National Park Service
U.S. Department of the Interior

Natural Resource Stewardship and Science

Evaluation of Fisher (*Pekania pennanti*) Restoration in Olympic National Park and the Olympic Recovery Area

2016 Final Annual Progress Report

Natural Resource Report NPS/OLYM/NRR—2017/1531

ON THE COVER
Fisher visiting remote camera station in Olympic National Forest.
Photograph courtesy of the National Park Service.

Evaluation of Fisher (*Pekania pennanti*) Restoration in Olympic National Park and the Olympic Recovery Area

2016 Final Annual Progress Report

Natural Resource Report NPS/OLYM/NRR—2017/1531

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October 2017

U.S. Department of the Interior
National Park Service
Natural Resource Stewardship and Science
Fort Collins, Colorado

The National Park Service, Natural Resource Stewardship and Science office in Fort Collins, Colorado, publishes a range of reports that address natural resource topics. These reports are of interest and applicability to a broad audience in the National Park Service and others in natural resource management, including scientists, conservation and environmental constituencies, and the public.

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All manuscripts in the series receive the appropriate level of peer review to ensure that the information is scientifically credible, technically accurate, appropriately written for the intended audience, and designed and published in a professional manner. Data in this report were collected and analyzed using methods based on established, peer-reviewed protocols and were analyzed and interpreted within the guidelines of the protocols. This report received formal peer review by subject-matter experts who were not directly involved in the collection, analysis, or reporting of the data, and whose background and expertise put them on par technically and scientifically with the authors of the information.

Views, statements, findings, conclusions, recommendations, and data in this report do not necessarily reflect views and policies of the National Park Service, U.S. Department of the Interior. Mention of trade names or commercial products does not constitute endorsement or recommendation for use by the U.S. Government. This paper has been peer reviewed and approved for publication consistent with U.S. Geological Survey Fundamental Science practices (http://pubs.usgs.gov/circ/1367/).

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Please cite this publication as:

Happe, P. J., K. J. Jenkins, T. J. Kay, K. Pilgrim, M. K. Schwartz, J. C. Lewis, and K. B. Aubry. 2017. Evaluation of fisher (Pekania pennanti) restoration in Olympic National Park and the Olympic Recovery Area: 2016 final annual progress report. Natural Resource Report NPS/OLYM/NRR—2017/1531. National Park Service, Fort Collins, Colorado.

NPS 149/140396, October 2017

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Conversion Factors

Inch/Pound to SI

Parameter	Multiply	By	To obtain
Length	foot (ft)	0.3048	meter (m)
	mile (mi)	1.609	kilometer (km)

SI to Inch/Pound

Parameter	Multiply	By	To obtain
Length	meter (m)	3.281	foot (ft)
	kilometer (km)	0.6214	mile (mi)
Area	square kilometer (km^2)	247.1	acre
	square kilometer (km^2)	0.3861	square mile (mi^2)
Mass	gram (g)	0.03527	ounce (oz)

Executive Summary

With the translocation and release of 90 fishers (*Pekania pennanti*) from British Columbia to Olympic National Park during 2008–2010, the National Park Service (NPS) and Washington Department of Fish and Wildlife (WDFW) accomplished the first phase of fisher restoration in Washington State. Beginning in 2013, we initiated a second phase of the project to determine the status of fishers on Washington's Olympic Peninsula 3–8 years after the releases and to further evaluate the short-term success of the restoration program. Objectives of the study are to determine the current distribution of fishers and proportion of the recovery area that is currently occupied by fishers, genetic characteristics of the reintroduced population, and reproductive success of the founding animals through genetic studies. This was the final year of the study. In this report we summarize field accomplishments during the final year of field work (2016) and summarize data collected from 2013-16. We are currently analyzing the complete data set for a series of publications that will comprise the final reporting and interpretation of the current fisher status on the Peninsula.

During 2016, we continued working with a broad coalition of cooperating agencies, tribes, and non-governmental organizations (NGO) to collect data on fisher distribution and genetics using non-invasive sampling methods. The sampling frame consisted of 775 24-km^2 hexagons (hexes) distributed across all major land ownerships within the Olympic Peninsula. From this frame we selected 157 hexes for sampling fisher presence within a target survey area that comprised the majority of the peninsula where the reintroduced fishers initially established home ranges. Additionally we selected 59 hexes for potential sampling in an expansion area where fishers were likely to expand their range. During 2016, federal, state, tribal and NGO biologists and volunteers established three motion-sensing camera stations, paired with hair snaring devices, in 82 hexes (68 in the target area and 14 in the expansion areas). An additional 20 hexes were sampled in 1) a pilot study of fisher density (10 hexes), and 2) a follow-up of fishers detected on a companion coastal marten study during the winter of 2015-2016 (10 hexes), providing additional information on fisher presence.

Each paired camera/hair station was left in place for approximately 6 weeks, with three checks on 2-week intervals. We documented fisher presence in 11 of the 82 hexes sampled as part of the fisher occupancy study in 2016. In two hexes we detected two different fishers. Ten fishers were identified through microsatellite DNA analyses. The 10 identified fishers included 3 of the original founding population of 90 translocated fishers and 7 new recruits to the population. Three additional fishers were detected with cameras but not DNA, consequently their identities were unknown. For the first time since initiating this study in 2013, we detected presence of fishers in the expansion area. Additionally, we identified fishers in 7 of the 10 hexes added for the density pilot and 6 of the 10 hexes added for the winter marten study follow-up. In those two efforts we identified 4 additional fishers that were not detected in the occupancy study. While conducting the occupancy study we also detected 46 other species of wildlife at the baited camera stations. We also obtained 5 additional confirmed records of fishers in the study area through photographs provided by the public, other researchers, and incidental live capture.

Over the 4 years of study, we sampled for fishers in 179 hexes as part of the fisher occupancy study; 143 in the target area, and 36 in the expansion area. One hundred and fifteen (80%) of the hexes in the target area were sampled twice (at a 2 year interval) and 2 were sampled 3 times. All but two of the hexes in the expansion area were sampled only once.

During 2017 we plan to synthesize and analyze the data, prepare peer-review publications, assist with continuing fisher studies conducted by partners (both on the Olympic Peninsula and elsewhere in Washington State), and seek funding for more detailed genetic analysis of the samples gathered during this study.

Acknowledgments

This project was funded principally through grants from the National Park Service Natural Resource Preservation Program (NRPP) to Olympic National Park, the U.S. Fish and Wildlife Service (USFWS) Recovery Program to U.S. Geological Survey (Forest and Rangeland Ecosystem Science Center), and the USDA Forest Service-Olympic National Forest (ONF). Several agencies and Tribes, including the following, provided indispensable in-kind support for field work (biologist salaries, supplies, and vehicles): Lower Elwha Klallam Tribe, Makah Tribe, ONF, Olympic National Park, Point-no-Point Treaty Council, Quileute Tribe, Skokomish Tribe, Quinault Nation, Washington Department of Fish and Wildlife, Washington Department of Natural Resources (WDNR), U.S. Geological Survey, Jefferson Land Trust.

This project would not have been as successful in 2016, without the help of many people. About one-third of the sampling in 2016 was completed by project partners. We want to thank (in no particular order) S. Murphie from the Makah Tribe; B. Ackerman, M. Ackerman, S. Miller, K. Cagey, B. James from the Skokomish Tribe; W. Michaelis, A. McMillan, B. Murphie, J. Becker, and S. Ament from WDFW; T. Cullinan from Point-no-Point Treaty Council; C. Godbolt from the Port Gamble S'Klallam Tribe; S. Horton and J. Hanawalt from WDNR; G. Rasmussen, P. Black, and D. Sampson from the Quileute Tribe; K. Sager-Fradkin, D. Manson, M. Sheldon, C. Macias, S. Cendejas-Zarelli, and K. Kaufman from the Lower Elwha S'Klallam Tribe; L. MacFarland from the Quinault Nation; C. Clendaniel, C. Jones, D. Gaulin, D. Rugh, D. Stockment, and J. Gardner from the Jefferson Land Trust; T. Kay, M. Murphy-Williams, M. Sagers, A. Sengsirirak, K.L. Hill, P. Colburn, E. Graham, M. Calloway, A. Albert, and M. Soap from the NPS fisher crew; A. Hokit, L. Platt, C. Grattan, and S. Gremel from other NPS crews that helped out when really needed.

In 2016 we had a lot of support from private and other landowners, who allowed us to set up cameras on their lands, or the lands they manage. This assistance greatly enhanced our research. We would like to thank Christina Vestal from the Rayonier Corporation, Green Diamond Resource Company, Blake Murden at Port Blakely Tree Farms, Tom Swanson at Green Crow, and Norm Schaaf at Merrill & Ring for all their help.

Big thanks go out to Betsy Howell, ONF, for providing up-to date maps for access on National Forest lands, and for arranging housing for the crew in the USFS Bunkhouse, and to Susan Piper, ONF, for arranging funding that has allowed us to expand survey effort appreciably. We thank Jody Tucker, USFS Rocky Mountain Research Station (RMRS), for consulting on several aspects of this study. Lastly, we would also like to thank the communications, ranger, and trail crew (packer) staffs at Olympic National Park for providing so many necessary logistical and safety supports of our field operations.

2016 NPS and USGS fisher team. From left to right: A. Albert, K. Jenkins, T. Kay, P. Colburn, A. Sengsgiriak, M. Soap, K. L. Hill, M. Sagers, M. Calloway, M. Murphy-Williams, L. Graham, and P. Happe.

Background and Study Objectives

The fisher, *Pekania pennanti*, once occupied coniferous forests at low to middle elevations throughout much of the Western United States, but was extirpated from Washington State during the last century. The fisher was listed as a State endangered species in October 1998. In 2006 Washington State developed a Fisher Recovery Plan, with a goal of establishing multiple self-sustaining fisher populations in Washington (Hayes and Lewis 2006). The West Coast Distinct Population Segment of fishers was proposed for listing as threatened by the U.S. Fish and Wildlife Service in 2014 (U.S. Fish and Wildlife Service 2014). In 2016, the USFWS decided that listing was not warranted at that time and withdrew the proposed rule (U.S. Fish and Wildlife Service 2016).

In 2007, the NPS and WDFW completed a Fisher Reintroduction Plan and Environmental Assessment for Olympic National Park (National Park Service 2007). The goal of that effort was to restore fishers to Olympic National Park (ONP) and Washington State. The project was designed to take up to 10 years to complete, and to be conducted in two phases. During Phase 1, 90 fishers were translocated from central British Columbia to the Olympic Peninsula from 2008 to 2010, and the initial success of the reintroduction was monitored by radio-tracking translocated fishers (2008–2011). Data were collected on post-release survival, movements, home-range establishment, and reproduction. Initial findings indicate that survival was highly variable among release years (Lewis 2014). In addition, access constraints in a large wilderness area prevented the reliable determination of breeding success for most of the released females, creating additional uncertainties about the current status of reintroduced fishers on the Olympic Peninsula.

The need for a second monitoring phase, consisting of non-invasive surveys of fisher distribution, was identified in both the State and Federal fisher recovery planning efforts (Lewis 2006; National Park Service 2007). The goal of Phase 2 of the fisher monitoring in the Olympic Recovery Area is to evaluate the status of reintroduced fishers on the Olympic Peninsula from 2013–2016. Specific objectives are to:

1. Determine the proportion of potential habitat occupied by fishers on the Olympic Peninsula,
2. Determine the genetic diversity and effective population size of the reintroduced fisher population,
3. Determine the minimum number of fishers known to be alive on the Olympic Peninsula,
4. Estimate the reproductive success of the released fishers and their known progeny, and
5. Determine if the population has experienced a genetic bottleneck.

Results of the first three years of the study (i.e. the 2013-2015 field seasons) were summarized by Happe et al. (2014, 2015, and 2016). In this report we summarize field accomplishments during the final year of field work (2016) and summarize data collected from 2013-16. We are currently analyzing the complete data set for a series of publications that will comprise the final reporting and interpretation of the current fisher status on the Peninsula.

Research Accomplishments

In 2016 we completed the final year of Phase 2 of the Olympic Fisher project, and brought to completion the primary field-data collection tasks identified in the Olympic National Park Fisher Reintroduction Plan (NPS 2007). Sampling design and methods followed those contained in the protocol developed during Phase 1 (Jenkins and Happe 2013) and used during the 2013, 2014, and 2015 field seasons (Happe et al. 2014, 2015, 2016).

In addition to completing the initial 2013-16 sampling goals, we also conducted two companion projects in 2016. Firstly, in the winter of 2015-2016 we collaborated with the U.S. Forest Service in conducting camera surveys aiming to document presence of Pacific martens (*Martes caurina*) on the Olympic coast (Moriarty et al. 2016). Although we did not detect any marten, we did detect fishers at 51% of the stations. In the fall of 2016 we resampled sites where fishers were detected in the winter, but where fisher DNA was not obtained (10 hexes), in order to improve our evaluation of fisher genetic status (Objectives 2, 4, and 5). Secondly, we initiated a pilot study to examine the feasibility of estimating density of fishers from camera surveys. The density pilot study was a direct extension of our fisher occupancy monitoring protocol, involving an intensified sampling effort. The goal of the density pilot was to address our third objective – determining the minimum number of fishers on the Olympic Peninsula. Fishers detected in either the winter marten survey, fall marten study re-sample, or the density pilot study are reported as incidental observations in this report.

Prior to the start of the 2016 field season we polled wildlife biologists working for state, federal and tribal agencies on the Olympic Peninsula to determine the level of continued interest in participating with the ongoing fisher surveys. We reported the results from the 2015 field season, reviewed the protocol, and made plans for 2016 during the annual meeting of Olympic Peninsula Wildlife Technical Group. Biologists from ONF, WDFW, WDNR, Makah Tribe, Quileute Tribe, Quinault Nation, Lower Elwha Klallam Tribe, Point no Point Treaty Council, Skokomish Tribe, and Jefferson Land Trust indicated that they would like to participate in the 2016 field sampling effort. Throughout the year the NPS and USGS continued to coordinate sampling efforts with all cooperators, provided most of the equipment (with the exception of bait and batteries), collated and processed photographic images and data, and assured that all hair samples were sent to our genetic cooperators at the USFS Conservation Genetic lab.

Study Area

Our study area consisted of accessible lands less than 4,700 ft (1,435m) in elevation within a target survey area and an expansion area. We defined accessible lands as lands that can be safely accessed on foot, and in the case of private and tribal lands, where access was permitted by the landowner. The target survey area consists of lands on Washington's Olympic Peninsula where most of the translocated fishers established their initial home ranges following their release, which excluded the Quimper Peninsula and other lands in the northeast and areas south of the USFS boundary (Figure 1). The expansion areas were defined as lands where the fisher population may have colonized if the population expanded, and included the Quimper Peninsula and other lands to the northeast and lands south of Olympic National Forest.

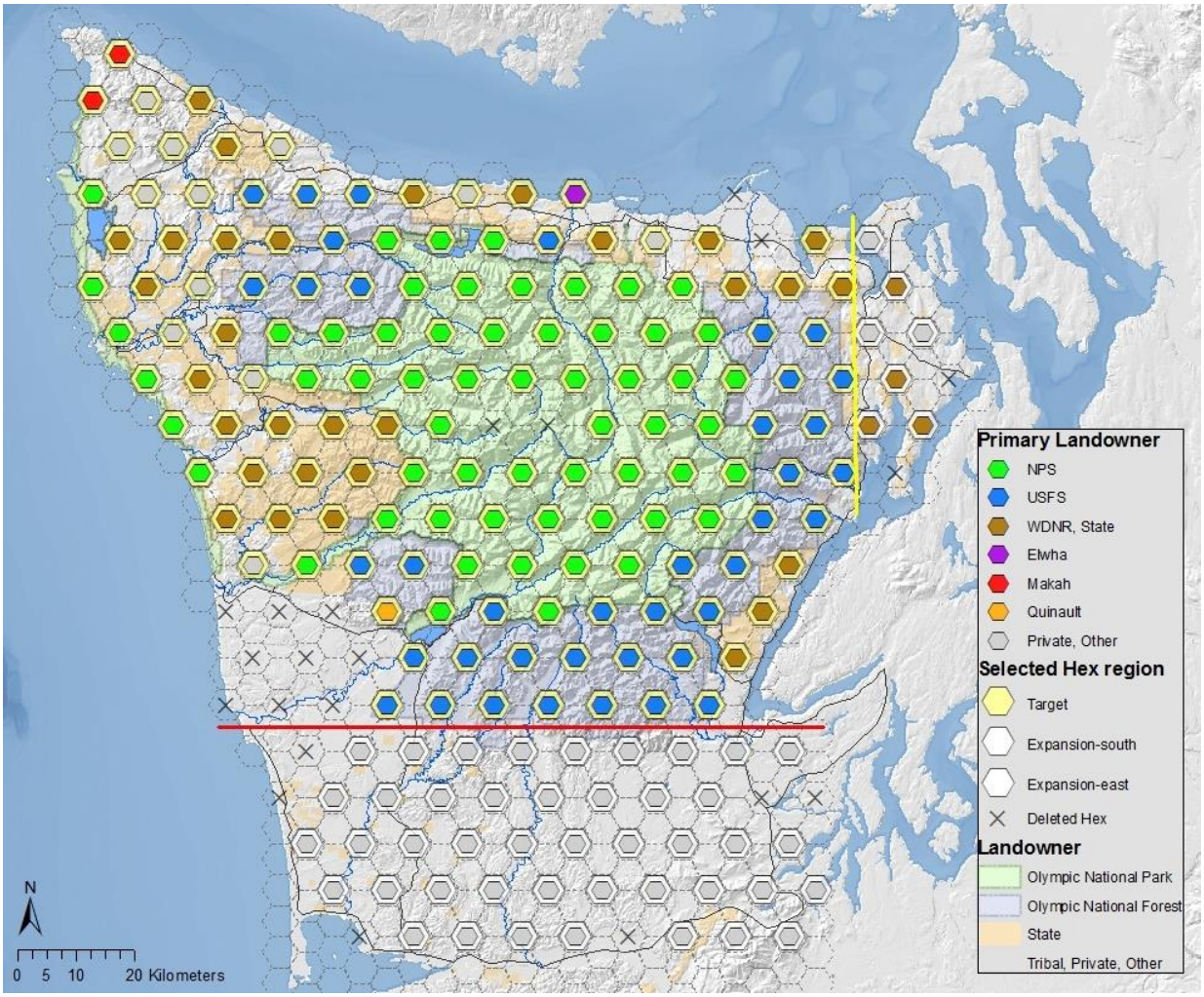

Figure 1. Sampling frame depicting all potential 24-km^2 hexagonal sampling units on Olympic Peninsula, and (in shaded hexes) the systematic sample of hexes selected for surveys north of State Highway 12. The target survey area includes the Olympic Peninsula (hexes with yellow outline) lands north of the horizontal red line) and excludes the Quimper Peninsula and other lands in the northeast (lands east of the vertical yellow line). The expanded survey area (hexes with white outline), designed to detect population expansion outside the target area, includes lands south of the horizontal red line and east of the vertical yellow line. Landowners are Washington Department of Natural Resources (WDNR), Lower Elwha S'Klallam Tribe (Elwha), Makah Tribe (Makah), Quinault Nation (Quinault), National Park Service (NPS), Private, and U.S. Forest Service (USFS).

Twenty-one hexes within the target and expansion areas were removed from the sampling frame by the end of 2016 (Figure 1). Ten hexes were removed from consideration on the Quinault reservation, as we did not have permission to work in that area. Eleven additional hexes were removed due to access and habitat limitations (2 that include portions of Mt. Olympus and have very little forested habitat below 4,700 feet that is safely accessible, and 9 on private lands which either do not contain enough fisher habitat to put in 3 stations, or we did not get permission to access).

The primary sampling units consisted of 24-km^2 hexagonal cells (hexes) [approximately the size of a core area used by female fishers in the study area (Lewis 2014)]. Using a randomly selected starting point, we selected every other hex for sampling, resulting in 216 hexes selected for sampling out of a total 775 hexes in the sampling frame; 157 selected hexes were in the target area, and 59 were in the expanded survey areas (50 south of the target area and north of State Highway 12, and 9 on the northeast part of the Peninsula (Figure 1). Within the target area, hexes occurred entirely or predominantly on lands managed by ONP (n=60), ONF (n=39), Washington State (n=30), Native American Tribes (n=14), private landowners (n=13), and the U.S. Fish and Wildlife Service (n=1). In the expansion area lands are primarily under private ownership.

We used a Generalized Random Tesselation Stratified (GRTS) sampling scheme to assign a random sampling order for each hex (U.S. Environmental Protection Agency 2011). Each partner selected the grouping of hexes in their area that they would try to sample from 2013-2016, and sampled them approximately in the random sampling order.

Methods

Within each hex we established three sampling stations in suitable fisher habitat (Jenkins and Happe 2013), with each station preferably at least 1 km apart (Figure 2). Suitable fisher habitat was defined as mid- to late-seral forests, or forested stands that most closely matched those conditions within each hex. Each station contained a motion-sensing camera and a hair-snaring device for collecting DNA. Our primary cameras were the Bushnell® Trophy Cam HD and Bushnell® Aggressor, both of which were equipped with a black LED flash. The hair snaring device was a triangular cubby box baited with a chicken drumstick and equipped with six gun-brushes attached to the inside walls, three near each entrance. The camera was focused on both the chicken bait affixed to a tree and the triangular cubby box (Figure 3). On the front of the bait tree we placed approximately 1 teaspoon of Caven's Gusto long-distance call lure (Minnesota Trapline Products, Inc., Pennock MN) to attract fishers. In 2016 we applied Gusto to a clump of moss that was protected under a small rain shield placed above the bait and placard. Following set up, field crews visited each station three times, with 14-day intervals between visits, resulting in 6 weeks of sampling within each hex. This design resulted in a hex being sampled for a total of nine station-visit events (that is, each of three sampling stations sampled for three 14-day intervals [visits]. The study design allowed for three 6-week sampling sessions (spring, summer, and fall) between May 24 and November 1, 2016. Hexes assigned to the 2016 sampling year were allocated to one of the 3 sampling sessions, based on seasonal accessibility constraints and logistical efficiencies (Jenkins and Happe 2013).

