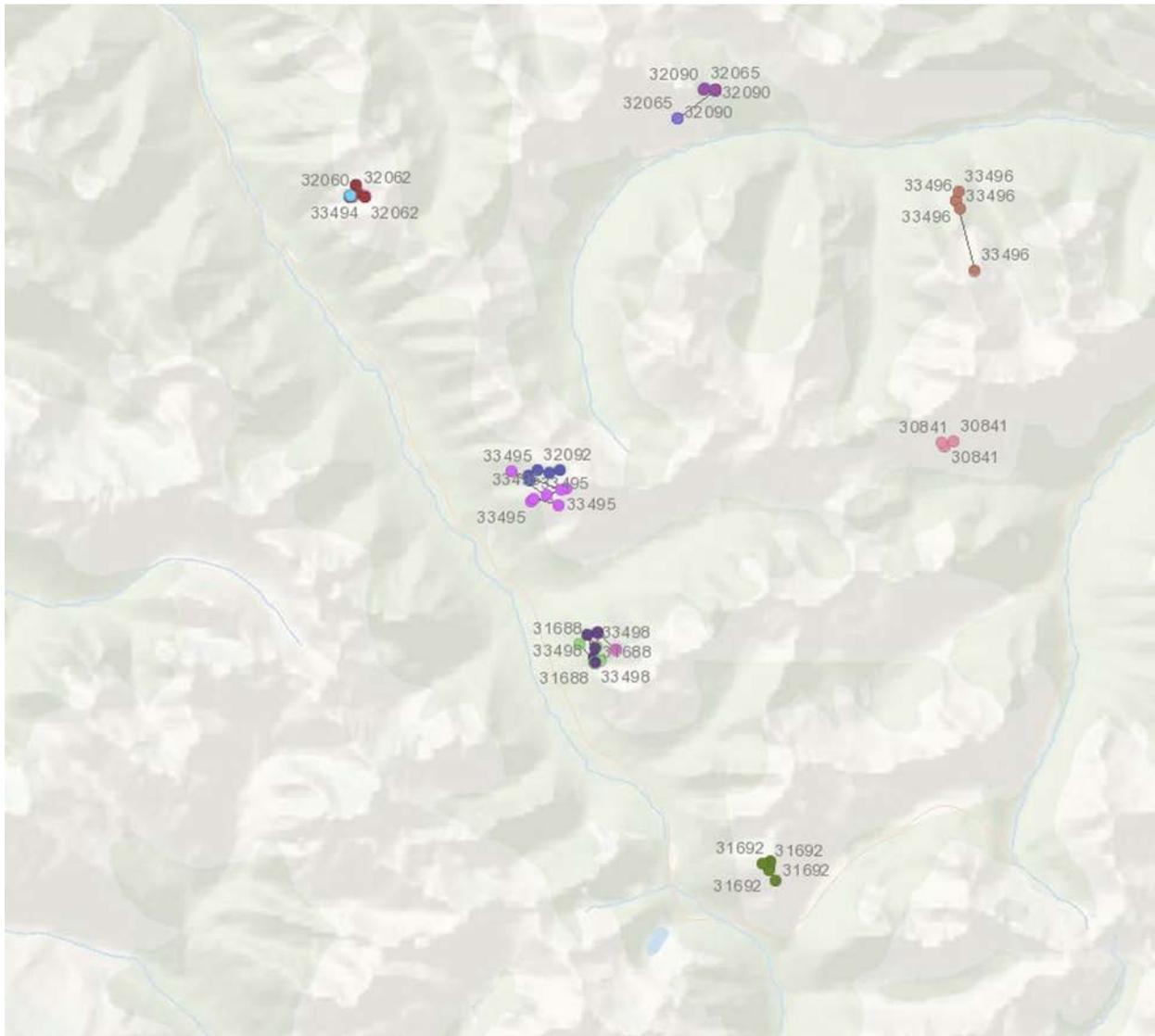


Figure 18. Locations of twelve of the GPS-instrumented goats released at Nugget Lakes in September 2018 during the 7 days ending November 26, 2018, illustrating reduced movements at this time of year.

4. *Interactions with humans.* To date, we know of no encounters between translocated goats and humans in which there was a risk of injury to the person. We have received a few reports of observations from the WDFW public “Report a Goat Incident” website, but none in which the goat approached the reporting party. We are unaware of any reports of property damage and/or crop damage caused by any translocated mountain goats.

