2018 REPORT

PROPOSAL FOR FOOD HABITS STUDY FOR THE SIERRA NEVADA RED FOX (*Vulpes vulpes necator*) AND PACIFIC FISHER (*Martes pennanti*) AT CRATER LAKE NATIONAL PARK, OREGON.

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EXECUTIVE SUMMARY

This Sierra Nevada Red Fox study continues with the support of wildlife science partners, Oregon Wildlife Foundation, The National Park Service and Oregon State University.

This work furthers identification of previously located and undiscovered SNRF in the Southern Oregon Cascades. SNRF Geneticists confirm from our scat samples that our foxes directly descend from a pure genetic line of ancient ice age fox; northern Oregon SNRF in contrast are hybridized. Therefore, scientists recommend priority attention to southern SNRF.

Some of our results include suggestions for home ranges using scat-centered locations delineating focused transects. This study reveals preliminary analysis of prey items for calculating SNRF niche breadth. Habitat surveys document percent cover attributes. Dr. Cate Quinn, noted SNRF scientist, advocates this study's continuance as a sound step toward developing a conservation strategy for Oregon's rarer southern SNRF population.

ACKNOWLEDGEMENTS

Once again, we are exceedingly grateful for the utmost support from the **Oregon Wildlife Foundation.** They have been integral to the success of this study and a more hopeful future for Oregon southern population of the Sierra Nevada red fox. Without their funds for a wildlife biologist to organize and train student volunteers, lead field work, guide lab breakdown of scats, liaison with UC Davis geneticists, and assist in report writing; continuing this study would be difficult.

Dr. Ben Sacks and Dr. Cate Quinn at UC Davis cannot be thanked enough for their generous support for genetic analysis of our scats for the last three years. (Congratulations Cate, on your completed Doctoral dissertation on SNRF).

Crater Lake National Park. Tireless National Park Terrestrial Ecologist, Sean Mohren, enthusiastically provided field support for students, lodging at the Park, great advice, equipment and communication radios. Sean facilitated a **National Park Service Cooperative Ecosystem Studies Unit grant.** Thanks so much Sean. Thanks to **Crater Lake Natural History Association** for campsite fees.

We appreciate **OSU Cascades** for lab facilities, office space and **Dr. Ron Reuter** for providing equipment and scat shipping costs.

And of course, our fabulous volunteers who worked so hard under all conditions, we Thank You!

Team lead: ***Ellen Robson; Tess Phillippi, Brian Berry, Lisa Horton, Nick Altimus, and Maya Laincz*****.**

INTRODUCTION

This is a continuing summer food habits study for the Sierra Nevada red fox, (*Vulpes vulpes necator*), Pacific fisher (*Pekania pennanti*) and American marten (*Martes americana*) in Crater Lake National Park, Oregon. This study initiated in the summer of 2016 continues its stated focus while expanding into deeper research as new insights are unearthed.

The study area focuses on Crater Lake National Park expanding into high elevations of adjacent Umpqua National Forest Mt. Thielsen Wilderness Area in 2018. Wolf (*Canis lupus*) inclusion is foci for data collection as well.

After rediscovery in California's Sierra Nevada Mountains in 2012, SNRF presence in Crater Lake National Park (CLNP) was noted and sightings verified. A food habits study offers genetic proof of species scat, information regarding population and food competition with likely similar size carnivores in similar habitats. Indeed, collecting enough scat samples might identify home ranges and habitat preferences that are statistically meaningful.

To this end, we enlist OSU Cascades Natural Resource wildlife student volunteers for summer field work. It involves intense on the job training for up to 2 months applying class and outdoor learning in data collection, recording data and honing observation skills for future professionals.

In 2016, SNRF sightings were declining in the Park to zero, our summer field results secured 2 scats. In the winter of 2017 SNRF were observed crossing roads in the Park and one scat was collected in a different location that summer. In summer of 2018 there was a sighting of a SNRF by Park staff near a ridge where collection of SNRF scat occurred the previous summer. Final genetic analysis is still underway for 2018 scats.