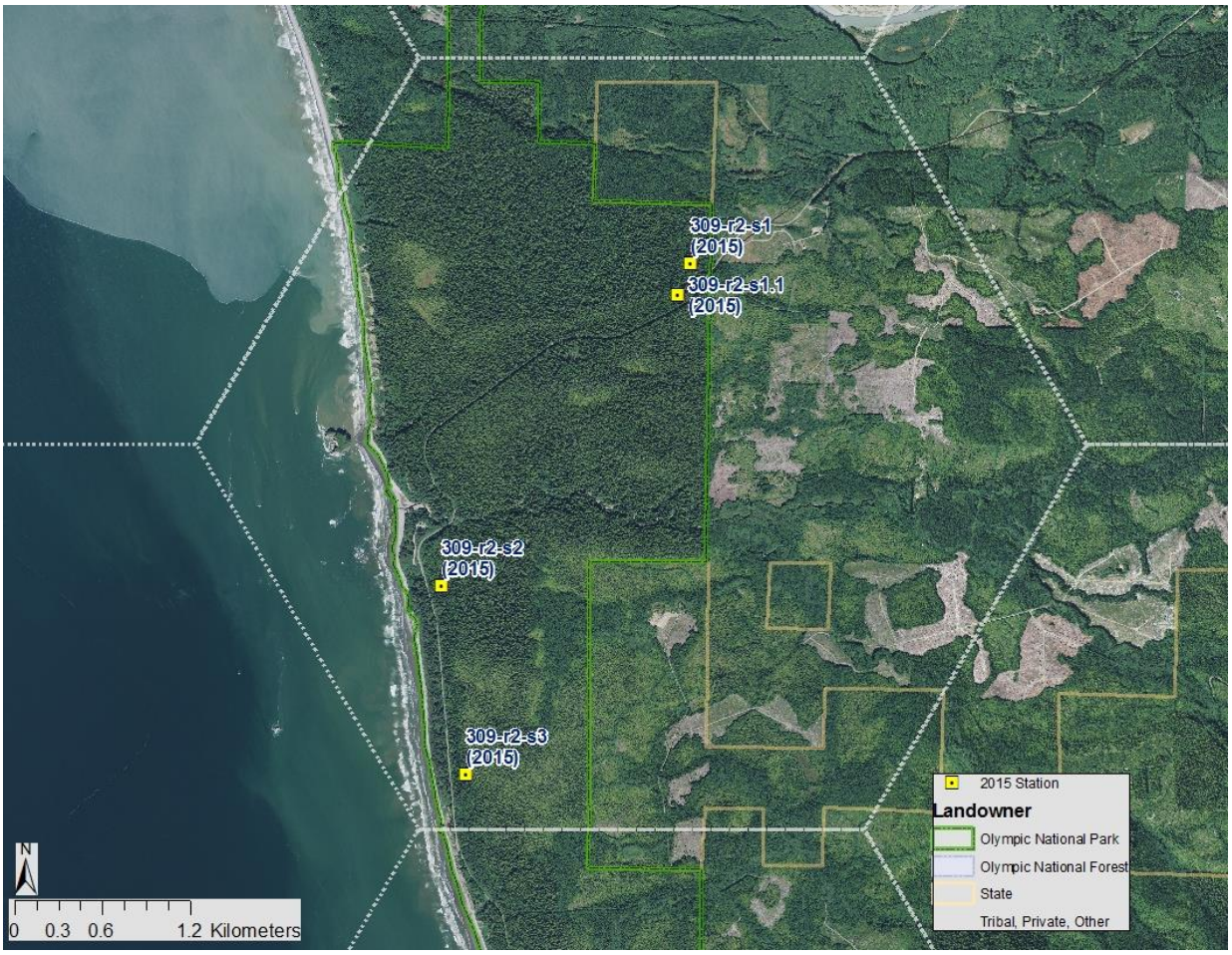

Figure 2. Example of locations of stations in a hex. Fishers were detected in this hex in 2013, 2015 and 2016. In 2015 station 1 had to be moved due to interference by black bears (309_r2-s.1 and s 1.1).

Figure 3. Field-crew member setting up a station within Olympic National Forest (Hex 234 Station 1). Note camera (circled in red) on left of frame is pointing to tree bait (yellow circle) and baited cubby box (blue circle) on the right of the frame. Above the tree bait is a placard indicating the Hex and station (white rectangle), with the Gusto call lure attached to the tree above the placard (green circle) (NPS Photo).

We modified field sampling methods for the two companion studies in 2016. For the density pilot survey, survey methods within each hex were identical to those for the standard occupancy survey (i.e., we sampled at 3 camera stations per hex, each visited three times on 14-day intervals). We intensified sampling effort, however, to comprise a block of contiguous hexes by adding 10 additional hexes to those sampled in 2014 (Figure 4). The pilot study area was chosen to include a cluster of fishers observed in four hexes in 2014 in the southeast portion of the target study area (Figure 4). To accommodate the intensified sampling density, all camera stations were at least 1 km apart both within and between adjacent hexes.

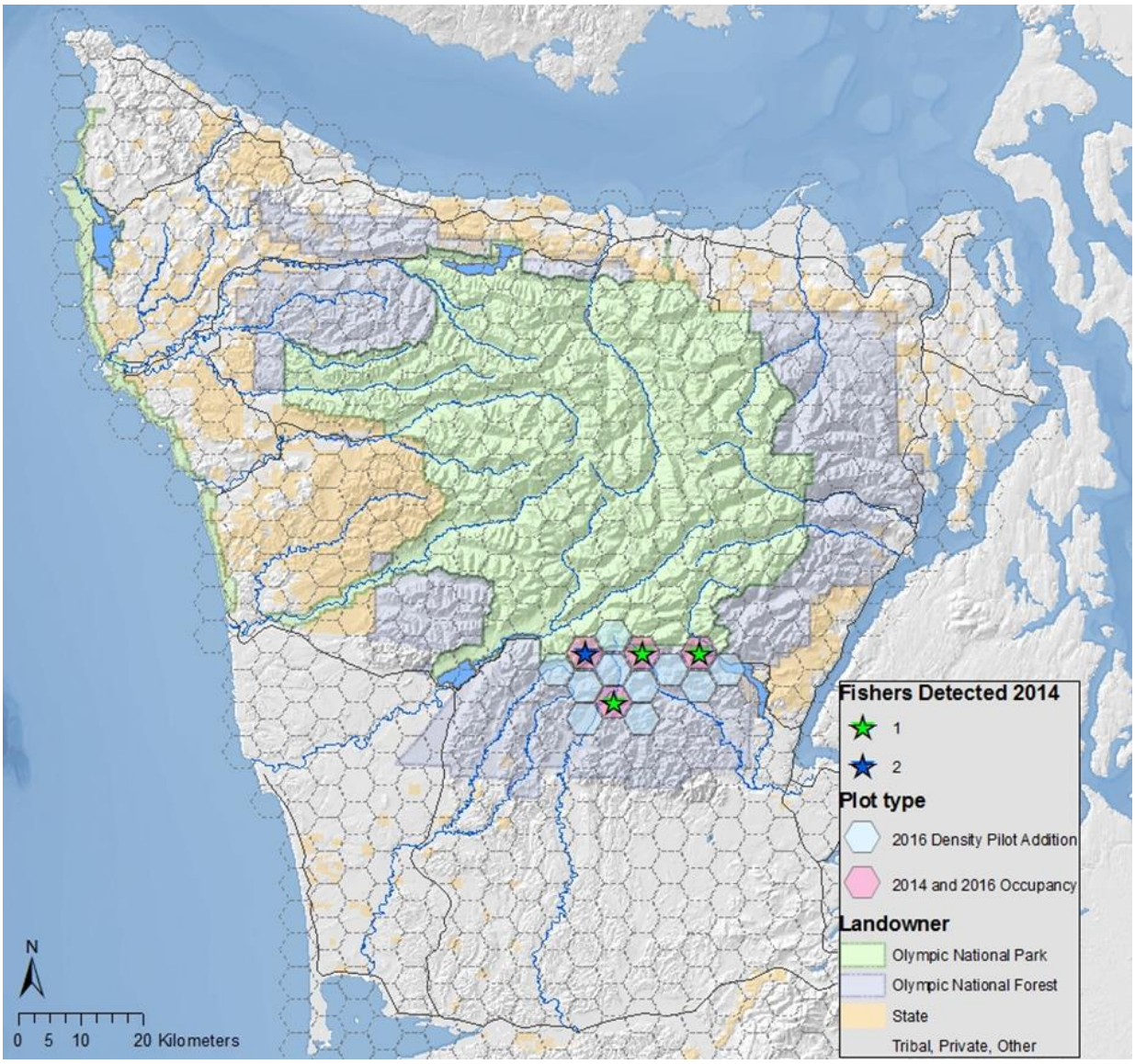

Figure 4. 2016 southeastern Olympics fisher density pilot study. Shown are location and number of fishers detected in the occupancy study in 2014 (stars), hexes sampled for the occupancy study in 2014 and 2016 (rose shaded hexes), and hexes added to the sample frame in this region in 2016 (blue hexes) for the density study.

During the winter of 2015-2016, staff from the USFS deployed 85 cameras in 44 sampling units along the Olympic coast in search of martens. Their sampling scheme differed from ours in several ways: 1) sampling units were distributed up and down the coast at 1 km intervals when access allowed; 2) in most units, pairs of camera stations, approximately 100-200 m apart, were deployed; 3) two baits –chicken and cat food, were used at each station; 4) no hair snares were deployed; 5) stations were deployed for approximately 90 days; 6) most stations were checked only once at the end of the interval. Although the winter coastal marten survey yielded no detections of martens, it did produce detections of fishers at 43 camera stations and at 25 of 44 sampling clusters (Figure 5). USFS staff were only able to follow up in the spring with hair snares at a few sites, most of which

were deployed for only a week. In that effort, they collected fisher hair samples at 3 sites and we identified two fishers through genetic analysis (Figure 5). In the fall of 2016 we re-surveyed a sub-sample of 15 marten study units (distributed in 10 hexes) where the USFS crew detected fishers, in an attempt to get genetic information on the fishers that they detected. We deployed only one camera and hair snare per sample unit, and did not sample in areas where they previously obtained genetic material (Figure 5). Sampling methods generally followed that of our occupancy study; however, there were only 1-2 stations per hex, sampled hexes were often adjacent (Figure 5), and not all stations were sampled for 6 weeks.

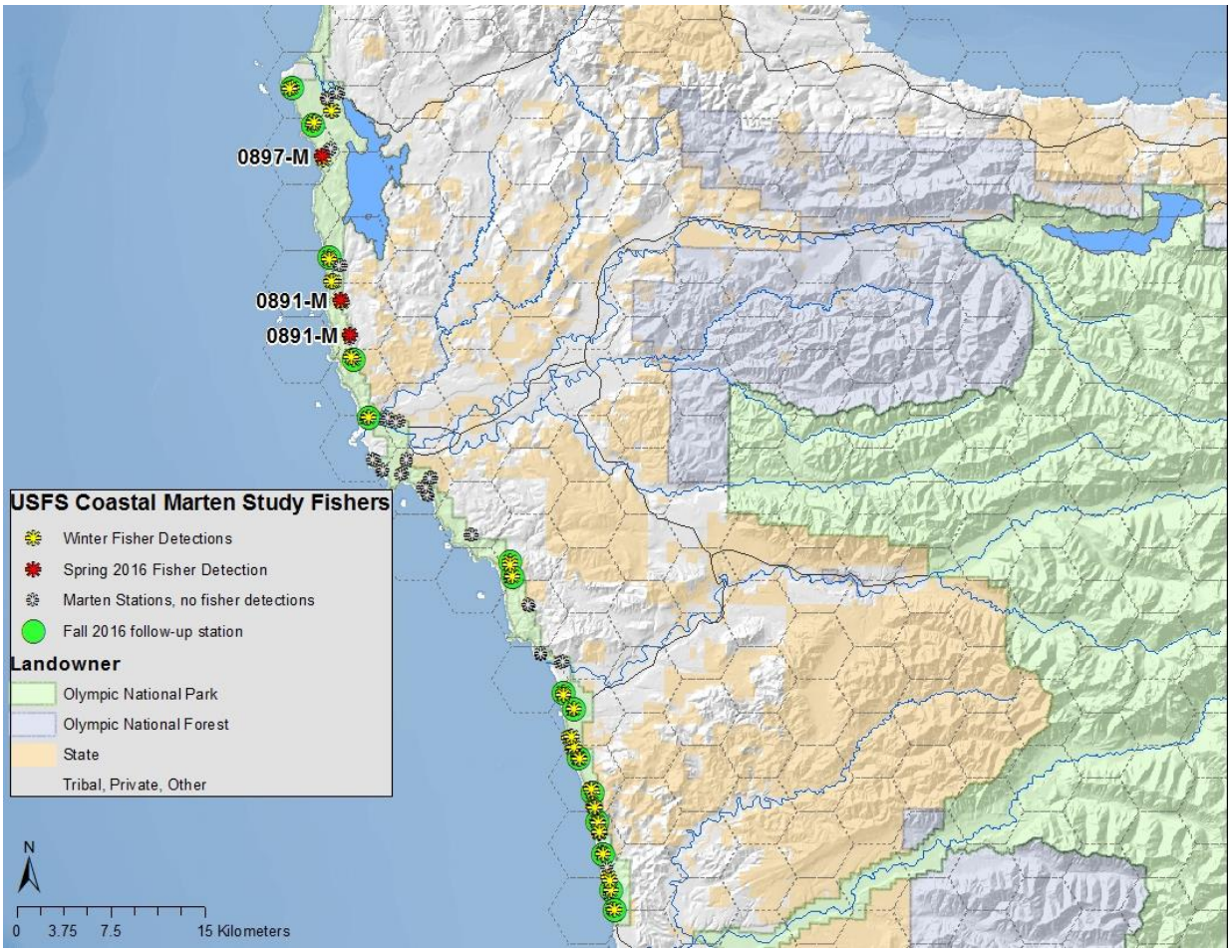

Figure 5. Station distribution and fishers detected in the USFS-led coastal marten study (winter 2015-2016). Shown are locations where fishers were detected but no DNA obtained (yellow asterisk) no fishers detected (gray asterisk) and where follow-up sampling in the spring obtained fisher DNA (red asterisk). Labels are fisher ID as determined from genetic analysis. Stations re-sampled in the fall of 2016 to obtain genetic information are indicated with large green dots.

Sampling Effort

In 2016, we sampled 82 hexes for the occupancy study, including all 68 hexes in the target area that were sampled in 2014. In addition we sampled 11 new hexes in the southern expansion area, and 3 hexes in the east, two off which were a re-sample (Figure 6).

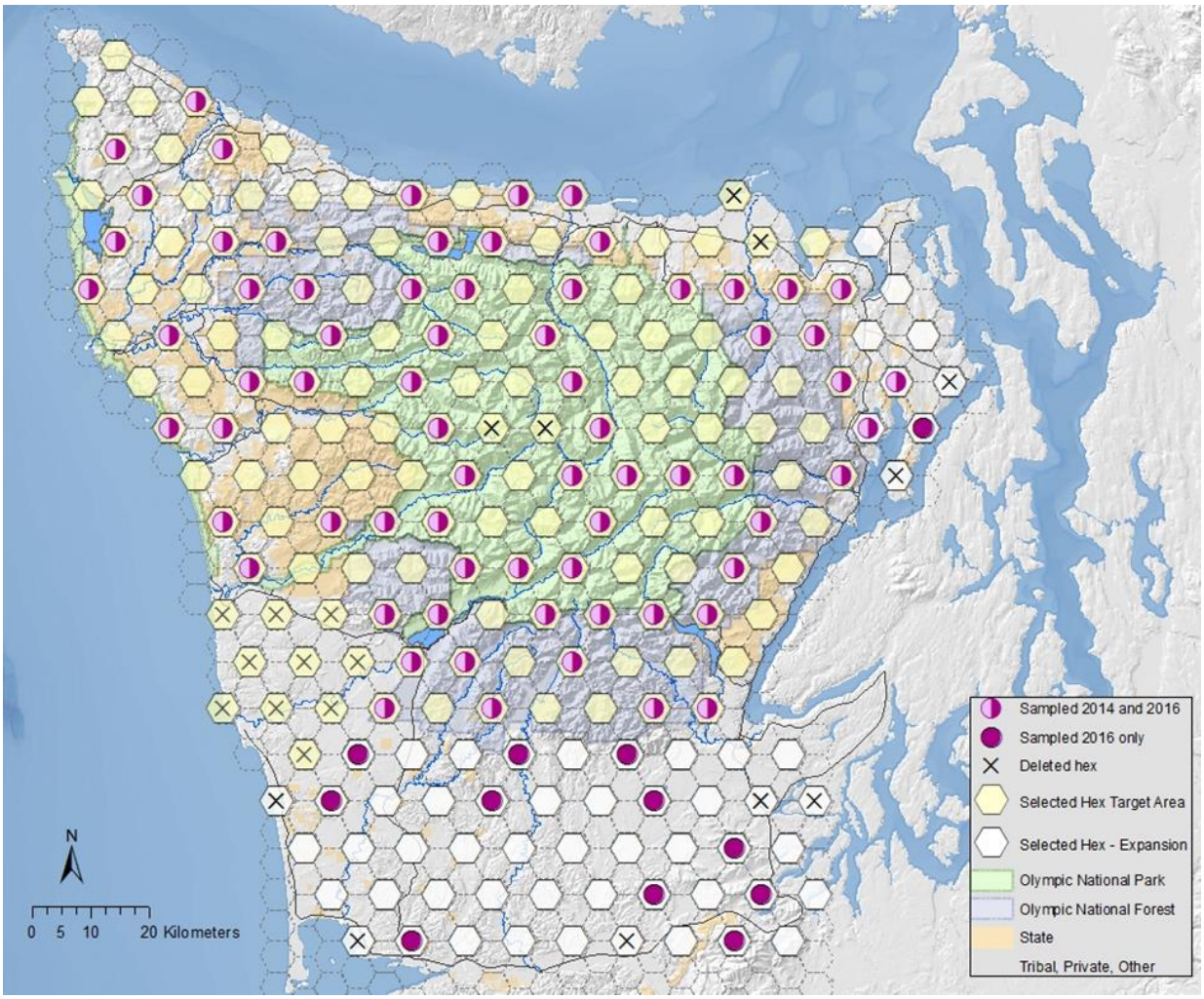

Figure 6. The sample frame, landownership, and location of hexes selected for sampling (all years combined) in the target area (yellow-shaded hexes) and expansion areas (white-shaded hexes). Landownership is indicated on the base map (green= NPS, blue=USFS, orange=State, grey= private, tribal and other landownerships). Hexes sampled in 2016 are indicated with a solid maroon dot if they were sampled in 2016 for the first time, and with a split pink and maroon dot if they were sampled first in 2014 and resampled in 2016. Deleted hexes contain an X.

From 2013-2016, 179 hexes were sampled for the occupancy study. In the target area we sampled all 143 accessible hexes; 26 hexes were sampled once (only in 2015), 115 hexes were sampled twice (49 in 2013 and 2015, 66 in 2014 and 2016), and two hexes were sampled three times (2013, 2014, and 2016 due to incomplete sampling in 2013). In the expansion areas 36 hexes were sampled between 2014 and 2016, 6 on the Quimper Peninsula and lands to the east, and 30 south of the target area (Figure 7). In the expansion area 34 of the hexes were sampled only once.

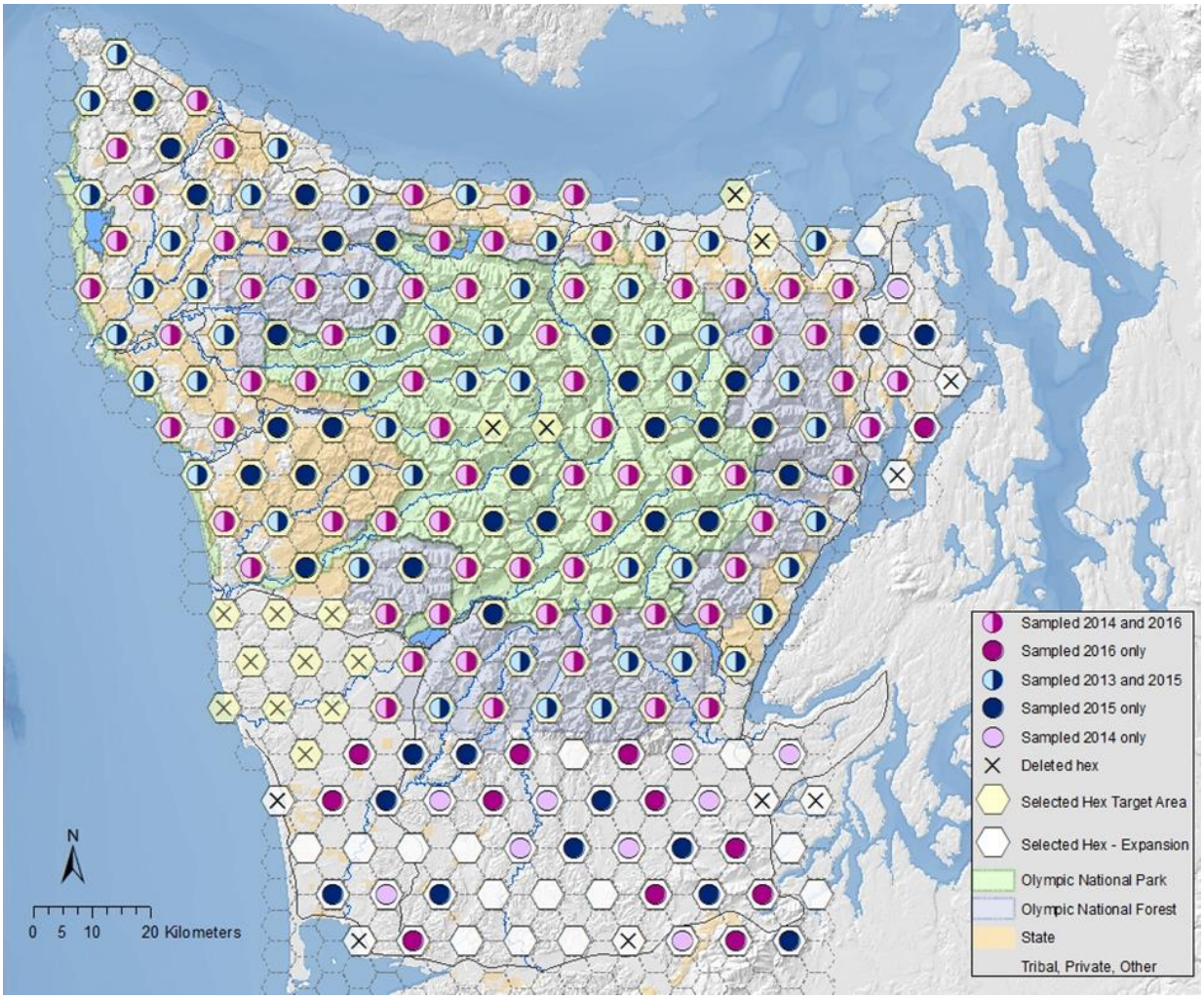

Figure 7. The sample frame, landownership, and location of hexes selected for sampling (all years combined) in the target sample area (yellow-shaded hexes) and expansion areas (white-shaded hexes). Landownership is indicated on the base map (green= NPS, blue=USFS, orange=State, grey= private, tribal and other landownerships). Hexes sampled in 2016 are indicated with solid maroon dot if they were sampled in 2016 for the first time, and with a split pink and maroon dot if they were sampled first in 2014 and resampled in 2016. Hexes sampled in 2015 are indicated with a solid dark blue dot if they were sampled in 2015 for the first time, and with a split dark and light blue dot if they were sampled first in 2013 and resampled in 2015. Hexes sampled in 2014 only are indicated with a solid pink dot. Deleted hexes contain an X.

Landownership of hexes sampled for the occupancy study in 2016 varied: 28 (34 %) were on federal lands, 1 (1%) on state lands, 8 (10%) on a mosaic of federal and state lands, 8 (10%) on private or tribal lands, and the remainder on lands with mixed ownership, including private, tribal, federal, land trust, and other state lands (Table 1). The diversity of landownerships sampled in 2016 is similar to that sampled in 2014-2016.