The story of nanny 4940, who came to be known as the “Rattlesnake Nanny” (in part from the media coverage she garnered) merits some discussion here. This 3-year-old female (84 kg at capture) was captured on the first day of operations, September 10, 2018 at Klahhane Ridge, and released the next morning (September 11, 2018) at Sutton Lake. Both her capture and release were uneventful. On September 19, a Cedar River Watershed employee photographed her on a low-elevation bridge, and noted that she appeared headed west. By September 27, 2018, she had arrived at the Rattlesnake Lake Recreation Area, operated by Seattle Public Utilities, approximately 26 km (16 miles) from her release site, and was using a prominent cliff face called Rattlesnake Ledge to rest and provide escape terrain. This goat quickly became the object of fascination and curiosity because the Recreation Area has popular hiking trails, the ledge itself is a common hiking destination, and because she was habituated to people (i.e., having lived her entire life near popular hiking trails she did not react to people, either positively or negatively, Fig. 19). We received at least one report from the public of her “following” a hiker, but the judgement of those familiar with goats was that she showed no aggressiveness, nor did she elicit particular interest in humans as a source of salt or food. Rather, our assessment is that she simply did not mind being around people, and her use of trails was independent of human use. When provided gentle negative stimulus, she retreated.

By the first week of October, it became clear that her continued presence at Rattlesnake Ledge risked a bad outcome, and the Seattle Public Utilities, the Muckleshoot Tribe, and WDFW agreed to plans to capture her using ground darting, and to move her to a more distant location. Following ground reconnaissance during the first week of October, a team of WDFW and MIT biologists attempted to capture her using ground darting on October 5. Although they had no trouble locating her, they were unable to move her to a position where she could be safely immobilized. The following day being a Saturday, the decision was made to wait until Monday, October 8, to make another attempt. However, her GPS collar indicated that on Sunday, October 7, she had begun moving in an easterly direction, away from Rattlesnake Ledge, and in the

direction of her release. Within a few days, she had moved all the way back to the area of her release (near Goat Mountain), about 16 miles from Rattlesnake Ledge, where human presence is uncommon. To date, she has remained in this general area, and has begun traveling with other released goats. We have no biological explanations either for her movement to Rattlesnake Ledge, her temporary sojourn there, or her return to the release site, except to note that had it not been for the ease with which she was observed by members of the public, her movements and behavior would not have been considered extraordinary in the context of the other 69 animals we followed during this time. However, her temporary presence in a high-use hiking area caused us to consider relocating her to less populated area, simply to avoid concerns from the public during the early stages of the relocation project.



Figure 19. Nanny 4940, who during September 26 to about October 7, made a temporary home for herself on Rattlesnake Ledge in the Rattlesnake Lake Recreation Area (operated by Seattle Public Utilities), near North Bend, WA. Because she was already habituated to people and the trail is popular with day-hikers, many such photographs were taken. WDFW and Muckleshoot Tribe biologists attempted to capture her, but she evidently had other plans, and moved back to the release site, ~ 16 miles away, where she has remained since that time.

4. c. Discussion

Previous translocations of mountain goats have documented considerable dispersal of animals immediately following release (Fielder and Keesee 1988, Jorgenson and Quinlan 1996), Harris and Steele 2014). We were thus not surprised to see similar behavior among many albeit not all, the released goats. However, visual depictions of goat locations (i.e., from maps) may not reflect how much goats know about each other, or about the terrain separating them. We have already noted instances in which animals seemed to find each other after being separated quite some distance. We also know that at least some of the 6 mountain goats translocated from eastern Oregon into the Cedar River drainage (Harris 2016), although dispersing widely, have evidently found resident animals and produced offspring (D. Vales, Muckleshoot Tribe, personal communication).

At this early stage, it seems likely that some of the translocated goats will live out their lives without forming new, or joining existing social groupings. However, we remain optimistic that many will find each other, begin producing offspring, and form the nucleus of new, or newly enlarged, breeding groups.

5. Preliminary plans for 2019

The second and third round of translocations are planned for July 8-20, and August 19-31, 2018. Unlike in 2018, we will stage captured goats from 2 areas: 1) In Olympic National Park, primarily at Hurricane Ridge as in 2018, and 2) on the Olympic National Forest, at the Hamma Hamma Gravel Pit in July, and at the Mt. Ellinor trailhead in August. Adding a second staging area on the Olympic Peninsula will facilitate capturing goats in the southern and southeastern portion of the distribution. We anticipate using Thiafentanil as the primary opioid anesthetic when darting goats for capture; net-guns will also be employed. Ten larger-sized crates are being built specifically to transport large billies.

Pending final affirmation of the USFS ROD (finalized on December 10, 2018), mountain goats will be released in up to 8 additional sites identified in the FEIS, 7 of which are in designated wilderness. We may have opportunity in 2019 to use a larger helicopter than in 2018. Because it can ferry our entire field crew at once and hoist more goats per trip, we expect to

require fewer round-trips, less time during the release process, and thereby further minimize our disturbance to wilderness values. As in 2018, most animals will be equipped with GPS-transmitting telemetry collars (except for some young kids, who will wear VFH-only, expandable, drop-off collars). In 2018, we experienced difficulty equipping yearling-aged mountain goat with telemetry equipment of the appropriate size and weight. We anticipate that new collars being built for us will lessen this problem in 2019, and thus expect to monitor yearlings as well. As in 2018, kids who cannot be confidently matched with captured mothers, will be provided to the consortium of zoos, and temporarily housed at Northwest Trek. In some cases, we will revisit some of the translocation sites used in 2018 if it appears that additional animals will increase the probability of long-term success.

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