Table 1. Landownership of hexes sampled in 2016 in the occupancy study.

Hex primary landownership	Number of hexes sampled
National Park Service (NPS)	19
NPS and Olympic National Forest (ONF)	6
NPS, ONF, and Washington Department of Natural Resources (WDNR), private or tribal	3
NPS, WDNR, and Private or Tribal	5
ONF	9
ONF and WDNR	1
ONF and private or tribal	6
ONF, WDNR, and private and tribal	7
ONF, private and tribal	1
WDNR	1
WDNR and private or land trust	14
WDNR, private, and tribal	2
Private or tribal	8

In 2016, 28 (34%) of the hexes were sampled by project partners; the remaining hexes were sampled by the NPS crew (Table 2). This is similar to the distribution of sampling effort in all years except 2013, when NPS efforts were hampered by the federal budget sequester and 50% of the sampling was conducted by project partners.

Table 2. Lead agencies and number of hexes they sampled, 2016.

Hex lead	Number of hexes sampled
Jefferson Land Trust	2
Lower Elwha Klallam Tribe	4
Makah Tribe	4
National Park Service	54
Quileute Tribe	2
Quinault Nation	2
Skokomish Tribe	3
Washington Department of Fish and Wildlife	6
Washington Department of Fish and Wildlife and Point no Point Treaty Tribes	3
Washington Department of Natural Resources	2

Our sampling protocol specified a 14-day interval between sampling visits. Thus, with 82 hexes sampled, the total sampling effort should have been 738 station/visit events (82 hexes * 3 stations/hex * 3 visits/station). In 2016 we ended up with 743 sampling events (Table 3); the extra sampling events were due to some stations being sampled for a 4th time to compensate for camera malfunction or theft. We averaged 14.4 days between station visits (Table 3). Although 84 percent of the sampling intervals were in our target range of 13–16 days, we did have some outliers. Intervals greater than 16 days were due to challenges with crew scheduling or illness.

Table 3. Station sampling intervals (days) for the 82 hexes sampled in 2016, excluding one outlier. n=742.

Value	Visit	Camera	Bait	Snare
Mean	14.3	13.7	12.2	12.6
Max	46	46	29	46
Min	10	0	0	0
Between 13 and 16 days	84%	80%	65%	60%

[Intervals reported for visits indicate the number of days between station checks. Intervals for camera, bait, and hair snare represent the number of days each device (or bait) was functional, if known, based on date stamps on camera images. The minimum of 0 days was due to camera theft.]

The average sampling interval for remote cameras was 13.7 working days per station/visit; 80 percent of the cameras were functional within our target range of 13–16 days. Twenty-one cameras were functional for no days due to either theft (1), or malfunctioning for the entire interval (20). The causes of malfunctioning cameras included not being turned on (1) or unexplained malfunctions where bait was taken but no pictures taken (19). As the cameras have aged, the amount of unexplained malfunctions has increased.

Baits placed on the tree or in the cubby box (Figure 3) were defined as functional if any chicken (including bones) remained at the end of the sample interval. Tree bait remained functional for an average of 12.2 days; 65 percent were functional for 13–16 days. At 35 percent of the sites, bait functionality was shortened due to consumption by black bears (*Ursus americanus*), spotted skunks (*Spilogale gracilis*), ravens (*Corvus corax),* opossums (*Didelphis virginiana*), domestic dogs (*Canis lupus familiaris*), or fishers before the sampling interval was complete. In some cases, where a station had repeated visits by bears, spotted skunks or ravens, we moved the station between sampling intervals; in some situations, however, it was not possible to move a station.

Hair snares were functional for an average of 12.6 days; 60 percent were functional for 13–16 days. During 48 intervals, however, snare functionality was unknown due to either camera malfunction or unclear pictures. Snare functionality was shortened due to either destruction of the cubby box by bears or consumption of the bait in cubbies by bears, spotted skunks, opossums, or fishers before the sampling interval was complete.

In the majority of hexes, cameras, tree baits, and cubbies were functional for greater than 75 percent of the sampling interval. In 8 hexes, however, cameras and/or tree baits were functional for less than 66 percent of the time, either due to technical problems or bait consumption. In the final analysis we will examine the effects of sampling effort on the probabilities of detection and estimates of site occupancy by fishers.

Fisher Detections in 2016

Remote Cameras

We detected fishers with cameras in 11 of 82 hexes sampled as part of the occupancy study (13.4% of the hexes), nine in the target area and two in the expansion area (Table 4, Figure 8). Two fishers with radio-collars (founders released between 2008 and 2010) were observed in photographic images; in addition one founder who had shed a collar was detected through genetic analysis in hex 507. In three hexes we detected fishers at two stations and on multiple visits. In five hexes fishers were detected only once, and in all those cases only on the last visit. In three hexes (82, 203, 402) we were not able to identify the fisher as the DNA was not of sufficient quality to determine individual identification. However in two hexes (202 and 507) we were able to identify two different fishers through the DNA analysis. In both hexes the fishers came to the same station, and in hex 507 they were there at the same time during one sampling event.

Table 4. Fishers detected by cameras and DNA analysis, 2016.

Study Type	Hex Number	Fisher on Camera	Hair Collected	DNA Amplified	Fisher ID[1]	Sex	Founder	Collar Visible	Number Stations[2]	Number Station-Visits[3]	First Visit[4]
Occupancy study, expansion area	82	yes	yes	no*	–	–	–	no	1	1	3
	106	yes	yes	yes	OPF-0175	male	no	n/a	1	1	3
Occupancy study, target area	135	yes	yes	yes	OPF-1079	male	no		1	1	3
	170	yes	yes	yes	M032	male	yes	yes	1	2	2
	202	yes	yes	yes	M075, M101	male	yes	yes, no	2	3	2
	203	yes	yes	no*	–	–	–	–	1	1	3
	204	yes	yes	yes	OPF-747	female	no	–	2	5	1
	232	yes	yes	yes	OPF-1028	male	no	–	2	4	1
	402	yes	yes	no*	–	–	–	–	1	2	1
	507	yes	yes	yes	M035, OPF-0817	male, female	yes, no	no	1	2	1
	552	yes	yes	yes	OPF-0897	male	no	–	1	1	3
Density pilot study, additional hexes	180	yes	yes	yes	M075	male	yes	yes	1	2	2
	181	yes	yes	yes	M032	male	yes	yes	2	2	1
	190	yes	yes	yes	M075	male	yes	yes	1	3	1

1: Fisher IDs that begin with OPF are fishers born on the Olympic Peninsula, and identified through genetic analysis conducted from 2013-2016. Fisher ID's that begin with M or F are founders: one of the 90 fishers that were captured in British Columbia and released in ONP from 2008-2010, with the exception of M101, who was a male kit orphaned in June 2010, rescued, raised until he could hunt on his own, and released in October 2010.

2: Number of stations a fisher was detected (maximum=3).

3: Number of station (3) and visit (3) combinations a fisher was detected (maximum=9).

4: Visit number a fisher was first detected.

* DNA was sufficient to determine it was a fisher, but not good enough for individual ID.

**: () indicates number of stations per hex in the winter marten follow-up study.

Table 4 (continued). Fishers detected by cameras and DNA analysis, 2016.

Study Type	Hex Number	Fisher on Camera	Hair Collected	DNA Amplified	Fisher ID[1]	Sex	Founder	Collar Visible	Number Stations[2]	Number Station-Visits[3]	First Visit[4]
Density pilot study, additional hexes (cont.)	191	yes	yes	yes	M075	male	yes	yes	1	2	1
	192	yes	yes	no*	–	–	–	yes	2	2	3
	193	yes	yes	yes	OPF-0805	female	no	–	2	3	1
	214	yes	no	–	–	–	–	–	1	1	3
Fall marten survey follow-up.	231 (2)**	yes	yes	yes	OPF-1234	male	no	–	2	4	1
	255 (2)	yes	yes	yes	OPF-0494	female	no	–	2	2	1
	281 (2)	yes	yes	yes	OPF-0494	female	no	–	2	4	1
	309 (2)	yes	yes	yes	OPF-0494	female	no	–	1	1	1
	467 (1)	yes	yes	yes	OPF-1256	female	no	–	1	1	3
	535 (1)	yes	no	–	–	–	–	–	1	2	1

1: Fisher IDs that begin with OPF are fishers born on the Olympic Peninsula, and identified through genetic analysis conducted from 2013-2016. Fisher ID's that begin with M or F are founders: one of the 90 fishers that were captured in British Columbia and released in ONP from 2008-2010, with the exception of M101, who was a male kit orphaned in June 2010, rescued, raised until he could hunt on his own, and released in October 2010.

2: Number of stations a fisher was detected (maximum=3).

3: Number of station (3) and visit (3) combinations a fisher was detected (maximum=9).

4: Visit number a fisher was first detected.

* DNA was sufficient to determine it was a fisher, but not good enough for individual ID.

**: () indicates number of stations per hex in the winter marten follow-up study.

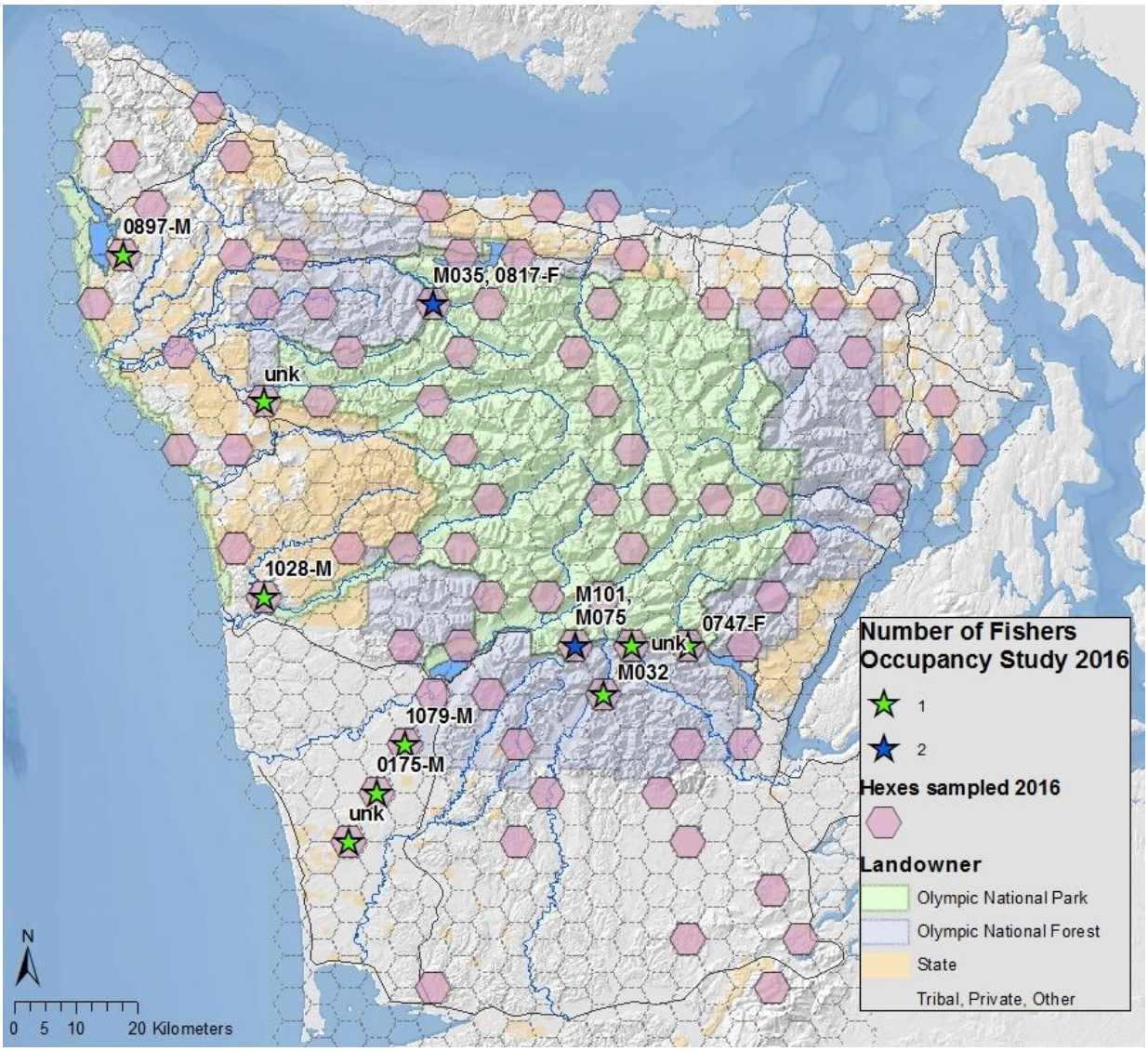

Figure 8. Location of fisher detections (stars) by cameras in hexes sampled in 2016 (rose hexagons) in the occupancy study. Labels by fisher detections are the fishers identified through DNA analysis. Labels starting with a number are new recruits, with sex indicated at the end of the string (F for females and M for males). ID numbers that start with a letter are founders, with the exception of M101, who was a male kit orphaned in 2010 who was rescued, raised until he could hunt on his own, and released in October 2010. Fishers in 3 hexes do not have a genetic ID.

In the occupancy study fishers were detected on multiple landownerships (Table 5). Twelve out of thirteen were detected in hexes comprised of mixed landownerships, and most (n= 11, 85%) contained some NPS or ONF lands within the hex.

Table 5. Landownerships where fishers were detected in 2016 in the occupancy study.

Hex primary landownership	Number of hexes sampled	Number of fishers detected
National Park Service (NPS)	19	–
NPS and Olympic National Forest (ONF)	6	6
NPS, ONF, and Washington Department of Natural Resources (WDNR), tribal or private	3	–
NPS, WDNR, and private	5	2
ONF	9	1
ONF and WDNR	1	–
ONF and private or tribal	6	–
ONF, WDNR, and private or tribal	7	1
ONF, private and tribal	1	1
WDNR	1	–
WDNR and private or land trust	14	1
WDNR, private, and tribal	2	1
Private	8	–

Fishers were detected at seven of the additional 10 hexes sampled in the density pilot study. In two hexes we were not able to identify the fisher detected, either due to a lack of hair on the hair snare, or DNA of too poor quality for analysis (Table 4). In the density study area, five different fishers were identified (M032, M075, M101, OPF-747, OPF-0805); two males were detected in multiple adjacent hexes, one male in only one hex, and both females in only one hex (Figure 9). One female (OPF-0805) was identified only in the pilot study.

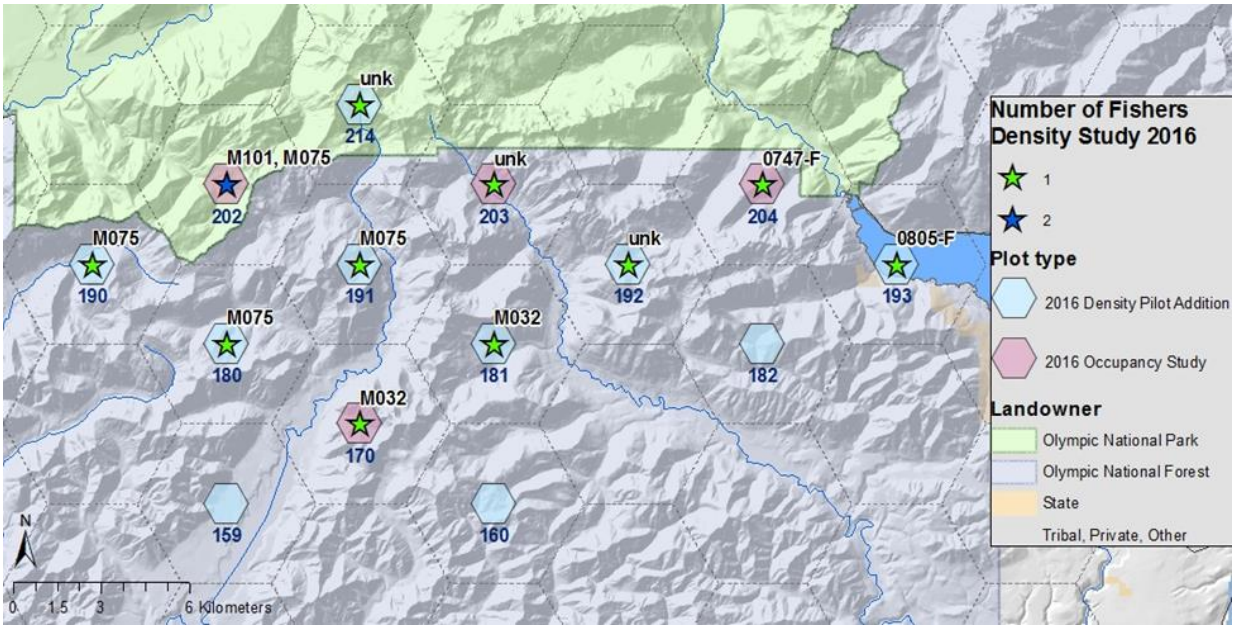

Figure 9. Location of hexes sampled and fishers detected in density pilot study. Rose hexes were part of the original occupancy sample. Blue hexes are additional hexes added for the pilot. Hex numbers are indicated in blue. Black labels below fisher detections are the fishers identified through DNA analysis. Labels starting with a number are new recruits, with sex indicated at the end of the string (F for females and M for males). ID numbers that start with a letter are founders, with the exception of M101. Fishers in 3 hexes do not have a genetic ID.

Along the coast, the marten follow-up surveys contributed detections of fishers in 6 of the 10 hexes (9 of the 15 stations) sampled (Table 4, Figure 10). Three different fishers were identified in the fall, two in the south coast and one near Lake Ozette. One fisher, in hex 535, did not leave hair on the hair snare and is unidentified. The three fishers identified in the fall were different from the two identified by the USFS crew in the spring.

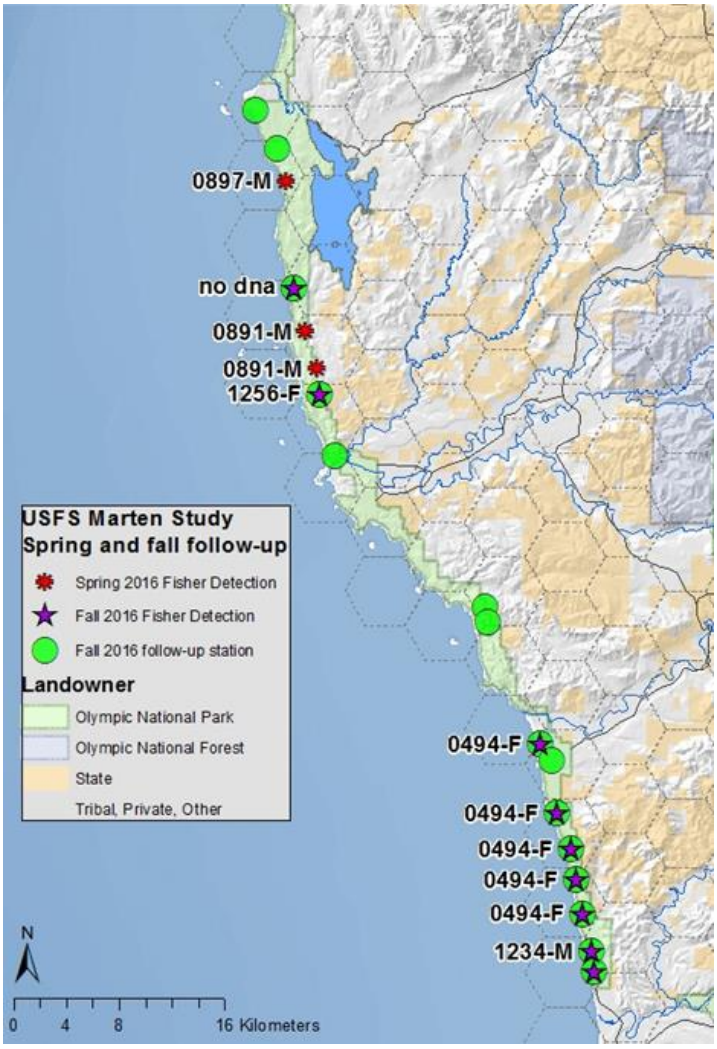

Figure 10. Stations re-sampled (green dots) in the fall 2016 follow-up of the USFS winter marten survey. Fishers detected in the fall are indicated with purple stars. Also shown are fishers detected in the spring 2016 follow-up (red asterisk). Labels indicate fishers identified through DNA analysis. A fall fisher in one location was not identified through genetic analysis.

DNA Analysis

Two hundred and forty hair samples were collected and sent to the laboratory in 2016 for DNA analysis; 6 from the spring coastal marten sampling, 58 from the fall coastal marten follow-up, 37 from the fisher density study area, and 139 from the occupancy study. The samples came from 71 station-visit events (1–6 samples per cubby) distributed among 37 different hexes. Twenty-five events were from intervals in which the camera was not fully functional and no fisher pictures were taken; those samples were sent in for analysis in the event that a fisher was present but was undetected by the camera (none were detected this way in 2016). The remaining 46 samples were from stations and intervals in which we did detect fishers with the cameras and also collected hair.

We attempted to identify individual fishers using microsatellite DNA analysis. Samples that did not contain DNA for this analysis ("no amplification") were either hair from another species, or an

inadequate sample from a fisher. In two samples we were able to identify that the hair was fisher, but the quality of the DNA was insufficient to determine individual fisher ID. We were able to identify individual fishers in 39 of the 46 (85%) sampling events in which a fisher was photographed and hair samples were obtained. For the samples where cameras were not working properly, species ID was determined on non-fisher samples. Other species identified through DNA included black bear (*Ursus americanus*) (1 event), Douglas squirrel (*Tamiasciurus douglasii*) (1), Virginia opossum (21), and spotted skunk (18).

Fourteen individual fishers were identified through DNA analysis in 2016 (Table 4, Figure 8). Ten individual fishers were identified in the occupancy study. One additional fisher was identified in the density pilot, and three more fishers in the fall coastal marten follow-up. We detected three founders, M032, M035 and M075, who were 8, 8, and 7 years old at the time of detection respectively (Appendix A). Additionally, we detected three new recruits that had been detected in prior years (M101, 747-F, 494-F) (Appendix B). Fisher M101 is an orphaned kit that was released in October 2010 (Happe et al. 2015) and was 6 years old at the time of detection in 2016. Eight fishers were first detected in 2016 (0175-M, 1079-M, 0805-F, 1234-M, 1028-M, 1256-F, 0817-F, 0897-M) (Appendix C). Because all of the new fishers detected are either second or third generation, it is not possible to definitively identify their parents with the current level of DNA analysis (Appendix C).

Resurvey of 2014 hexes

We detected fishers in nine out of the 68 hexes in the target area that were sampled both in 2014 and 2016, an increase of 80% from the five hexes that had fishers in 2014. We detected fishers in all five of the hexes that had fishers in 2014 (Table 6, Figure 11). In one hex we can definitively say it was the same fisher each year (0747-F in H204) but in others, due to lack of complete DNA amplification in either 2014 or 2016, turnover is not possible to determine. In 2014 in hex 202 we detected two fishers: M101 and an unknown collared fisher. In 2016 in hex 202 we again detected M101 and collared fisher M075 – but we cannot say for sure if this was the collared fisher detected in 2014. In hex 170 we detected a collared fisher in both 2014 and 2016; in 2014 we detected M082 but in 2016 we found M032.

Table 6. Comparison of hexes that were sampled in both 2014 and 2016, and in which fishers were detected in at least one of those years.

Hex Number	Fisher 2014 (n)[1]	Fisher IDs 2014	Founder 2014	Fisher 2016 (n)[2]	Fisher IDs 2016	Founder 2016	Same fisher
135	0	–	–	1	1079-M	No	n/a
170	1	M082	Yes	1	M032	Yes	No
202	2	M101, unknown (collar)	No, Yes	2	M101, M075	No, Yes	Yes, unknown
203	1	M101	No	1	unknown	unknown	unknown

1: Number of fishers detected in the hex in 2014

2: Number of fishers detected in the hex in 2016

Table 6 (continued). Comparison of hexes that were sampled in both 2014 and 2016, and in which fishers were detected in at least one of those years.

Hex Number	Fisher 2014 (n)[1]	Fisher IDs 2014	Founder 2014	Fisher 2016 (n)[2]	Fisher IDs 2016	Founder 2016	Same fisher
204	1	0747-F	No	1	0747-F	No	Yes
232	1	unknown	unknown	1	1028-M	No	unknown
402	0	–	–	1	unknown	–	n/a
507	0	–	–	2	M035, 0817-F	Yes, No	n/a
552	0	–	–	1	0897-M	No	n/a

1: Number of fishers detected in the hex in 2014

2: Number of fishers detected in the hex in 2016

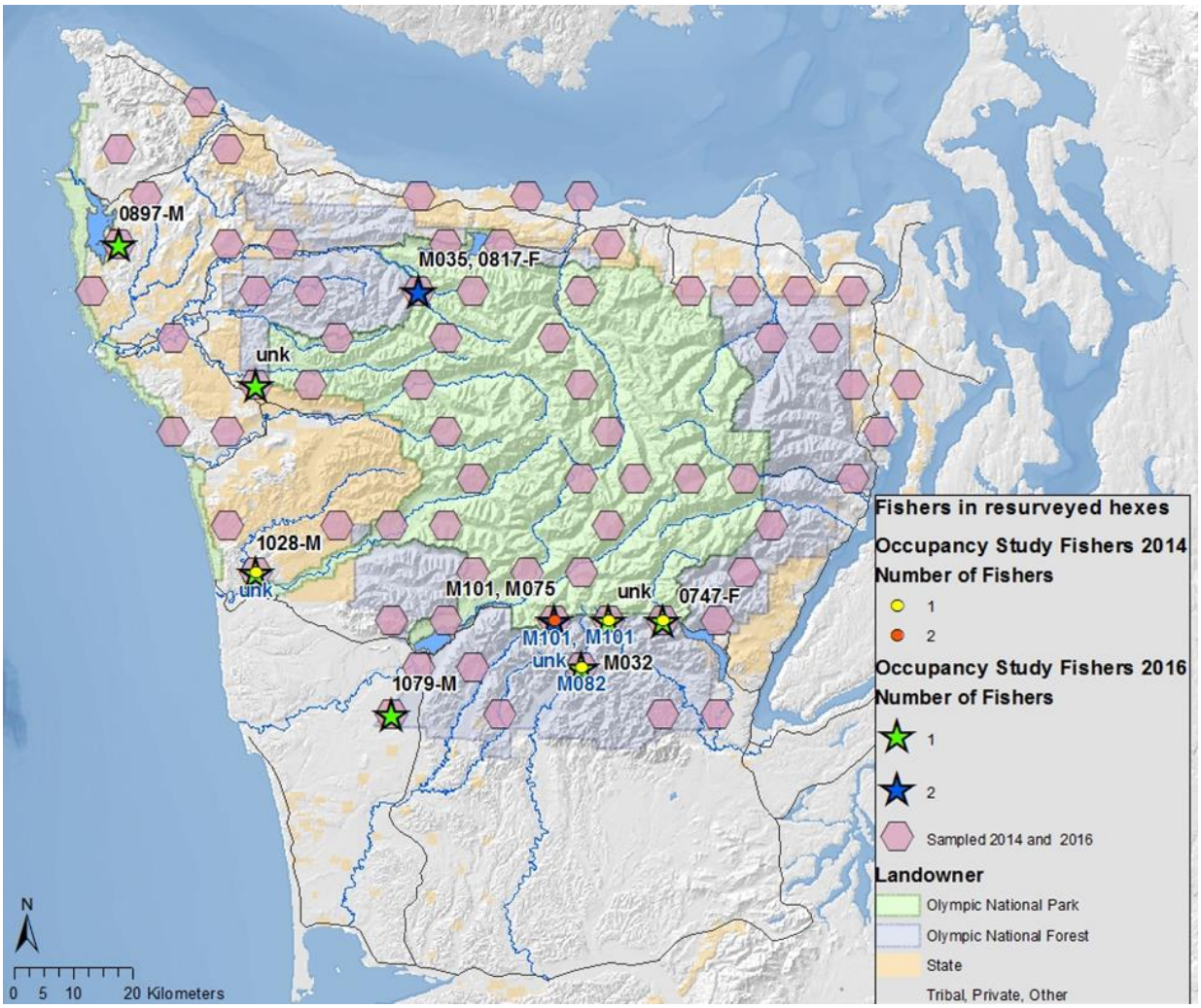

Figure 11. Fishers detected in the occupancy study in hexes sampled in both 2014 and 2016 (pink hexes). Fishers detected in 2014 are indicated with dots and 2016 with stars. Fisher ID as determined with DNA analysis in 2014 are in blue text and in 2016 with black text.

In addition, in 2016 we detected fishers in 4 hexes in the target area that did not have fisher detections in 2014. In hex 507 we detected two different fishers – M035 (a founder that was last detected in hex 455 in 2013) and a new female.

Incidental Detections

In addition to fishers detected through our study and the marten survey efforts, five fishers were also detected through other means on the Olympic Peninsula in 2016 and early 2017 (Figure 12) by non-project personnel. All five were accompanied by verifiable photos; UF-118 and UF-119 were detected in April 2016 and in April 2017, respectively, in very close proximity; it is unknown if it was the same fisher each year. UF-116 was found in a willow tree after being treed by coyotes (which were chased off by dogs). The person walking the dogs took a picture of the fisher with his cell phone. UF-120 was captured on a private game camera in the winter of 2016-2017, very near one of our 2016 stations. Finally 1035-M was incidentally trapped in a bobcat trap and later released.

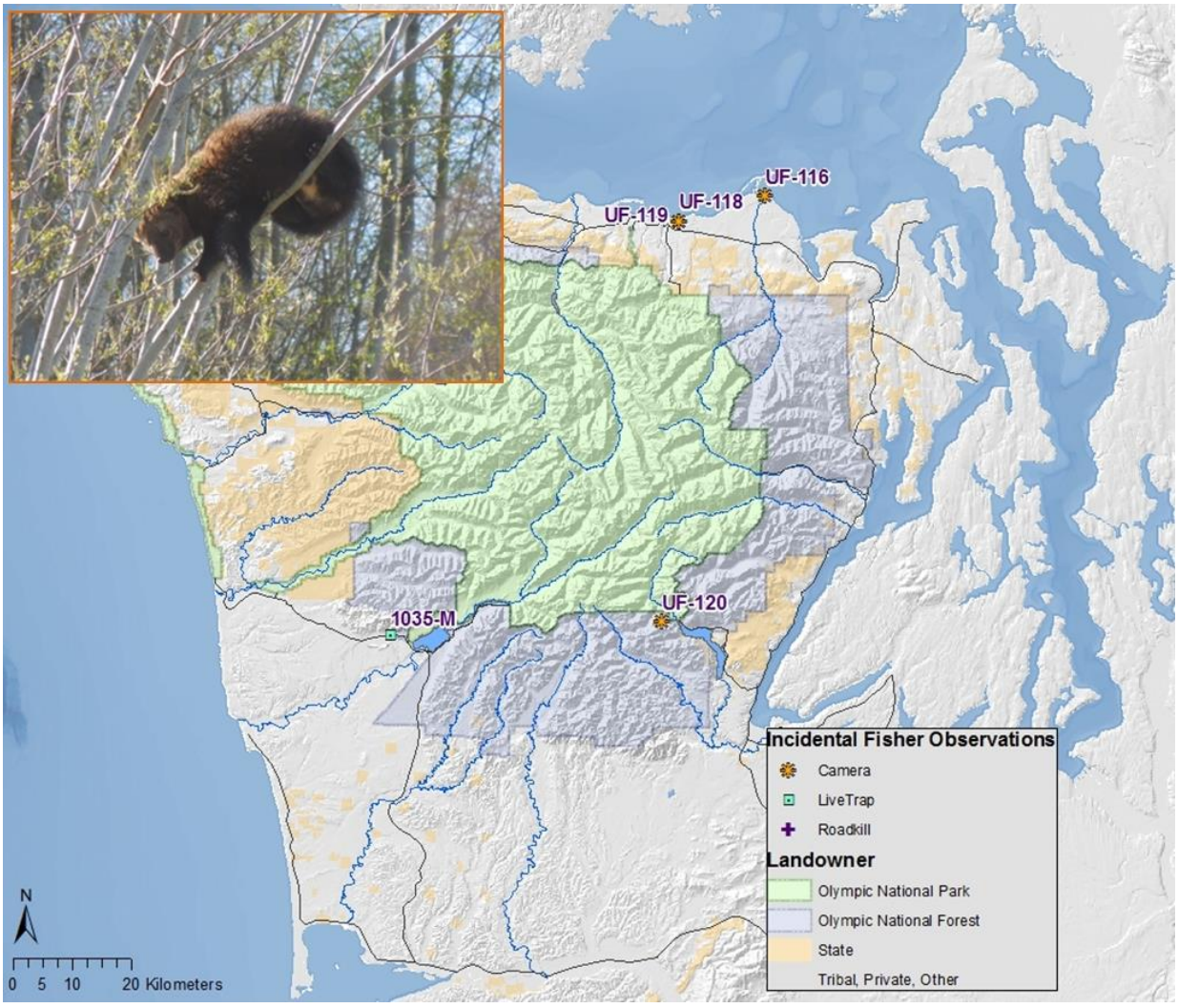

Figure 12. Incidental fisher locations, December 2016 – April 2017. Labels by detection location are tracking numbers for fishers without genetic ID (UF) or ID for those fishers where genetic ID was determined (1035-M). Inset is UF-116.

Fisher Detections 2013- 2016

Over the four years of study we identified 35 individual fishers (Table 7). Twenty-two were detected in the occupancy study (Figure 13), 13 were obtained incidentally or via other investigations, and five were detected in both incidentally and in the occupancy study (Figure 14). Seven fishers were detected in multiple years. In addition, we obtained over 19 additional fisher detections in which we were not able to determine individual ID through genetic analysis. It is unknown how many more unique animals these captures represent.

Of the animals identified, 10 were founders (1 female and 9 males), 13 were first generation (6 females and 7 males), and 12 were second or later (5 females and 7 males) generation fishers. We detected 11 fishers that were collared prior to their release (10 founders and 1 rehabilitated kit); five of the 11 had shed their collars at the time of detection.

Table 7. All fishers detected in the Olympic Study area, 2013 - April 2017.

Study Type	First Year Detected	Last Year Detected	Hex First Detected	DNA Amplified	Fisher ID[1]	Gender	Generation[2]	Collar Visible	Type of Detection(s)[3]
Fishers detected on the occupancy study	2013	–	172	YES	0005-M	Male	1	n/a	Study
	2013	2014	309	YES	M079	Male	F	YES	Study/ Incidental*
	2013	–	410	YES	0678-M	Male	1	n/a	Study
	2013	2016	455	YES	M035	Male	F	No	Study
	2013	–	511	YES	0728-M	Male	1	n/a	Study
	2013	–	560	YES	F006	Female	F	YES	Study
	2013	2014	563	YES	0301-M	Male	1	n/a	Study/ Incidental
	2013	–	645	YES	0077-F	Female	1	n/a	Study
	2013	–	309	No	Unknown	Unknown	Unknown	No	Study
	2013	–	630	No	Unknown	Unknown	F	YES	Study
	2014	–	170	YES	M082	Male	F	YES	Study
	2014	2016	202, 203	YES	M101	Male	1	No	Study
	2014	2016	204	YES	0747-F	Female	1	n/a	Study

1: Fisher IDs that begin with a number are fishers born on the Olympic Peninsula, and identified through genetic analysis conducted from 2013-2016. Fisher ID's that begin with M or F are founders: one of the 90 fishers that were captured in British Columbia and released in ONP from 2008-2010, with the exception of M101, who was a rescued orphaned kit. Fisher ID's that begin with UF are incidental detections of unidentified fishers.

2: Generation: F=founder, 1=offspring of 2 founders, >1 second generation or greater, or offspring of a founder and first generation fisher.

3: Type of Detection: Study=Occupancy study; Incidental=verified fisher reported by non-project personnel; F.M. follow-up= investigation of fishers detected in marten study, conducted in the fall of 2016; S.M. follow-up= investigation of fishers detected in marten study, conducted in the spring of 2016; W.M. study=winter marten study, led by USFS staff along the coast of ONP, Dec 2015-Feb. 2016.

*Incidental detection was a recovered carcass.

** Unidentified fisher was determined to be a founder through presence of a visible radio-collar

Table 7 (continued). All fishers detected in the Olympic Study area, 2013 - April 2017.

Study Type	First Year Detected	Last Year Detected	Hex First Detected	DNA Amplified	Fisher ID[1]	Gender	Generation[2]	Collar Visible	Type of Detection(s)[3]
Fishers detected on the occupancy study (cont.)	2014	–	202	No	Unknown	Unknown	F**	YES	Study
	2014	–	232	n/a	Unknown	Unknown	Unknown	No	Study
	2015	2016	309	YES	0494-F	Female	1	n/a	Study, F.M. follow-up
	2015	–	354	YES	0517-M	Male	1	n/a	Study
	2015	–	455	YES	M099	Male	F	No	Study
	2015	–	600	YES	0828-F	Female	>1	n/a	Study
	2015	–	355	No	Unknown	Unknown	Unknown	No	Study
	2015	–	363	No	Unknown	Unknown	Unknown	No	Study
	2015	–	645	No	Unknown	Unknown	Unknown	No	Study
	2016	–	106	YES	0175-M	Male	>1	n/a	Study
	2016	–	135	YES	1079-M	Male	>1	n/a	Study
	2016	–	170	YES	M032	Male	F	YES	Study
	2014	2016	204	YES	M075	Male	F	YES	Study/ Incidental
	2016	–	232	YES	1028-M	Male	>1	n/a	Study

1: Fisher IDs that begin with a number are fishers born on the Olympic Peninsula, and identified through genetic analysis conducted from 2013-2016. Fisher ID's that begin with M or F are founders: one of the 90 fishers that were captured in British Columbia and released in ONP from 2008-2010, with the exception of M101, who was a rescued orphaned kit. Fisher ID's that begin with UF are incidental detections of unidentified fishers.

2: Generation: F=founder, 1=offspring of 2 founders, >1 second generation or greater, or offspring of a founder and first generation fisher.

3: Type of Detection: Study=Occupancy study; Incidental=verified fisher reported by non-project personnel; F.M. follow-up= investigation of fishers detected in marten study, conducted in the fall of 2016; S.M. follow-up= investigation of fishers detected in marten study, conducted in the spring of 2016; W.M. study=winter marten study, led by USFS staff along the coast of ONP, Dec 2015-Feb. 2016.

*Incidental detection was a recovered carcass.

** Unidentified fisher was determined to be a founder through presence of a visible radio-collar

Table 7 (continued). All fishers detected in the Olympic Study area, 2013 - April 2017.

Study Type	First Year Detected	Last Year Detected	Hex First Detected	DNA Amplified	Fisher ID[1]	Gender	Generation[2]	Collar Visible	Type of Detection(s)[3]
Fishers detected on the occupancy study (cont.)	2016	–	507	YES	0817-F	Female	>1	n/a	Study
	2016	2016	584	YES	0897-M	Male	>1	n/a	Study, S.M. follow-up
	2016	–	82	No	Unknown	Unknown	–	No	Study
	2016	–	203	No	Unknown	Unknown	–	Unknown	Study
	2016	–	402	n/a	Unknown	Unknown	–	No	Study
Fishers detected in incidental and other sampling only	2013	–	595	YES	FF102	Female	1	n/a	Incidental*
	2013	–	560	YES	FF103	Female	1	n/a	Incidental*
	2013	–	432	YES	FF104	Female	1	n/a	Incidental*
	2013	–	256	n/a	M023	Male	F	YES	Incidental*
	2013	–	542	n/a	UF-NB-2	Unknown	–	No	Incidental
	2013	–	305	n/a	UF-ONF1	Unknown	–	No	Incidental
	2013	–	74	n/a	UF-105	Unknown	–	No	Incidental
	2013	–	106	n/a	UF-106	Unknown	–	No	Incidental

1: Fisher IDs that begin with a number are fishers born on the Olympic Peninsula, and identified through genetic analysis conducted from 2013-2016. Fisher ID's that begin with M or F are founders: one of the 90 fishers that were captured in British Columbia and released in ONP from 2008-2010, with the exception of M101, who was a rescued orphaned kit. Fisher ID's that begin with UF are incidental detections of unidentified fishers.

2: Generation: F=founder, 1=offspring of 2 founders, >1 second generation or greater, or offspring of a founder and first generation fisher.

3: Type of Detection: Study=Occupancy study; Incidental=verified fisher reported by non-project personnel; F.M. follow-up= investigation of fishers detected in marten study, conducted in the fall of 2016; S.M. follow-up= investigation of fishers detected in marten study, conducted in the spring of 2016; W.M. study=winter marten study, led by USFS staff along the coast of ONP, Dec 2015-Feb. 2016.

*Incidental detection was a recovered carcass.

** Unidentified fisher was determined to be a founder through presence of a visible radio-collar

Table 7 (continued). All fishers detected in the Olympic Study area, 2013 - April 2017.

Study Type	First Year Detected	Last Year Detected	Hex First Detected	DNA Amplified	Fisher ID[1]	Gender	Generation[2]	Collar Visible	Type of Detection(s)[3]
Fishers detected in incidental and other sampling only (cont.)	2014	–	193	YES	0751-F	Female	>1	n/a	Incidental
	2014	–	483	n/a	UF-109	Unknown	–	No	Incidental
	2015	–	255	YES	0489-M,	Male,	1	n/a	Incidental
	2015	–	653	YES	M011	Male	F	No	Incidental
	2015	–	186	YES	M064	Male	F	No	Incidental
	2015	–	656	n/a	UF-113	Unknown	–	No	Incidental
	2016	–	622	n/a	UF-116	Unknown	–	No	incidental
	2016	2017	579	n/a	UF-118	Unknown	–	No	incidental
	2016	–	193	YES	0805-F	Female	>1	n/a	Density Study
	2016	–	192	No	Unknown	Unknown	F**	YES	Density Study
	2016	–	214	n/a	Unknown	Unknown	–	No	Density Study
	2016	–	501	YES	0891-M	Male	>1	n/a	S.M. follow up
	2016	–	535	n/a	Unknown	Unknown	–	No	W.M. Study, F.M. follow-up

1: Fisher IDs that begin with a number are fishers born on the Olympic Peninsula, and identified through genetic analysis conducted from 2013-2016. Fisher ID's that begin with M or F are founders: one of the 90 fishers that were captured in British Columbia and released in ONP from 2008-2010, with the exception of M101, who was a rescued orphaned kit. Fisher ID's that begin with UF are incidental detections of unidentified fishers.

2: Generation: F=founder, 1=offspring of 2 founders, >1 second generation or greater, or offspring of a founder and first generation fisher.

3: Type of Detection: Study=Occupancy study; Incidental=verified fisher reported by non-project personnel; F.M. follow-up= investigation of fishers detected in marten study, conducted in the fall of 2016; S.M. follow-up= investigation of fishers detected in marten study, conducted in the spring of 2016; W.M. study=winter marten study, led by USFS staff along the coast of ONP, Dec 2015-Feb. 2016.

*Incidental detection was a recovered carcass.

** Unidentified fisher was determined to be a founder through presence of a visible radio-collar

Table 7 (continued). All fishers detected in the Olympic Study area, 2013 - April 2017.

Study Type	First Year Detected	Last Year Detected	Hex First Detected	DNA Amplified	Fisher ID[1]	Gender	Generation[2]	Collar Visible	Type of Detection(s)[3]
Fishers detected in incidental and other sampling only (cont.)	2016	–	231	n/a, YES	Unknown, 1234-M	Unknown, Male	>1	Unknown	W.M. Study, F.M follow up
	2016	–	243	n/a	Unknown	Unknown	–	Unknown	W.M. Study
	2016	–	384	n/a	Unknown	Unknown	–	Unknown	W.M. Study
	2016	–	433	n/a	Unknown	Unknown	–	Unknown	W.M. Study
	2016	–	467	n/a, YES	Unknown, 1256-F	Unknown, Female	>1	Unknown	W.M. Study, F.M. follow up
	2016	–	518	n/a	Unknown	Unknown	–	Unknown	W.M. Study
	2016	–	600	n/a	Unknown	Unknown	–	Unknown	W.M. Study
	2016	–	613	n/a	Unknown	Unknown	–	Unknown	W.M. Study
	2017	–	177	Yes	1035-M	Male	>1	n/a	Incidental
	2017	–	193	No	unknown	Unknown	–	Unknown	Incidental

1: Fisher IDs that begin with a number are fishers born on the Olympic Peninsula, and identified through genetic analysis conducted from 2013-2016. Fisher ID's that begin with M or F are founders: one of the 90 fishers that were captured in British Columbia and released in ONP from 2008-2010, with the exception of M101, who was a rescued orphaned kit. Fisher ID's that begin with UF are incidental detections of unidentified fishers.

2: Generation: F=founder, 1=offspring of 2 founders, >1 second generation or greater, or offspring of a founder and first generation fisher.

3: Type of Detection: Study=Occupancy study; Incidental=verified fisher reported by non-project personnel; F.M. follow-up= investigation of fishers detected in marten study, conducted in the fall of 2016; S.M. follow-up= investigation of fishers detected in marten study, conducted in the spring of 2016; W.M. study=winter marten study, led by USFS staff along the coast of ONP, Dec 2015-Feb. 2016.

*Incidental detection was a recovered carcass.

** Unidentified fisher was determined to be a founder through presence of a visible radio-collar

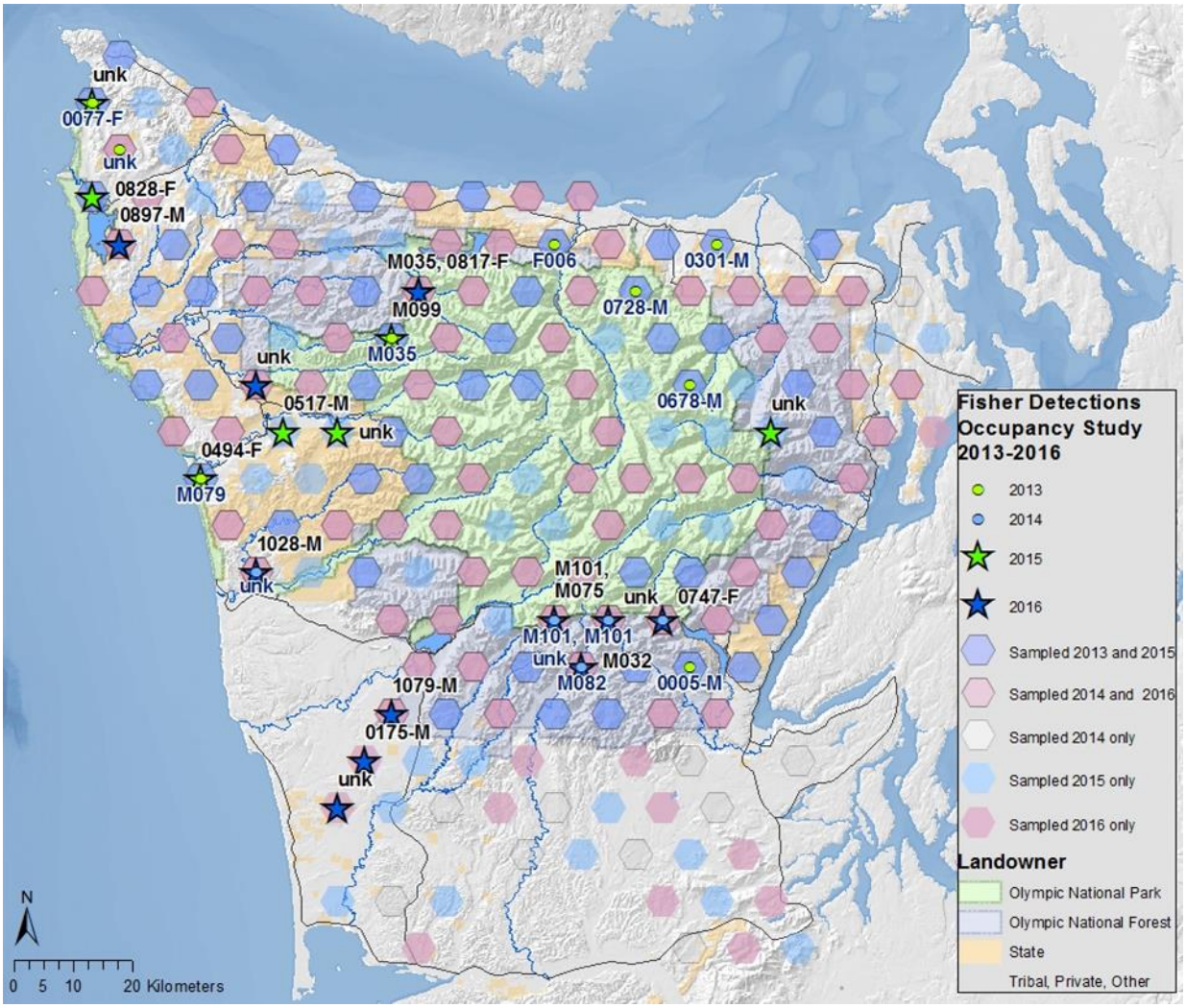

Figure 13. All hexes sampled and fishers detected in the occupancy study, 2013-2016. 2013 and 2014 detections are indicated by dots and blue labels, 2015-2016 detections with stars and black labels.

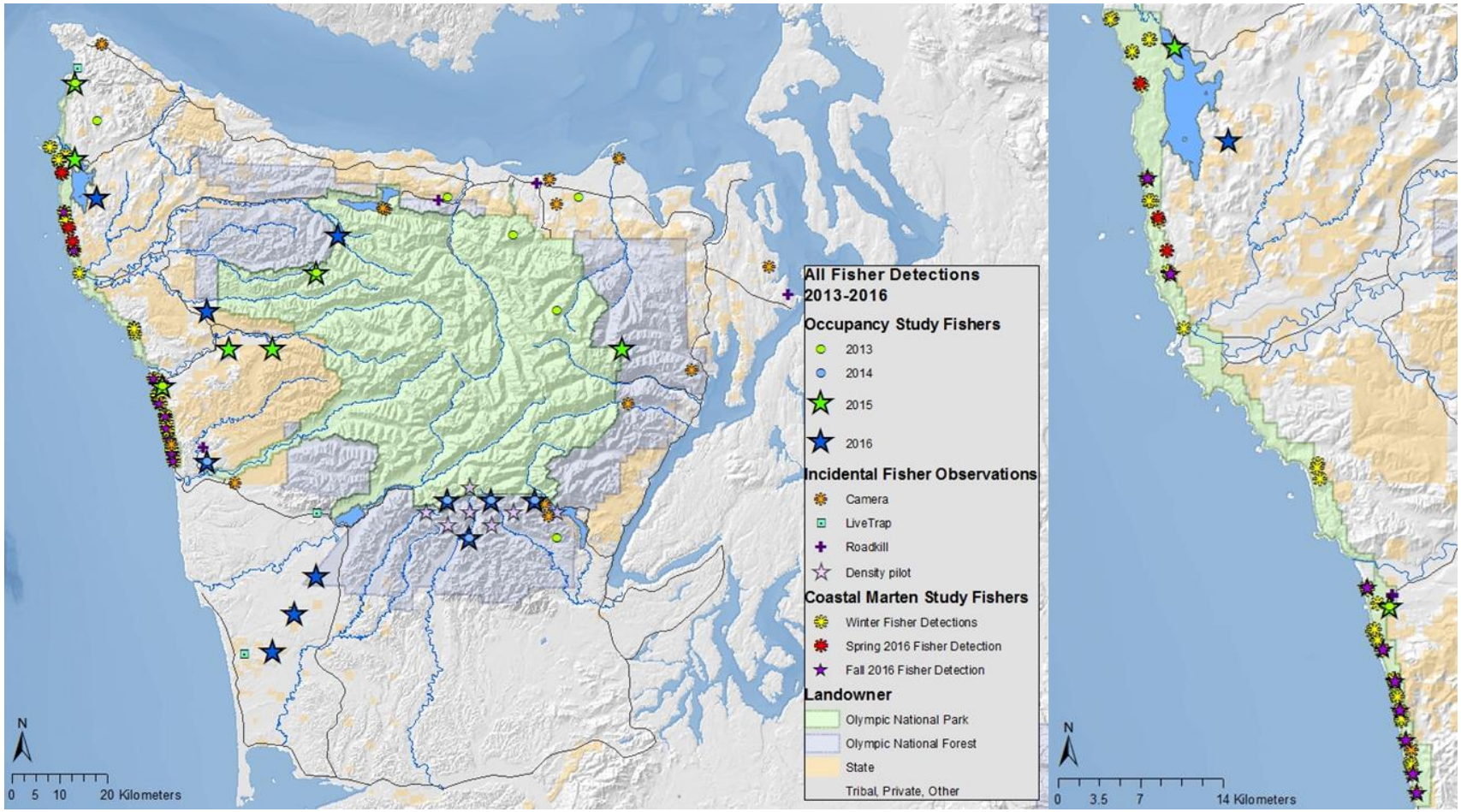

Figure 14. All fishers detected 2013-March 2017 by detection type (left). Expanded view of fisher detections, by type, along the parks coastal strip (right).

Other Species Detected in 2016

We collected more than 125,000 digital photographs and detected 46 wildlife species in 2016. At the scale of individual hexes, black bears were the most frequently detected species as in all previous years; they were detected in 62 (76 %) hexes and in 160 (22 %) station-visit events (Table 8). Spotted skunks, bobcats (*Lynx rufus*), and coyotes (*Canis latrans*) were the next most frequently detected carnivores, detected in 55, 36 and 21 hexes respectively. However, spotted skunks were detected in more station-visit events (208) than any other species; when they occur in an area they revisit baits repeatedly and are detected frequently.

We also obtained detections of potential fisher prey with remote cameras. In 2016, mice (*Peromyscus* spp., *Microtis* spp., *and Zapus trinitatus*), Douglas' squirrels (*Tamiasciurus douglasii*), snowshoe hares (*Lepus americanus*) and chipmunks were detected in over 40% of the hexes. In 2016, we detected a new species not previously detected on our cameras-a beaver (*Castor canadensis*) detected near the Queets River (Table 8).

Table 8. Number of times a species or species group was detected with remote cameras in 2016 in the occupancy study, by hex and station-visit events. n=82 hexes and 742 station-visits.

Taxa group	Species	Hexes	Station / Visits
Carnivores	Black Bear	62	160
	Spotted Skunk	55	208
	Bobcat	36	51
	Coyote	21	34
	Cougar (*Puma concolor*)	17	23
	Weasel[1] (*Mustela* spp.)	16	23
	Fisher	11	23
	Raccoon (*Procyon lotor*)	9	13
	Domestic Dog	6	10
	Mink or Marten	0	0

1: Short-tailed Weasel (21), Long-tailed Weasel (4), or unidentifiable weasel (5).

2: Dark-eyed Junco (*Junco hyemalis*) (5), Hermit Thrush (*Catharus guttatus*) (4), Varied Thrush (*Ixoreus naevius*) (43), American Robin (*Turdus migratorius*) (38), Pacific Wren (*Troglodytes pacificus*) (3), Swainsons Thrush (*Catharus ustulatus*) (2), Black-headed Grosbeak (*Pheucticus melanocephalus*) (1), Brown Creeper (*Sitta pusilla*) (1), Spotted Towhee (*Pipilo erythrophthalmus*) (1), or unidentifiable bird (28).

3: Gray Jay (*Perisoreus canadensis*) (17), Steller's Jay (*Cyanocitta stelleri*) (26) or American Crow (*Corvus brachyrhynchos*) (2).

4: Sooty Grouse (*Dendragapus fuliginosus*) (7), Ruffed Grouse (*Bonasa umbellus*) (7), or unidentifiable grouse (4).

5: Saw-whet Owl (*Aegolius acadicus*) (2), Northern Pygmy Owl (*Glaucidium gnoma*) (1), Western Screech Owl (*Otus kennicottii*) (1), Barred Owl (*Strix varia*) (1), unidentified *Strix* owl (3), unidentified owl (2).

6: Northern Flicker (*Colaptus auratus*) (4), Hairy Woodpecker (*Picoides villosus*) (1).

Table 8 (continued). Number of times a species or species group was detected with remote cameras in 2016 in the occupancy study, by hex and station-visit events. n=82 hexes and 742 station-visits.

Taxa group	Species	Hexes	Station / Visits
Birds	Passerine[2]	111	194
	Jays and Crows [3]	31	65
	Raven	17	19
	Grouse[4]	21	24
	Turkey Vulture	15	24
	Owl[5]	5	7
	Woodpecker[6]	4	4
	Coopers Hawk (*Accipiter gentilis*)	1	1
Ungulate	Black-tailed Deer (*Odocoileus hemionus columbianus*)	49	87
	Elk (*Cervus elaphus*)	15	21
Small and medium mammals	Douglas' Squirrel	55	110
	Mice and Voles	57	171
	Flying Squirrel	27	41
	Snowshoe Hare	39	70
	Chip**m**unk	36	76
	Bushy-tailed Woodrat (*Neotoma cinerea*)	3	6
	Mountain Beaver (*Aplodontia rufa*)	5	5
	Beaver	1	1
	Rat (*Rattus spp*)	1	1
Miscellaneous	Human	14	22
	Virginia Opossum	22	95

1: Short-tailed Weasel (21), Long-tailed Weasel (4), or unidentifiable weasel (5).

2: Dark-eyed Junco (*Junco hyemalis*) (5), Hermit Thrush (*Catharus guttatus*) (4), Varied Thrush (*Ixoreus naevius*) (43), American Robin (*Turdus migratorius*) (38), Pacific Wren (*Troglodytes pacificus*) (3), Swainsons Thrush (*Catharus ustulatus*) (2), Black-headed Grosbeak (*Pheucticus melanocephalus*) (1), Brown Creeper (*Sitta pusilla*) (1), Spotted Towhee (*Pipilo erythrophthalmus*) (1), or unidentifiable bird (28).

3: Gray Jay (*Perisoreus canadensis*) (17), Steller's Jay (*Cyanocitta stelleri*) (26) or American Crow (*Corvus brachyrhynchos*) (2).

4: Sooty Grouse (*Dendragapus fuliginosus*) (7), Ruffed Grouse (*Bonasa umbellus*) (7), or unidentifiable grouse (4).

5: Saw-whet Owl (*Aegolius acadicus*) (2), Northern Pygmy Owl (*Glaucidium gnoma*) (1), Western Screech Owl (*Otus kennicottii*) (1), Barred Owl (*Strix varia*) (1), unidentified *Strix* owl (3), unidentified owl (2).

6: Northern Flicker (*Colaptus auratus*) (4), Hairy Woodpecker (*Picoides villosus*) (1).

Table 8 (continued). Number of times a species or species group was detected with remote cameras in 2016 in the occupancy study, by hex and station-visit events. n=82 hexes and 742 station-visits.

Taxa group	Species	Hexes	Station / Visits
Unidentified	Small mammal	37	55
	Medium mammal	7	7
	Large mammal	6	6
	Animal	12	12

1: Short-tailed Weasel (21), Long-tailed Weasel (4), or unidentifiable weasel (5).

2: Dark-eyed Junco (*Junco hyemalis*) (5), Hermit Thrush (*Catharus guttatus*) (4), Varied Thrush (*Ixoreus naevius*) (43), American Robin (*Turdus migratorius*) (38), Pacific Wren (*Troglodytes pacificus*) (3), Swainsons Thrush (*Catharus ustulatus*) (2), Black-headed Grosbeak (*Pheucticus melanocephalus*) (1), Brown Creeper (*Sitta pusilla*) (1), Spotted Towhee (*Pipilo erythrophthalmus*) (1), or unidentifiable bird (28).

3: Gray Jay (*Perisoreus canadensis*) (17), Steller's Jay (*Cyanocitta stelleri*) (26) or American Crow (*Corvus brachyrhynchos*) (2).

4: Sooty Grouse (*Dendragapus fuliginosus*) (7), Ruffed Grouse (*Bonasa umbellus*) (7), or unidentifiable grouse (4).

5: Saw-whet Owl (*Aegolius acadicus*) (2), Northern Pygmy Owl (*Glaucidium gnoma*) (1), Western Screech Owl (*Otus kennicottii*) (1), Barred Owl (*Strix varia*) (1), unidentified *Strix* owl (3), unidentified owl (2).

6: Northern Flicker (*Colaptus auratus*) (4), Hairy Woodpecker (*Picoides villosus*) (1).

We detected no marten in 2016. In this study, our only Pacific marten detection was at a high-elevation site in the Hoh Valley in 2015 (Happe et al. 2016).

We also continued to detect Virginia opossum, a species that appears to be invading the Olympic Peninsula from the south (Figure 15). They were detected in 14 hexes in 2014 and 22 hexes in 2016 (Figure 15).

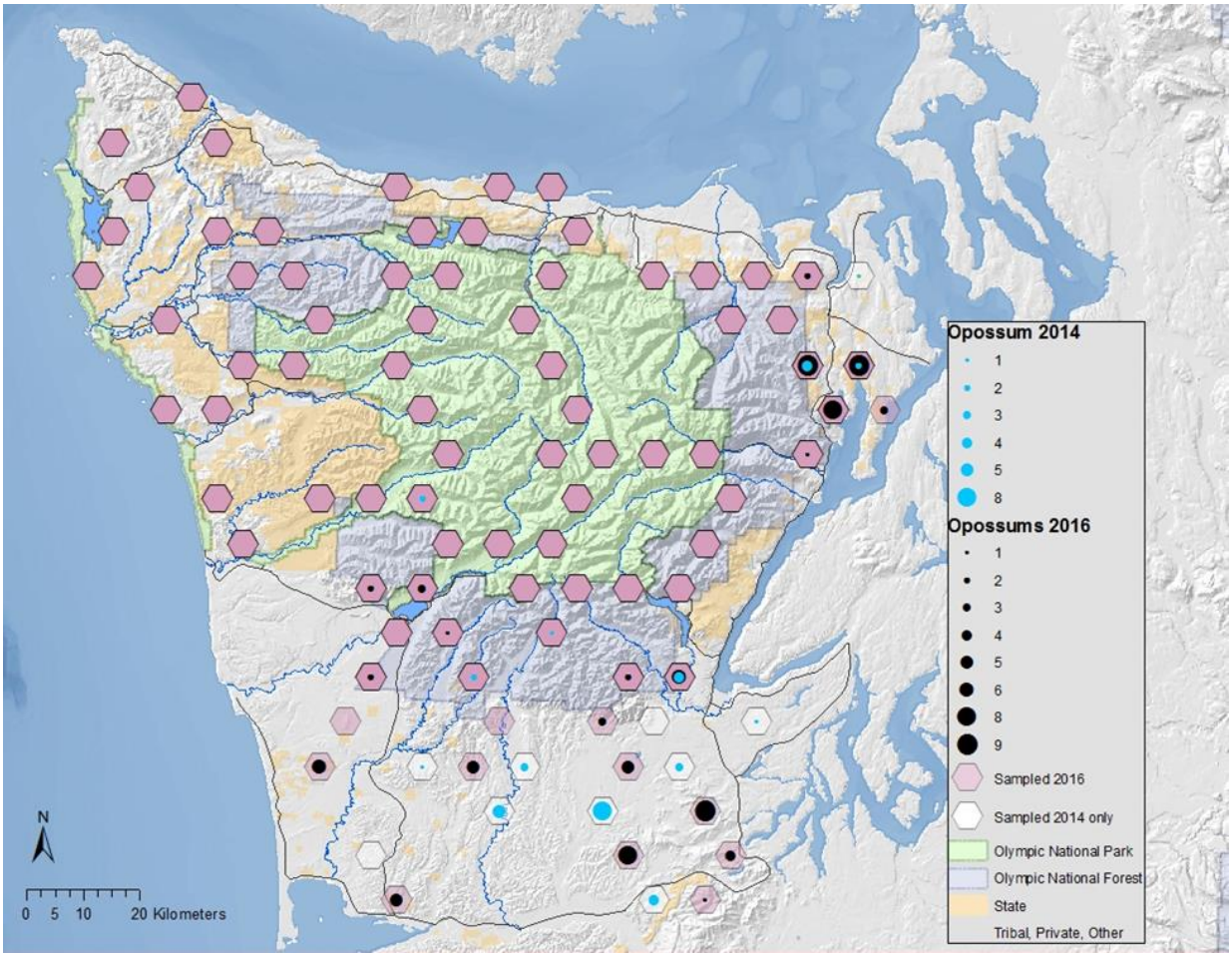

Figure 15. Hexes sampled and location and number of Virginia opossum station-visit events in 2014 (blue dots) and 2016 (black dots). Size of dot indicates the number of station/ visit events that an opossum was detected at a hex (maximum=9). Hexes sampled in 2014 only are indicated with transparent white shading, 2016 only with transparent pink shading, and 2014 and 2016 with opaque pink shading.

Plans for 2017

2016 was the 4th and final year of data collection for this study. With the support from the NPS, USFS, USGS, and the USFWS Recovery Program, assistance from our partners, and support for an intern received from SCA NPS Academy, we were able to fully implement our monitoring protocol in 2016. Through our joint efforts we were able to re-sample all hexes sampled in 2014 (68 hexes) in the target area, continue sampling into the expansion areas, intensify sampling in the southeastern Olympics to obtain a better understanding of the minimum number of animals in this area, and follow-up on fishers detected in the coastal marten study.

In 2017 we will complete data QA/ QC, prepare metadata, analyze data and prepare peer-reviewed publications. Specific analyses planned include:

- Occupancy patterns of fishers on the Olympic Peninsula (over time, between sexes, habitat and environmental relationships)
- Relationship of fisher occupancy to that of fisher predators (cougar, bobcats and coyotes) and prey (hares, mice and squirrels).
- Evaluate methods to estimate density of fishers with occupancy data, using data from the density pilot study.

Publications and Public Outreach Activities (2016)

Reports:

Happe, P. J., K. J. Jenkins, T.J. Kay, K. Pilgrim, M. K. Schwartz, J. C. Lewis, and K. B. Aubry. 2015. Evaluation of fisher (*Pekania pennanti*) restoration in the Olympic National Park and the Olympic recovery area: 2015 annual progress report. Natural Resource Data Series NPS/OLYM/NRDS—2016/1274. National Park Service, Fort Collins, Colorado.

Presentations:

March 2016: Sequim Science Cafe. Reintroducing the Fisher to Washington: the Olympic fisher Project. Sequim, WA.

Funding (2016 and 2017)

This project received $131,000 in funding from NPS-NRPP in 2016 and $40,000 from Olympic National Forest in 2016 and 2017. In addition, USFWS Recovery Program funding to USGS supported the DNA analysis, equipment and supplies, and vehicle costs in FY2016 and early 2017.

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Appendix A. Founders detected in 2016.

Animal ID	How Detected	Method	Hex	Release Date	Age at Release	Age in 2016	Sex
M032	Occ. and Density Studies	Camera and DNA	170, 181	21-Dec-08	0	8	male
M035	Occ. Study	Camera and DNA	507	21-Dec-08	0	8	male
M075	Occ. and Density Studies	Camera and DNA	180, 190, 191, 202,	21-Jan-10	0	7	male

M032 was released in the Elwha on 21 December 2008 at age 8 months. He headed south after his release, and settled down south of the park in May 2009, below the target area (Figure A1). He moved out of that area during the breeding season in 2010, and was found northwest of Lake Cushman in June 2010. He stayed in that area until we lost contact with him in September 2010. Although we have not detected him prior to 2016, we knew he was alive and in the area for a while, as he was determined to have bred with 0747-F and be the father of 0751-F (Happe et al 2015). He is also suspected to be the father of 0817-F (again with 0747-F) and 0805-F (with a different, unknown, female) (see appendix C).

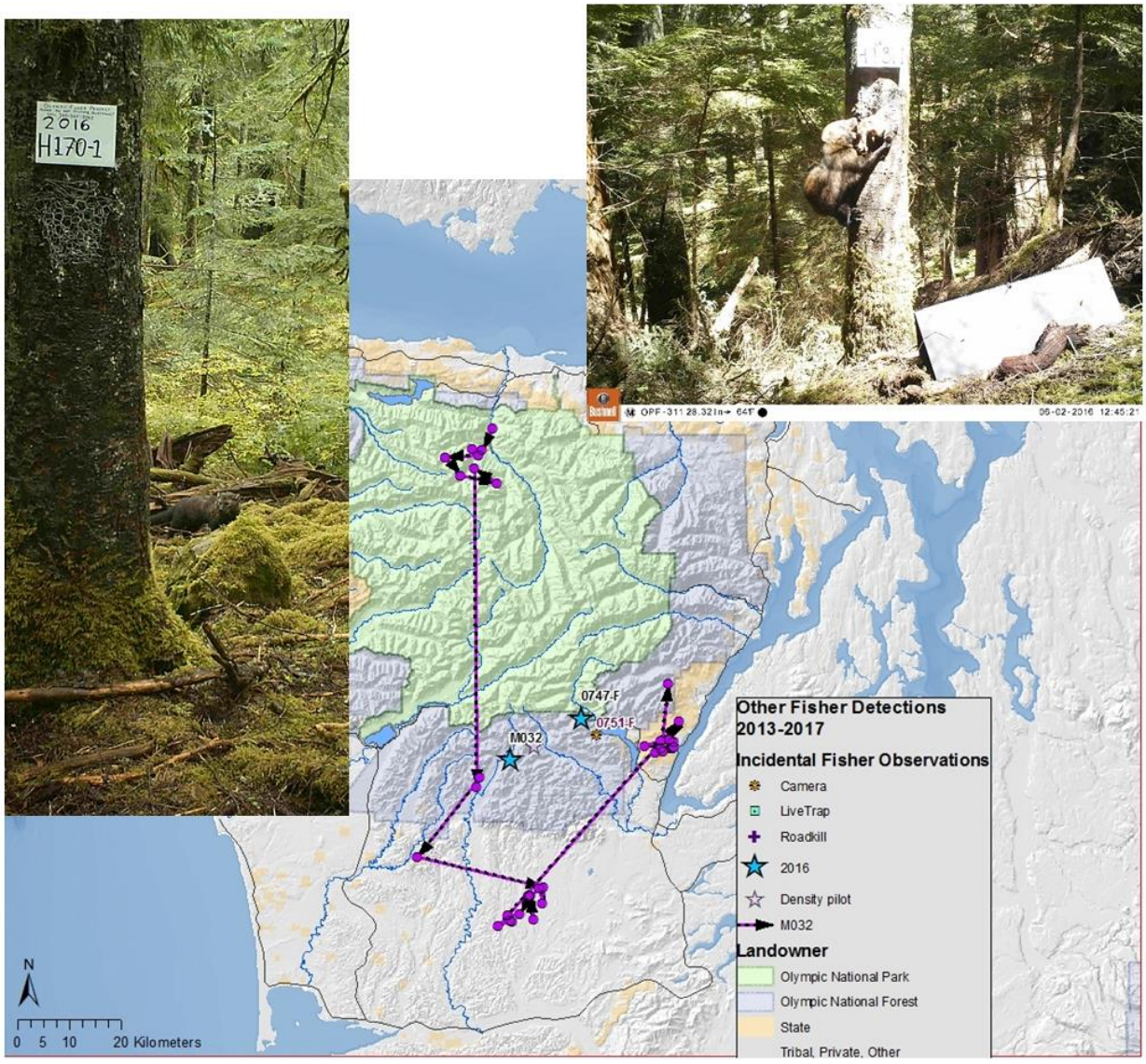

Figure A1. Movements of M032 (purple dots) from release in 2009 through 2010. Also shown are detection locations in 2016, and location of 0747-F – a female he bred with, and one of his offspring (0751-F). Inset are pictures of M032 in hex 170 and 181.

M035 was released in the Sol Duc Valley at the Aurora trailhead on 21 December 2008. He was 8 months old at the time of release. He did not move extensively following his release, and set up a home range in the Sol Duc area (Figure A2). We obtained 40 locations on him until we received a mortality signal on 12 April 2010. Upon investigation, all that was found was a shed collar. He was detected in 2013 in hex 455, but not there again in 2015 when we re-sampled that hex. Fisher 0517-M, detected in 2015, is the offspring of M035 and F006 (Happe et al 2016).

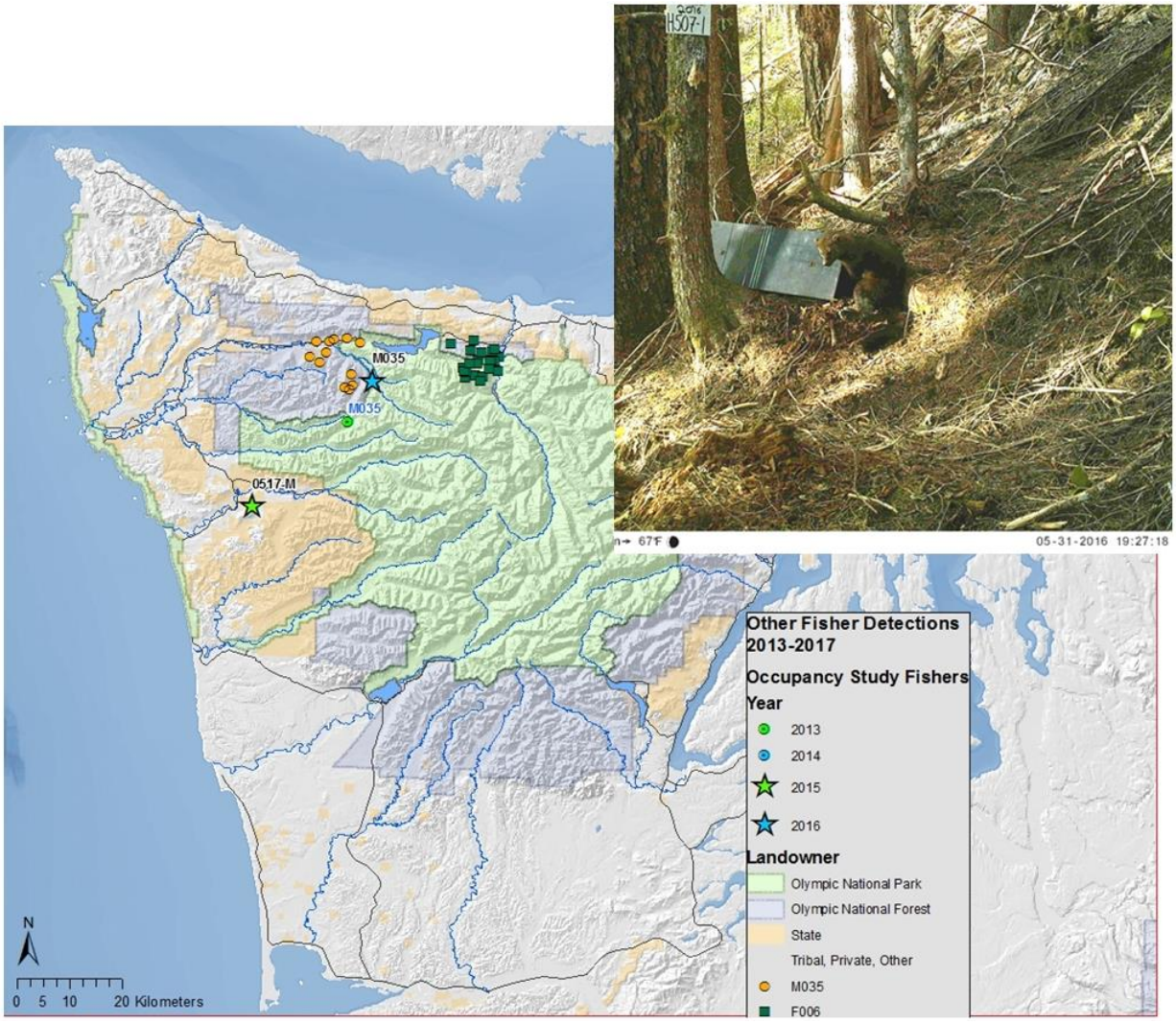

Figure A2. Movements of M035 (orange dots) in his home range from 2009 through when he shed his collar in 2010. Also shown are detection locations in 2013 (green dot) and 2016 (blue star), location of offspring 0517-M (detected in 2015) and F006 (green squares) from 2009-2010 (0517-M's mother). Inset is a picture of M035 taken in 2016.

M075 was released in the Quinault Valley on 21 January 2010. He was 8 months old at the time of release, and was radio-tracked for 23 months, until his signal was lost (presumably the batteries in his radio collar died). Although we radio-tracked his movements for almost two years we do not have many telemetry locations from him; his long-distance and unpredictable movement patterns made him a challenge to radio-track and (Figure A3). He is the father of 0728-M, detected in 2013 (Happe et al. 2014). In 2014 he was detected in Hex 204 by the USFS Marten crew on 18 March 2014, but not detected by the study crews when the hex was sampled from May-July 2014. We speculated in 2014 that since March is the breeding season, this detection may represent a breeding season movement and not a location within his primary home range. In 2014 in hex 202 we detected a collared fisher, but were unable to determine its identity through DNA analysis. We detected M075 in hexes 180, 190, 191, and 202 in 2016.

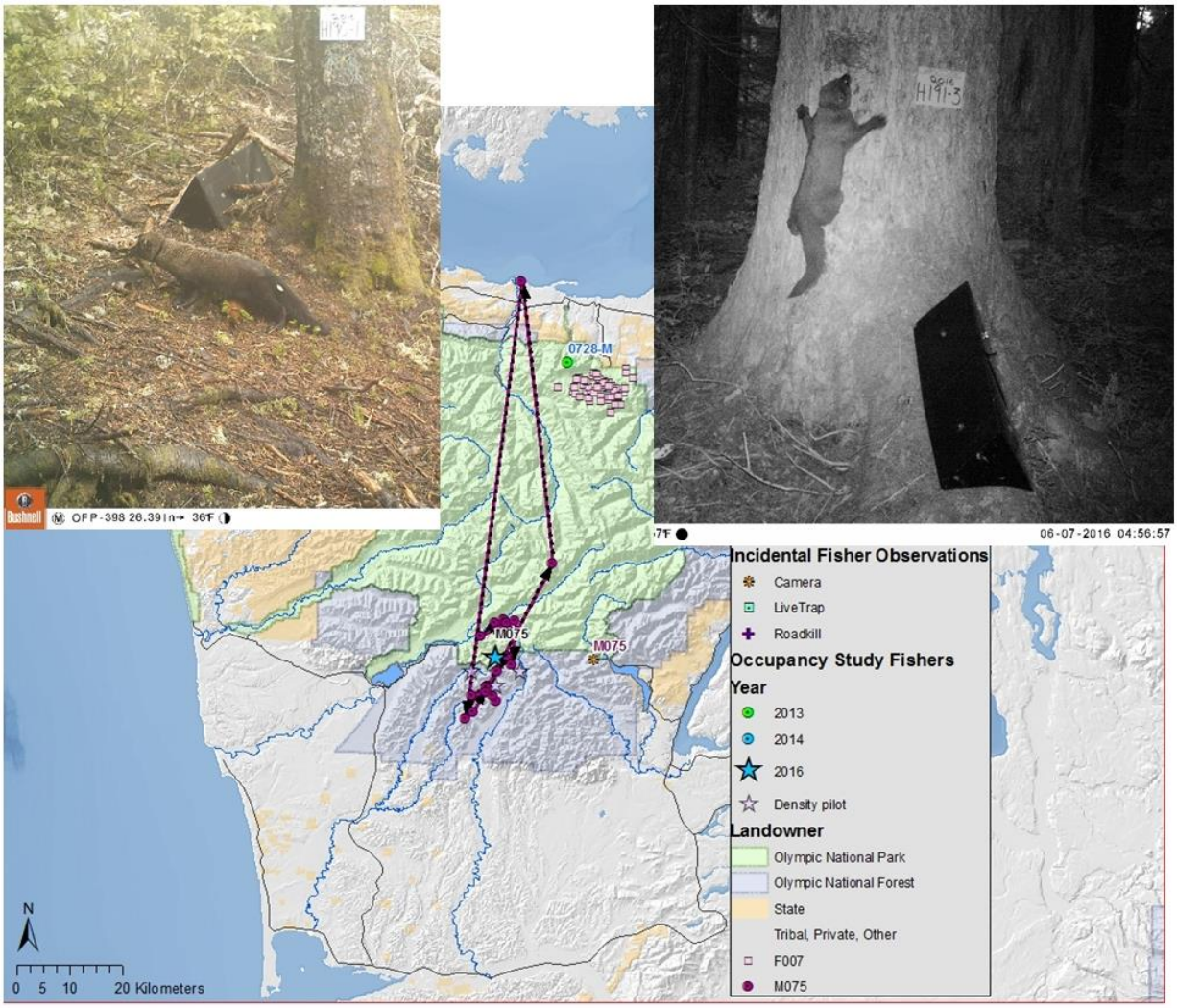

Figure A3. Post release movements of M075 from 2010 through 2011 (maroon dots). Also shown are detection sites in 2014 (orange asterisk) and 2016 (blue and purple stars), location of offspring 0728-M, detected in 2013, and 0728-M's mother F007 (pink squares). Insets are pictures of M075.

Appendix B. New recruits recaptured in 2016.

Animal ID	How Detected	Method	Hex 2016	Prior detection	Age at Release	Age in 2016	Sex
M101	Occupancy Study	Camera and DNA	202	Hex 202, 2014, Occupancy study	0	6	Male
0747-F	Occupancy. Study	Camera and DNA	204	Hex 204, 2014. Occupancy study	–	6-7	Female
0494-F	Fall marten-follow up	Camera and DNA	255, 281, 309	Hex 309, 2015 Occupancy study	–	>4	Female

M101 was one of the two kits born to F088 in 2010. F088 was a 3 year old female that was captured on 22 January 2010 in BC, and released into the park on 20 February 2010 in the Boulder Creek Drainage. She was pregnant at the time of her release, and quickly settled down and denned on DNR lands on the NE Peninsula by 5 April 2010. Her den site was closely monitored, and we documented that a bobcat was frequenting the den tree. She was found dead on 8 June 2010 due to bobcat predation. We retrieved her two remaining kits on that day, and transferred them to Northwest Trek on 10 June where they were raised with minimal human contact. Following attainment of near mature size, and after they were observed to capture and kill live prey, they were released in to the Park on the road to Obstruction Peak on 15 October 2010. M101 was radio-tracked until 28 June 2011, at which time he shed his collar. He was detected in Hex 202 and 203 in 2014, 47 km from his release site (Happe et al. 2015), and again in hex 202 (at two stations) in 2016 (Figure B1). He was 6 years of age at the time of his detection in 2016.

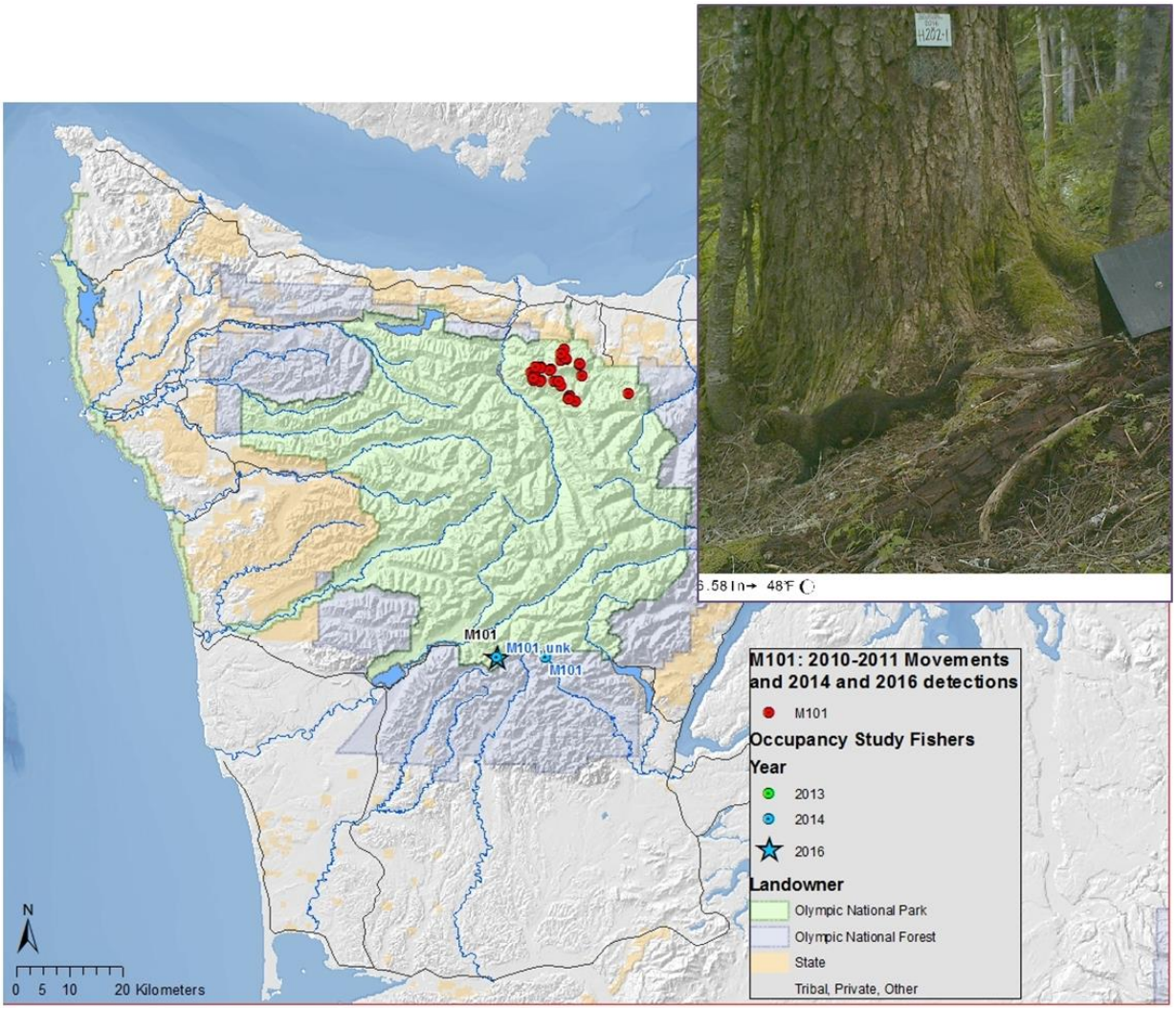

Figure B1. Post release movements of M101 from 2010 and detection sites in 2014 and 2016. Inset is a picture of M101 taken in 2016.

0747-F was detected in Hex 202 in 2014 (Happe et al 2015). She is a first generation fisher, whose parents were F007 and M009. She is the mother of 0751-F (detected in 2014) and 0817-F (detected 2016), and was estimated to have been born in either 2009 or 2010 (Happe et al. 2015), which would make her at least 6 years old in 2016. She was detected at the same 2 stations in both 2014 and 2016 (Figure B2).

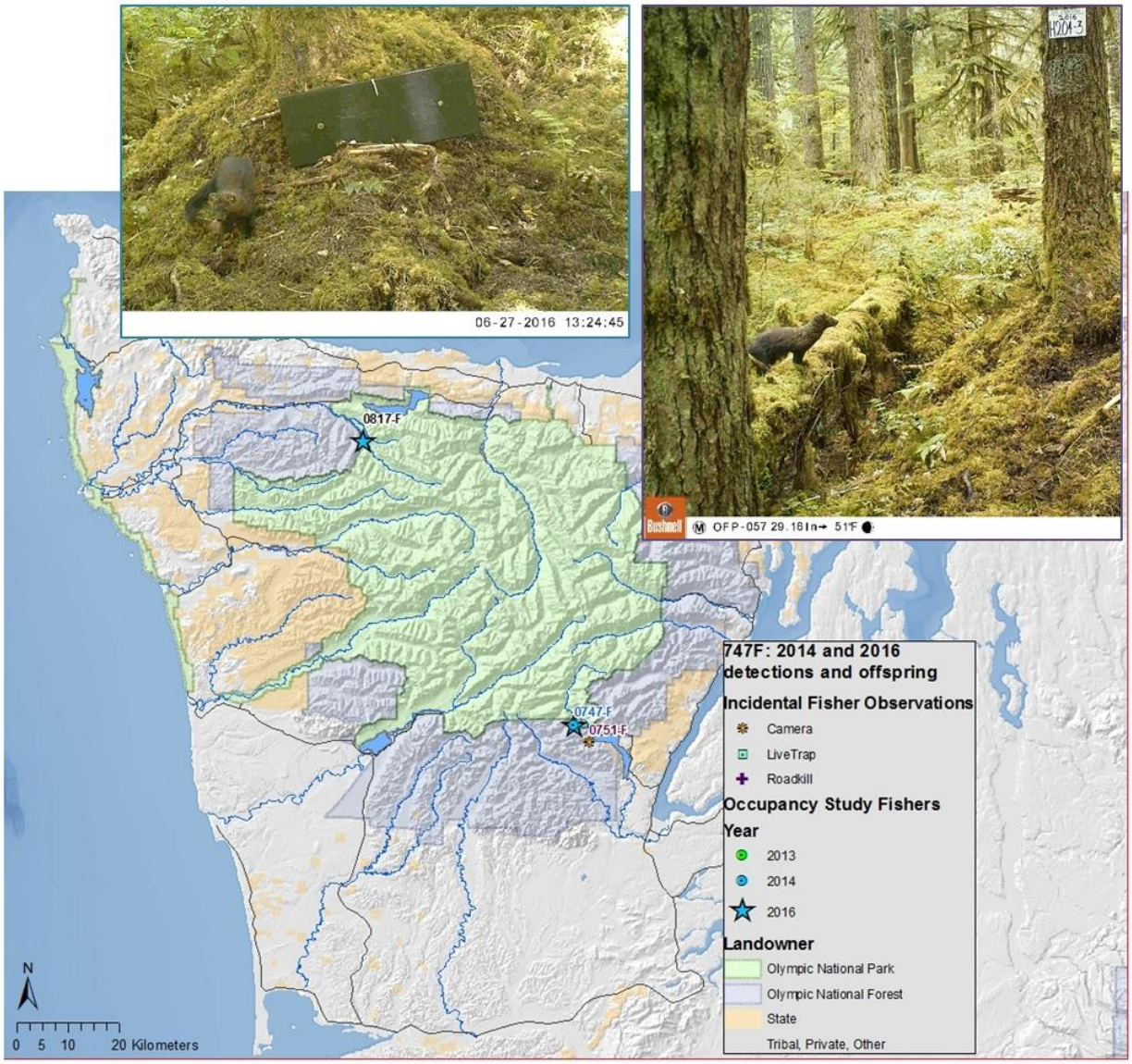

Figure B2. Detection location of 0747-F in 2014 and 2016, and the location of her offspring 0751-F and 0817-F. Insets are pictures of 0747-F taken in 2016.

0494-F was detected in hex 309 in 2015, and is the offspring of founders F048 and M097 (Happe et al 2016), and estimated to have been born in 2011 or 2012. She was detected in the same area in 2016, but in stations set up along the coast for the winter marten-follow-up (Figure B3). She is the mother of 0828-F, who was detected in 2015, and 0897-M and 1028-M who were detected in 2016 (Appendix C). She has had at least two litters: M082 is the father of 0828-F and 0897-M, but 1028-M's father is either M062 or an unknown male.

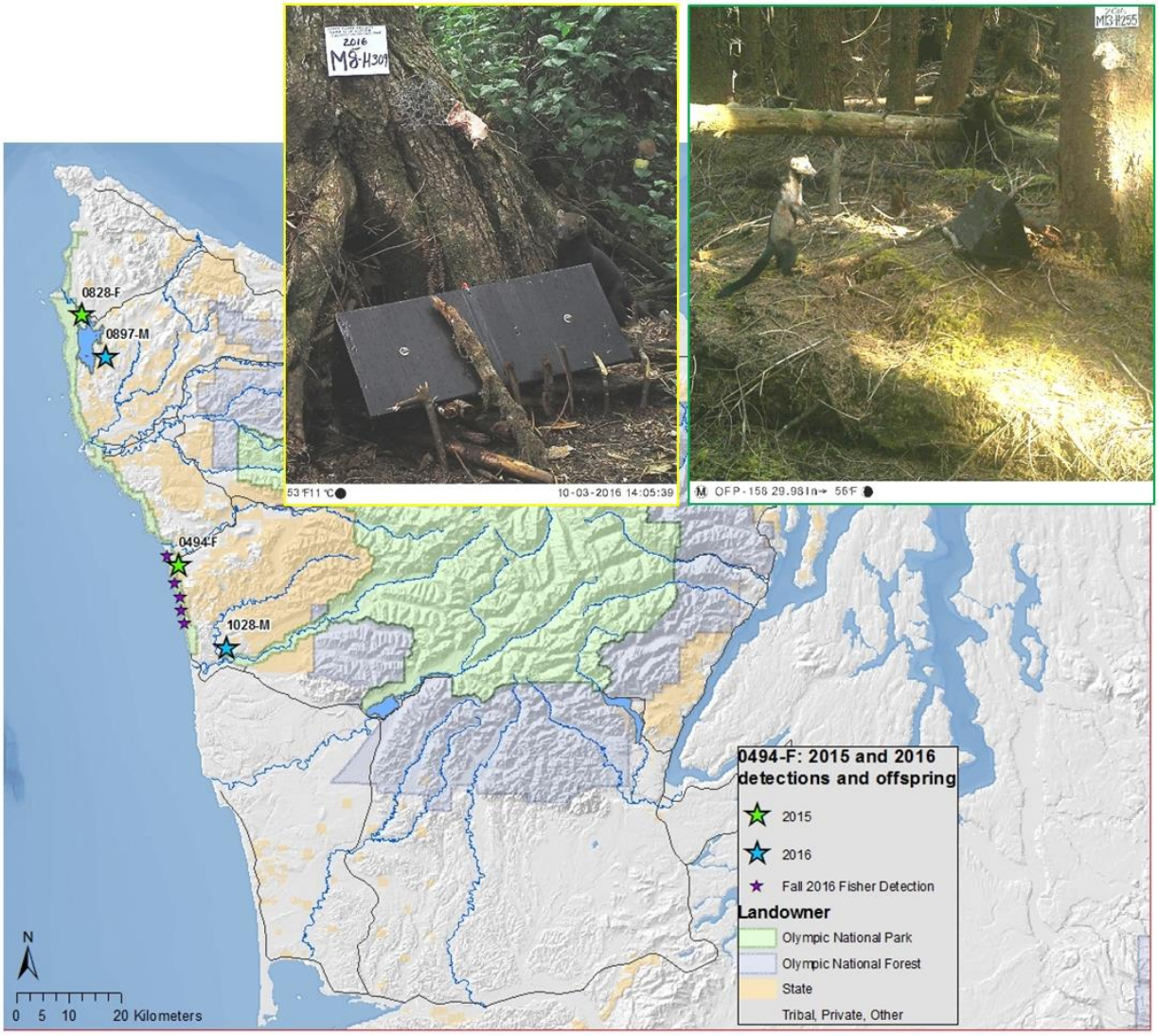

Figure B3. Detection locations of 0494-F in 2015 (green star) and 2016 (purple stars). Also shown are locations of her offspring 0828-F, 0897-M and 1028-M. Insets are pictures of 0494-F in 2016.

Appendix C. Parentage of recruits first identified by DNA in 2016.

Table C1. New fishers identified in 2016 and early 2017 on the Olympic Peninsula, and individuals genetically consistent with a parent/offspring relationship. Listed are relationships that are genetically possible, but some are more likely than others. For five fishers there is single pairing that is genetically consistent; those animal identifications are in bold letters and are the most likely the parents of the new individual. However, there may be other individuals in the study area that are un-sampled that may also be a possible parent.

Animal ID	How Detected*	Method	Where	Mother	Father	Gender
OPF-0891	S.M. follow up	Camera and DNA	Hex 501	**F103**, F104, 0077-F	**M062**, 0728-M	Male
OPF-1234	F.M follow up	Camera and DNA	Hex 231	F004, F017, F103, F102	0489-M, 0175-M	Male
OPF-0175	Occ. study	Camera and DNA	Hex 106	F004	M093, OPF-1234	Male
OPF-1256	F.M follow up	Camera and DNA	Hex 467	F076	M082, 1079-M	Female
OPF-1079	Occ. study	Camera and DNA	Hex 135	**1256-F**, F074	M058, **M077**, M082	Male
OPF-0805	Density study	Camera and DNA	Hex 193	F004, F057, F068, 0751-F	M032, M056, M092	Female
OPF-0817	Occ. study	Camera and DNA	Hex 507	**0747-F**, F022	**M032**, M063	Female
OPF-0897	Occ. study, S.M. follow-up	Camera and DNA	Hex 552	F074, **0494-F**	**M082**, M097	Male
OPF-1028	Occ. study	Camera and DNA	Hex 232	F001, **0494-F**	M014, M031 **M062**, M083	Male
OPF-1035	Incidental	Live trap, released	Hex 177	F004	unknown	Male

* S.M. follow up=marten study follow-up sampling, conducted spring (March) 2016; F.M.= marten study follow-up sampling, conducted September-October 2016; Occ. study = fisher occupancy study; Density Study=density pilot study.

As the years post release have progressed it has become harder to assign parentage to new recruits that are discovered. This is because as we get into the second or third generation of fishers, there are often multiple possibilities. Also, the opportunity for unknown (unsampled) fishers to be on the landscape increases – especially since we are sampling only 30% of the landscape in the target area (non-contiguous hexes) and less in the expansion areas. In some cases new fishers show up as possibilities for each other's parents – it is clear that there is some relationship, but what that

relationship is hard to discern. Below we used knowledge of founder survival, distribution and reproduction, in addition to where new recruits were detected, to evaluate probable, possible, unlikely, and impossible parentage.

OPF-0891-M: There is a pairing in the database that is consistent for both being the parents of 0891-M: female F103 and male M062 (Table C1); all the alleles for OPF-0891 fall out nicely if those two mated.

This pairing is possible, however if correct, it confirms our suspicion that the teeth samples got switched in the lab while doing age determination. In 2013 we recovered the carcasses of 3 females – F102 (April 2013), F103 (May 2013), and F104 (December 2013); all were offspring of F004 and M009. The field and necropsy notes indicate that F102 was young (0-1 years old) with no history of pregnancy, F103 was a lactating adult with four placental scars, and F104 was a young adult with no history of recent pregnancy (Happe et al 2014). The results from the tooth lab indicated that F102 was 4 years old and F103 was 2 and F104 was 1 year old. We suspect that the samples were switched somehow in the lab, and F103 was 4 years old at the time of her death – which would have then made her one of the 4 kits known to be born to F004 in 2010.

M062 was released in 2010 at 8 months of age. We received a mortality signal on him in January 2011, but his carcass was never found. It is possible that he slipped his collar (as did fishers M035, M099 and M101 which we have detected in this study). The few locations we have for him are on the northern portion of the study area, near where F103 was recovered (Figure C1).

F103 could have bred with M062 in 2011, and given birth to 0891-M in 2012.

0077-F is possible as the mother. She was detected in 2013 near where 0891-M was detected (Figure C5), and she could have mated with an un-sampled fisher any year after 2012.

0728-M could be the father. 0728-M is the offspring of F007 and M077, and was detected in 2013 in the northern portion of the study area. He could have bred with an unknown female any year after 2012.

F104 is unlikely as the mother, as she was recovered dead in 2013 and estimated to be either 1 or 2 years old, and had no signs of prior pregnancy.

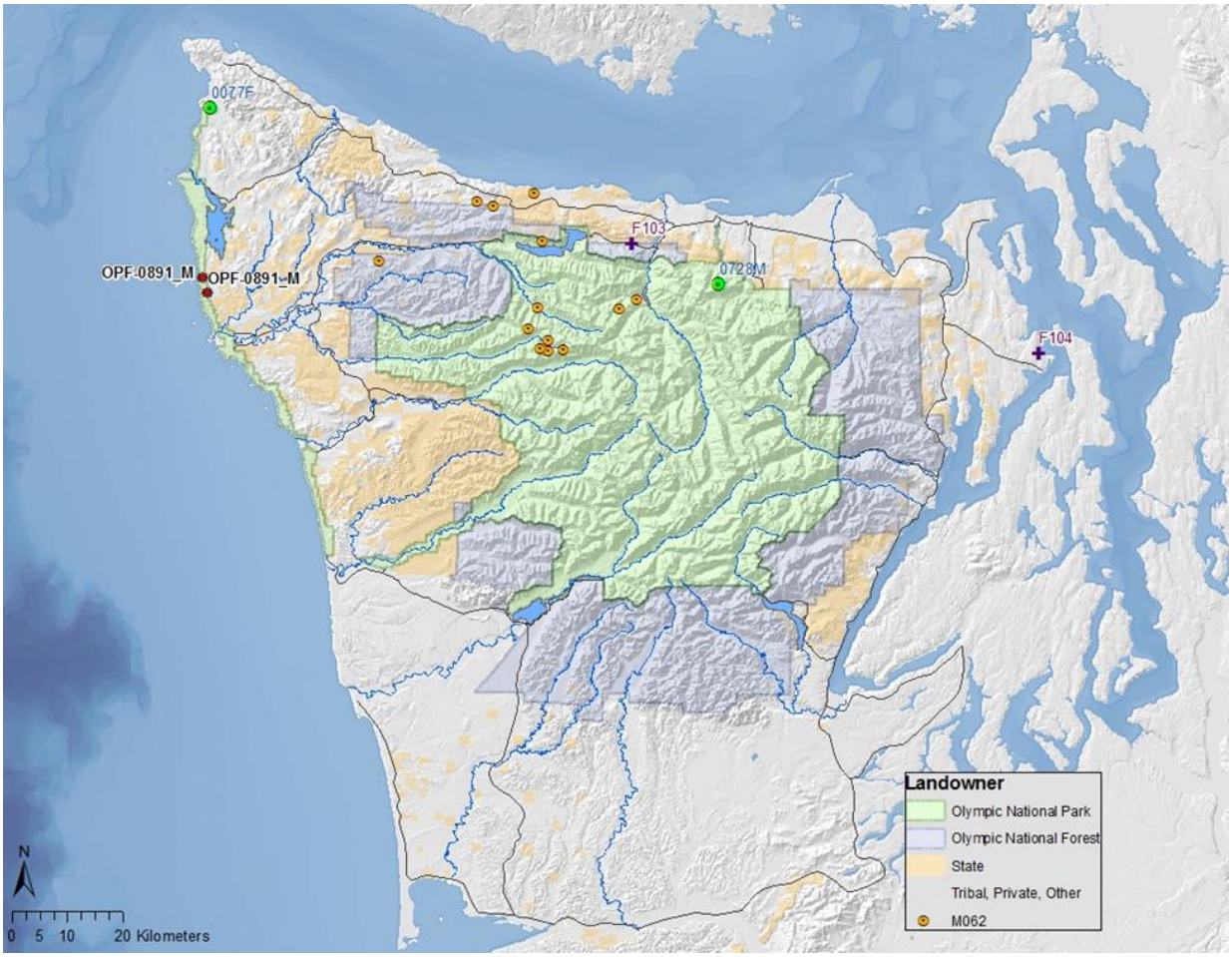

Figure C1. Detection sites for 0891-M, and location or detection sites for his possible parents. Shown are mortality sites for F103 and F104, telemetry locations for M062 (2010), and detection locations for 0077-F (2013) and 0728-M (2013).

OPF-1234-M: The lab was unable to determine the parents of OPF-1234-M; there were no pairings of fishers in the database that would be consistent with both being 1234-M's parents (Table C1).

Either 0489-M or F017 could be one of 1234-M's parents.

0489-M: Could be the father of 1234-M, given his location. He is the offspring of F004 and M009, and the sibling of (but not necessarily the same litter) F102 and F103. He was detected near Kalaloch in 2015 (Figure C2); we have been getting reports of park staff seeing a fisher in that area since 2012, and we detected an un-collared fisher there in 2014 but the DNA did not amplify.

F017: Could be 1234-M's mother. F017 was released in 2008 at age 0, and after wandering for several months, settled down in the lower Queets corridor, near where 1234-M was detected (Figure C2). She was radio-tracked until April 2010 when her collar failed. It is possible for her to have lived for a number of years, and mated with an un-sampled male.

F004 is possible but unlikely. She was released in 2008 at age 2. We know she had 3 litters with M009, starting in 2010 (at age 5) – doubtful that she had more litters (with an unknown male) given her age.

F103: Not possible. She was born in 2010, appears to have had a litter in 2012, the first year it was possible for her to have denned (see discussion for 0891-M above) and she died in early 2013.

F102: Not possible. She died in April 2013 at age 1 or 2, and could not have had a litter.

OPF-0175-M: The lab was unable to determine the parents of OPF-0175-M; there were no pairings of fishers in the database that would be consistent with both being his parents. There is some genetic relationship between 0175-M and 1234-M (Table C1).

1234-M is likely the father of 0175-M. There is some genetic relationship between these two. They are not siblings (as the only parent they both have in common is F004, and because she is not their mother, they are not siblings).

F004 is possible but unlikely, for the same reasons as she is unlikely to be a parent of 1234-M.

M093 is unlikely to be the father. He was released in 2010 and died in May 2011- so if the female he mated with is not in the database, it had to be one that was born in 2009 or 2010 and there were not a lot of those that we know of.

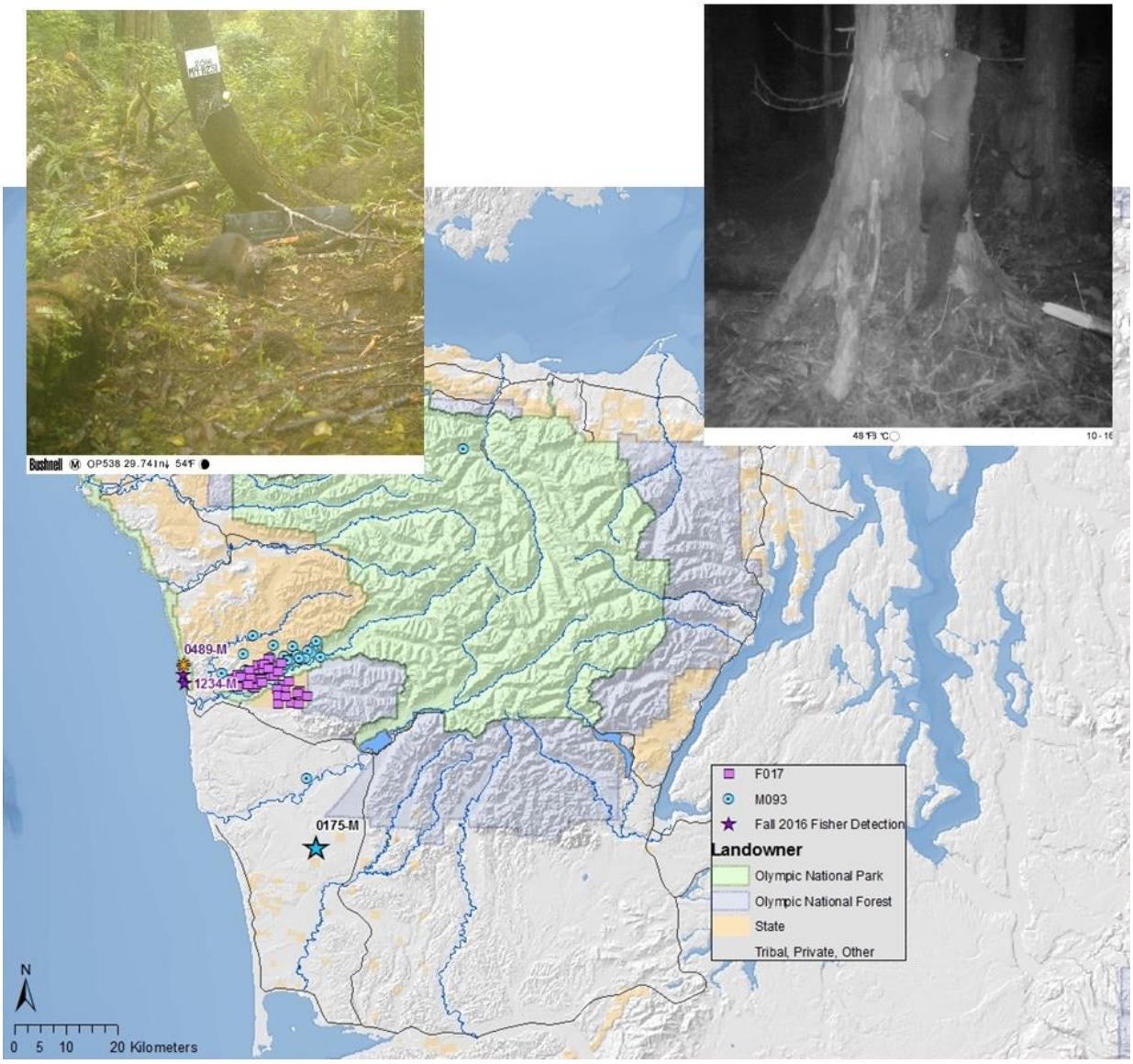

Figure C2. Location of detection sites for 1234-M and 0175-M. Shown are the locations for possible parents of 1234-M (telemetry locations for F017 (2008-2010) and detection location of 0489-M) and possible parents of 0175-M (1234-M and telemetry locations of M093 (2010)). Insets are 1234-M (left) and 0175-M (right).

OPF-1256-F: The lab was unable to determine the parents of 1256-F; there were no pairings of fishers in the database that would be consistent with both being 1256-F's parents (Table C1).

Either F076 or M082 could be one of the parents of 1256-F.

F076 could be 1256-F's mother. F076 was released in 2010, but based on her movements, did not den in 2010. She settled down on the coastal plain, north of Kalaloch, in June 2010 (Figure C3). She was tracked until February 2011, when we lost contact with her – we assume the collar failed, so her ultimate fate is unknown.

M082 could be 1256-F's father. M082 was released in 2010 and lived on coast near Kalaloch until at least 2012. He was detected in 2014 in hex 170 (but not there in 2016), and is the father 0828-F and 0678-M.

OPF-1079-M: There is a pairing in the database that is consistent for both being the parents of 1079-M, and that is 1256-F and male M077 (Table C1). This pairing is possible. 1256-F is the offspring of an unknown first or second generation fisher (born 2009 or later) and either F076 (released in 2010 – did not den in 2010) or M082 (released in 2010 at age 0; he could have bred in 2011 and had offspring born in 2012) – which would put 1256-F born around 2011 or 2012 at the earliest. She would then have bred with M077 in 2013 or later and 1079-M would have been born in 2014 or later. This scenario makes a bit of sense in that this may be a younger animal since this hex was unoccupied in 2014.

M077 was released in 2010, and tracked through 2011, and set up a home range in 2010 in the southern edge of the study area. However he did wander a bit – and is the father of 0077-F, another female that was detected on the north coast in 2013 (Figure C3). [Whose mother is F080 who was last seen in the northern portion of the study area.] It is possible that M077 shifted home ranges over the years (see distribution of M032 from 2010-2016 in Figure C4).

F074 is possible as a mother for 1079-M, but less likely: she was released in 2010 and tracked through June 2011. By 2011 she was pretty well settled down on the east side of the Olympics.

M058 is possible. He was released in 2010, but we have very little information on him (he was missing from February-October 2010). He was last found on 1 February 2011, after which we lost contact with him.

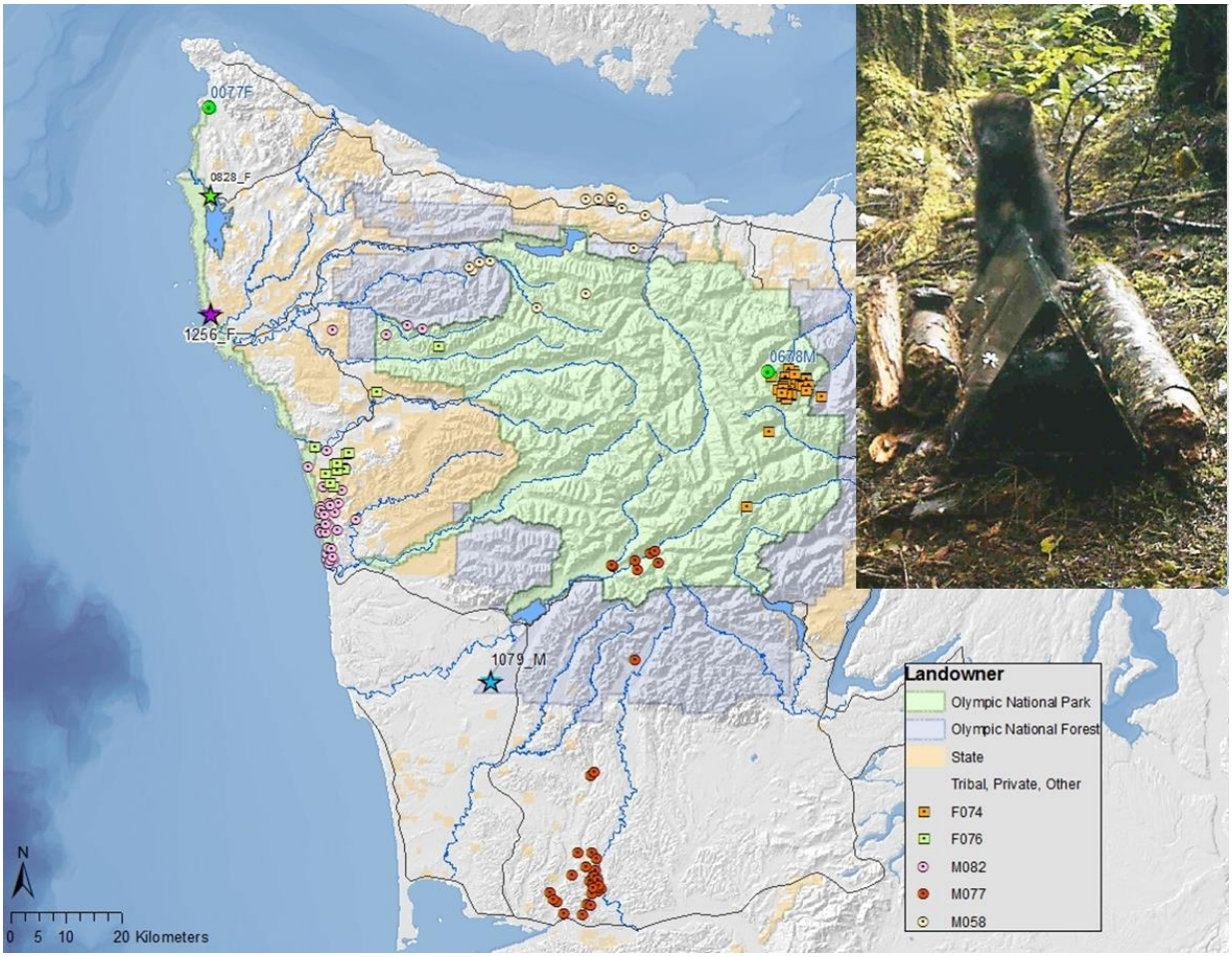

Figure C3. Detection locations of 1256-F and 1079-M. Also shown are locations of possible parents of 1256-F (telemetry locations of F076 (2010-2011) and M082 (2010-2011)) and possible parents of 1079-M (telemetry locations of M077 (2010-2011), F074 (2010-2011) and M058 (2010). Also shown are detection locations of other offspring of M077 (0077-F) and offspring of M082 (0828-F and 0678-M). Inset is 1079-M.

OPF-0805 - The lab was unable to determine the parents of 0805-F. There were no pairings of fishers in the database that would be consistent with both being 0805-F's parents (Table C1).

M032 is the most likely parent of 0805-F. He was released in 2009, has been in the area since 2010, and was still alive in 2016. It is possible there is an unknown female in the area that he mated with sometime over the years. Also, of all the candidates listed, he's the only one that has alleles at two of the loci that OPF-0805 has.

0751-F could possibly be a parent of 0805-F. 0805-F was found in the same spot as where female 7051-F was detected in the spring of 2014 (Figure C4). Since 0751-F is the daughter of 0747-F and M032, and 0747-F the daughter of F007 and M009, 0805-F could be part of the 3rd generation of fishers to be born here.

F004 is possible but unlikely. She was released in 2008 at age 2. We know she had 3 litters with M009, starting in 2010 (at age 5) – doubtful that she had more litters (with an unknown male) given her age.

F057 is possible. She was released in 2010, and we know she mated with M082 and had 0678-M who was detected in 2013.

F068 is possible. She was released in 2010 and radio-tracked until July 2011, when we lost contact (presumably radio-collar failure). She could have mated with an unknown male.

M056 is possible but less likely. He was released in 2010 at age 0. We received a mortality signal on him in June 2011 but his carcass was not recovered. It is not likely that he bred an unknown female in 2010 (due to his age and the availability of females born in 2009), but he could have in 2011 (still not too likely). He could have slipped his collar and not be dead, however.

M092 is possible. He was released in 2010 at age 2 and equipped with an ARGOS collar that failed right away; we have no idea what happened to him. M079, who also had a failed ARGOS collar, was detected in 2013, and recovered dead in 2014.

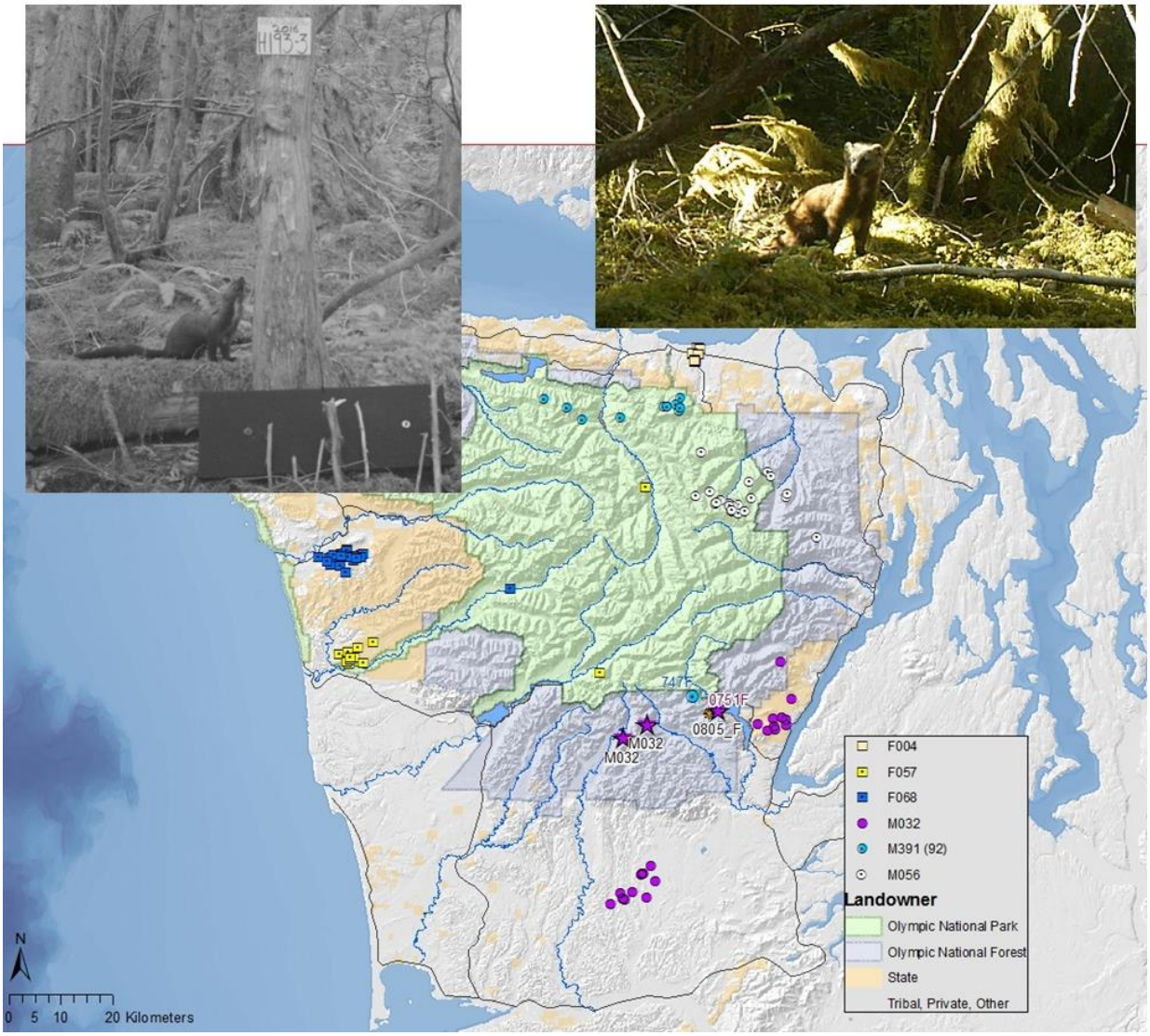

Figure C4. Detection location of 0805-F and all her possible parents. Shown are telemetry locations for F057 (2010-2011), F004 (2008-2010), F068 (2010-2011), M092 (2010), M056 (2010-2011) and M032 (2009-2010) in addition to detection location of M032 in 2016 and 0751-F in 2014. Insets are two pictures of 0805-F.

0817-F: There is a pairing in the database that is consistent for both being the parents of 0817-F, the pairing of female 0747-F and male M032 (Table C1). The pairing of 0747-F and M032 is very possible, as they occur near each-other (and were both detected still alive in 2016) (Figure C5), and are also the parents of 0751-F. 0817-F would have had to disperse over 68 km, but that is not unheard-of in the Olympics. Based on the allele composition, OPF-747 and M032 definitely look like the parents.

M063 is possible, but unlikely. He was released in 2010 at age 2, radio-tracked for a while, and found dead in October 2010. If he was the father, he would have had to have bred with a female born in 2009 for the mother not to be in the system (and there are only 2 females that we know

successfully denned in 2009 – F022 and F007) who then would have had to be able to successfully raise young at age 2.

F022 is possible as the mother. She was released in 2009, came down from BC pregnant and successfully denned. She left her home range in February 2010 and we lost contact with her. This could be her offspring from 2009 (the father in BC and consequently unknown to us), or a later litter from a male that was born here and not captured by us. She is the mother of H001-F (NB-2), a female that was detected in 2012, whose father was a 2010 release (M058) – so we know that F022 lived until at least 2011.

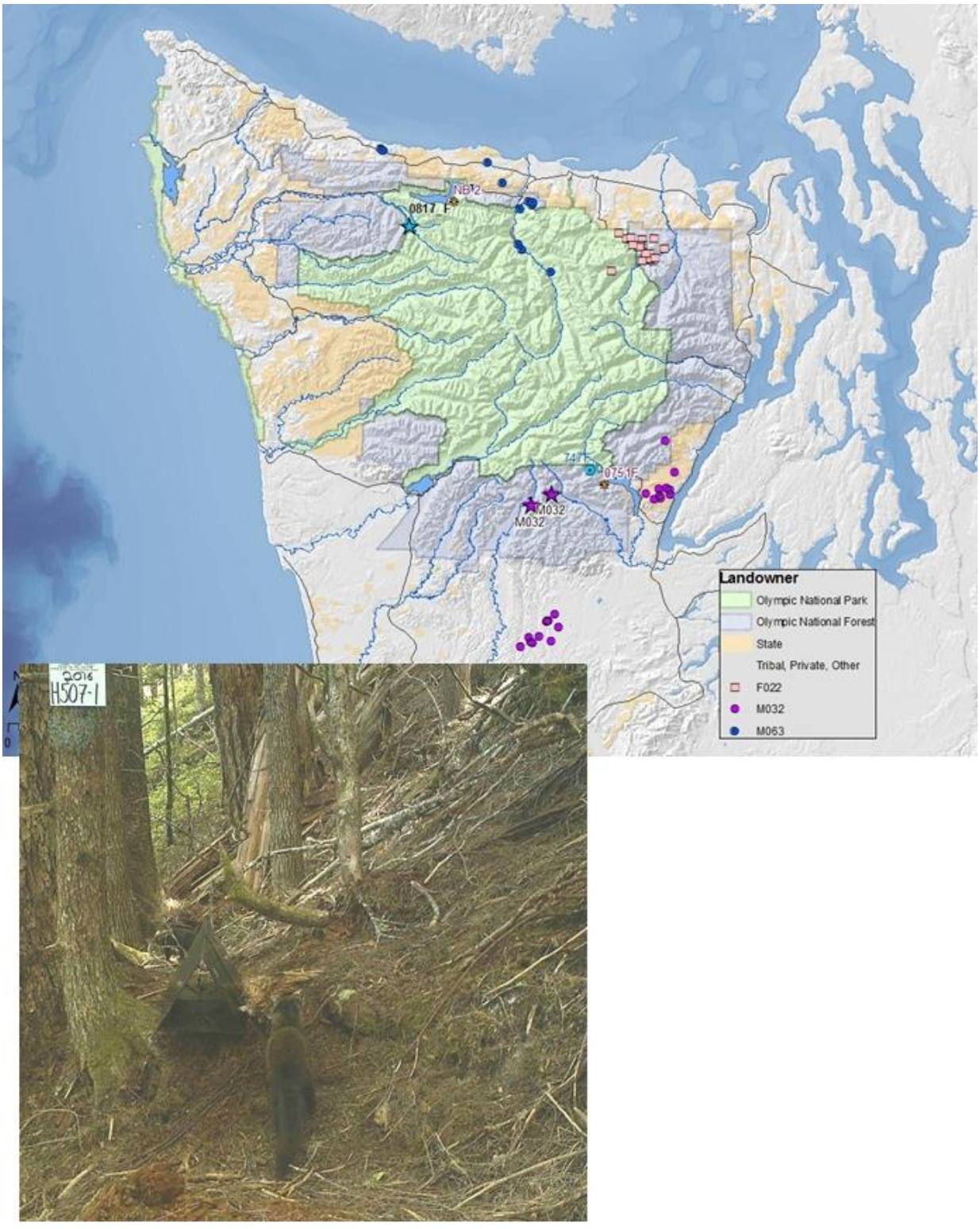

Figure C5. Detection location for 0817-F and possible parents. Shown are telemetry locations for M032 (2009-2010), F022 (2009-2010), and M063 (2010). Also shown are detection locations for 0747-F and M032 in 2016 and detection locations for possible siblings 0751-F and NB-2. Inset is picture of M035 AND 0817-F at the station at the same time. One fisher is behind the cubby.

0897-M: 0897-M was detected near Lake Ozette during both the coastal marten study in March 2016 and in the occupancy study in September 2016. There is a pairing in the database that is consistent for both being the parents of 0897-M: female 0494-F and male M082 (Table C1). This pairing is both possible and very likely, as they occurred near each-other, and are the parents of 0828-F who was detected near lake Ozette in 2015 (Happe et al. 2016) (Figure C6). In addition, 0897-M and 0828-F appear to be siblings.

F074 is possible, but less likely: she was released in 2010 and tracked through June 2011. By 2011 she was pretty well settled down on the east side of the Olympics.

M097 (388) is unlikely to be the father. He was released in 2010 with an ARGOS collar (number 388) that quickly failed, so we are not sure of his fate. However, almost all his locations were concentrated in a very small, but remote, area. We suspect he died soon after release, but were unable to confirm that suspicion. It is possible that he shed his collar, but unlikely given the characteristics of the ARGOS collar.

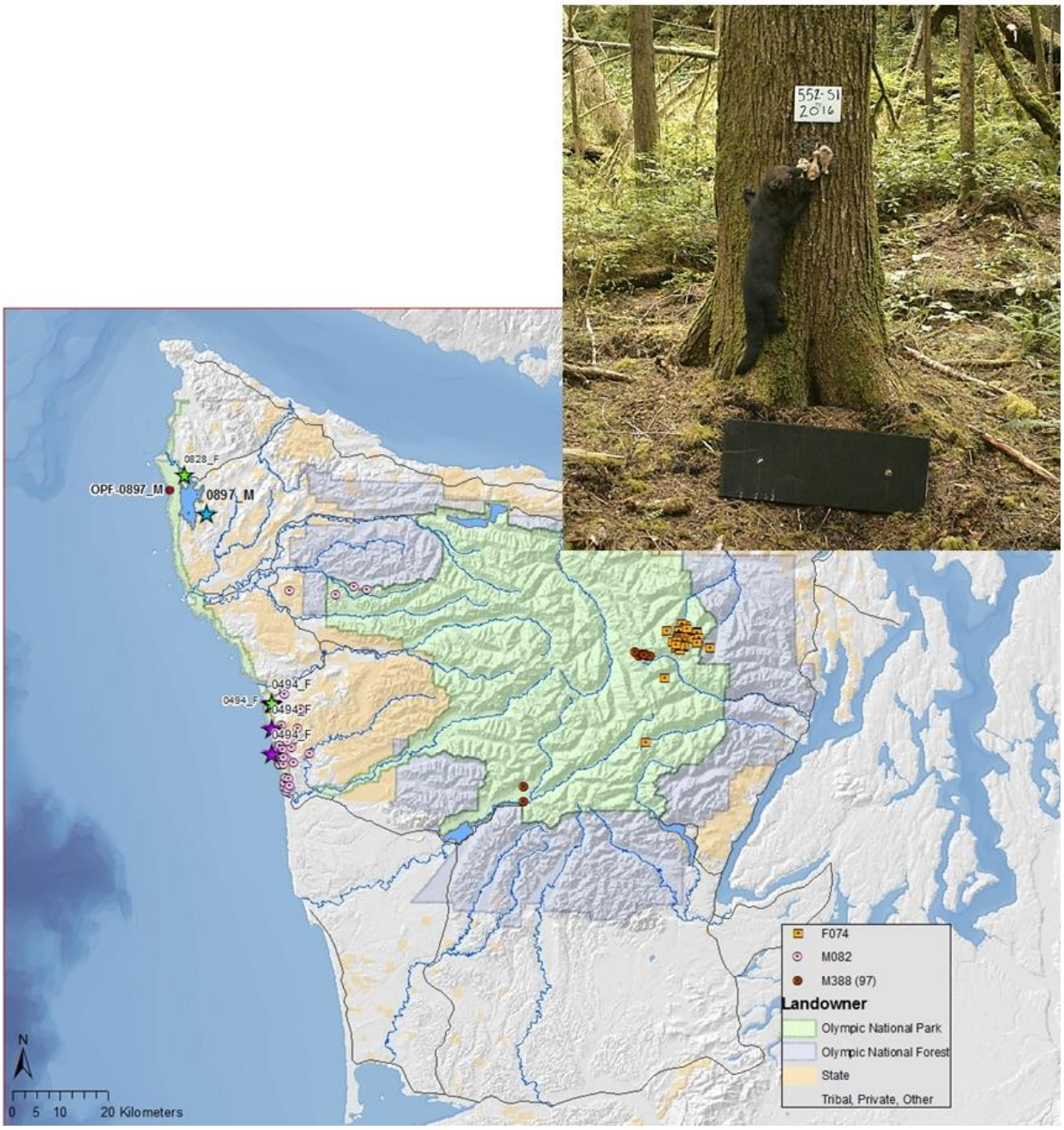

Figure C6. Detection locations of 0897-M in the winter marten study (red asterisk) and the occupancy study (blue star). Also shown are telemetry locations of possible parents F074 (2010-2011), M388/97 (2010) and M082 (2010-2011) and detection locations of 0494-F in 2015 (green star) and 2016 (purple stars). Also shown is detection location of sibling 0828-F who was detected in 2015. Inset is 0897-M in hex 552.

1028-M: 1028-M was detected in Hex 232 in 2016 (Figure C7). In 2014 we also detected a fisher in 232, but did not obtain any DNA, so it is unknown if he was in this hex in 2014 also. There is a pairing in the database that is consistent for both being the parents of 1028M: 0494-F and M062 (Tab le C1).

The pairing of 0494-F and M062 is possible, but not as likely as other scenarios. 0494-F was known to be alive in 2015 and 2016, and born in 2011 at the earliest (Happe et al. 2016). M062 was released in 2010 at 8 months of age. We have little data on his movements: he was missing between April 26 2010 and Jan 11 2011, when we received a mortality signal. We were not able to find his carcass, so he could be alive with a shed or malfunctioning radio-collar, and have moved to near the coast where 0494-F is. OPF-0494 is a good fit for the mom given her alleles (OPF-1028 has alleles at several loci that only OPF-0494 has) so 1028-M is either her offspring with M062 or an unknown male (but M062's alleles fit like a glove with hers to produce 1028).

M014 is possible as the father (with an unknown female). He was released in 2008, established a home range on the coast near Grays Harbor, and was radio-tracked until we lost his signal in 2010 when his collar failed. It is possible that he mated with an unknown female.

M083 is possible as the father (with an unknown female). M083 was released in 2010 and tracked until April 2011 when we lost contact, presumably due to collar failure.

F001 cannot be the mother. F001 did not den in 2008, may have denned in 2009, and died in June 2010. If she had a litter in 2010 the kits would not have survived. If she denned in 2009, she would have had to mate with a known male in 2008, and there are no possible pairs for F001 and known males that work for 1028-F.

M031 is not likely to be the father. He was released in 2009 at 8 months of age, and recovered dead in May 2009. He was too young to be an effective breeder in 2009 and to our knowledge there were no unknown females in the population in 2009 for him to breed with.

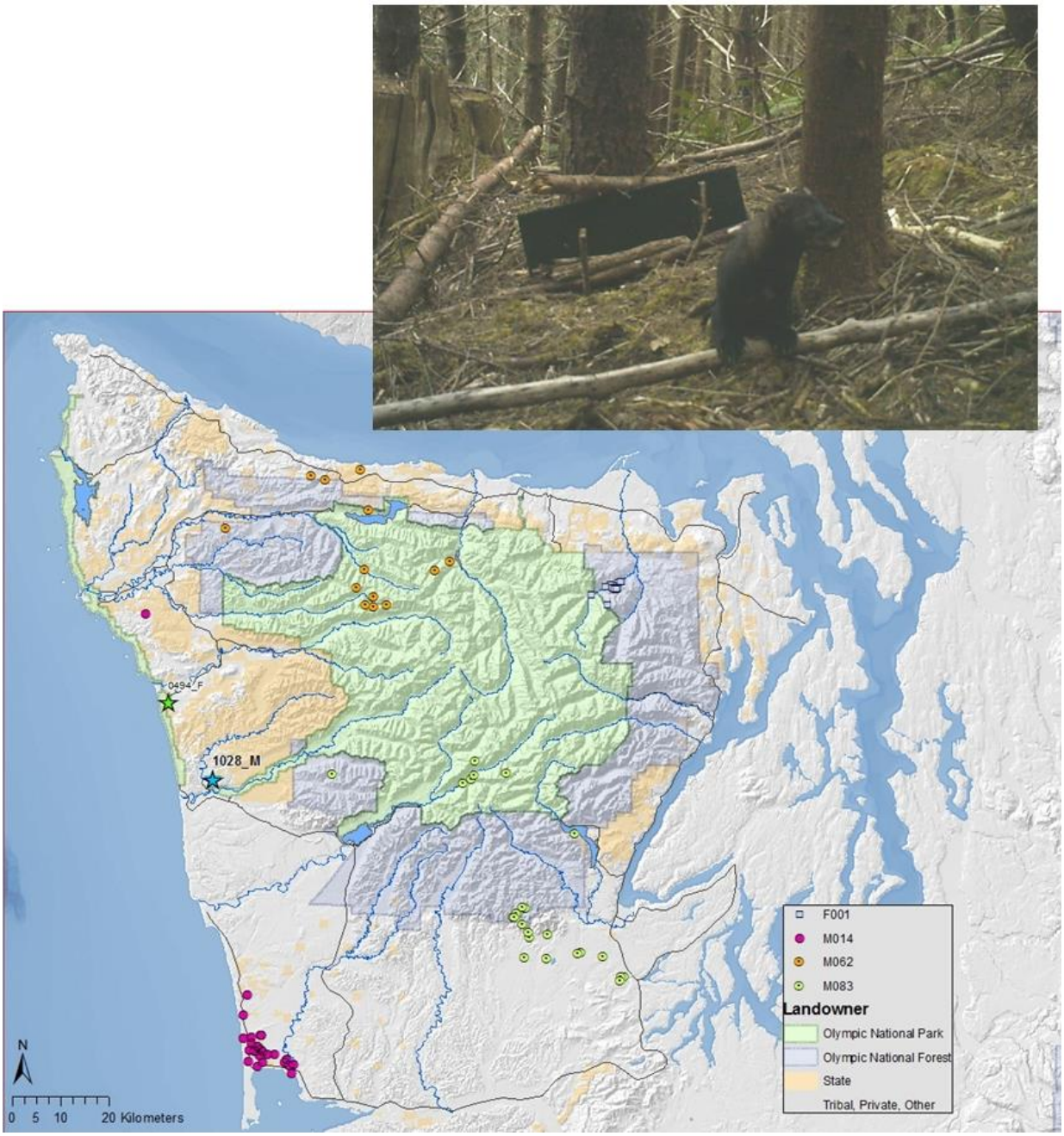

Figure C7. 1028-M and possible parents. Shown are telemetry locations for F001 (2009), M014 (2008-2010), M083 (2010) and M062 (2010) and detection location for 0494-F in 2015. Although M014 established a home range in the southwest portion of the study area, he was observed in 2009 to make an excursion into the central portion of the study area during the 2009 breeding season. He returned to his home range after that excursion. Inset is 1028-M.

1035-M: 1035-M was caught in a trap intended for a bobcat in February 2017. The trapper immediately contacted WDFW, who requested that a hair sample be collected if at all possible prior to the animal's release. We have no pictures of the animal, however we did review film clip images of its release. The lab was unable to identify any parent of 1035-M (Table C1). The only possible

mother was F004, and no possible father was identified. For the same reasons discussed previously with 1234-M and 0805-F, it is very unlikely that F004 is 1035-M's mother.

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

NPS 149/140396, October 2017

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