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METHODS

In 2018, we employed identical search, scat collection, storage and genetics testing of sample techniques used in earlier (2016 and 2017) field seasons (Gumtow-Farrior and Gumtow-Farrior, 2017). Working in teams of two or three, spaced about 4-m apart, workers systematically searched trail systems and high elevation ridges and slopes for putative SNRF scat.

All scat collected satisfied predetermined measurement criteria that are within the size range of SNRF (Pete Figuera, 2016, pers. comm.). At each scat site, we recorded elevation, latitude and longitude, photographed the scat in situ, and placed the scat in a marked paper bag. Excluding a small scat sample reserved for genetics analysis, we stored all bagged scats in a chest freezer. For genetics samples, we preserved a small sample of each newly collected scat in separate, labeled vials containing 95% ethanol and at season's end shipped our genetics samples to the Veterinary Genetics Laboratory at UC Davis.

In 2018 The SNRF Working Group, a meeting of researchers and fox experts convened, out of which evolved a preliminary draft compiling guidance to researchers on the ground. Also establishing direction for future study, the working group enlightens new research. (Sacks and Quinn, 2018).

They determined the most effective method for SNRF detection, rather than trail cameras and hair traps, employs strictly ground searches, collecting scat for genetic analysis. Applying this method since study inception in 2016, it continues as our choice for identifying SNRF.

The working group suggests procedures for monitoring known and unknown SNRF populations. In 2018, we began employing these suggestions for intense transect surveys in areas of previous year's SNRF scat. Field volunteers walked a line sweeping known fox ridges. In line 10 ft to either side searchers scanned the ground. This method was applied on Dutton ridge and the Mt. Scott area with greater limitations for coverage due to terrain.

In search of unknown SNRF populations, guidelines pointing to what we already use in our fox searches begun at study inception in 2016. Expanding searches in 2018 to high elevations adjacent to the Park in Umpqua National Forest, Mt. Thielsen Wilderness Area, students began following trails at lower than expected fox elevations moving upward. In 2019, overnight backpack treks are planned to put researchers at SNRF elevations for hopeful new fox scat discovery.

Given that SNRF are known to have occurred in CLNP in the few years immediately preceding our study (Quinn et al., 2017, Mohren 2015) but rarely observed during our study thus far, we employed techniques for both occupancy surveys (surveys in known historical range where the current presence is unknown) and focal population surveys (monitoring the status of small, previously documented SNRF populations from our study previous years). (Sacks and Quinn, 2018). As part of this strategy, we searched for SNRF scat at similar elevations where we found scat in prior years, but also at lower elevations than we have previously found scat where SNRF observations have been documented by Park personnel.

Student support allows searching vast areas for scat, while collecting and preserving samples. Laboratory genetic verification clinches species and lineage information. After field work completion, all participants engage in breakdown of remaining scat in the lab and sort contents. Bone, hair and other materials are separated and recorded. With adequate samples a niche breadth analysis for detecting food sources and utilization of resources available is possible.

We log digital information e.g. elevation, latitude and longitude points using an iPad. Tracking data is recorded for pathways of researcher searches over trails and ridges for SNRF. We graph elevation and species for each scat location.

In 2018, based on 2017's locations of SNRF and marten scat, we surveyed vegetation characteristics on scat-centered and associated random habitat plots. Using Circular Plot survey methods, we established percent cover and plant species type surrounding the scat center location of each target species found. GIS mapping will display locations and habitat features as we proceed.

The Pacific fisher in CLNP to date, is absent from our scat collections. This is a mystery as habitat types and elevations of our searches include suitable locations for fisher. The Park ecologist suggests that publicly owned lands managed by the Umpqua U.S. Forest Service surrounding the Park, do appear to have adequate fisher population numbers according to Forest Service agency biologists' studies. (Sean Mohren, pers. comm.). We continue searching for fisher in the Park applying the same methods.

RESULTS AND DISCUSSION

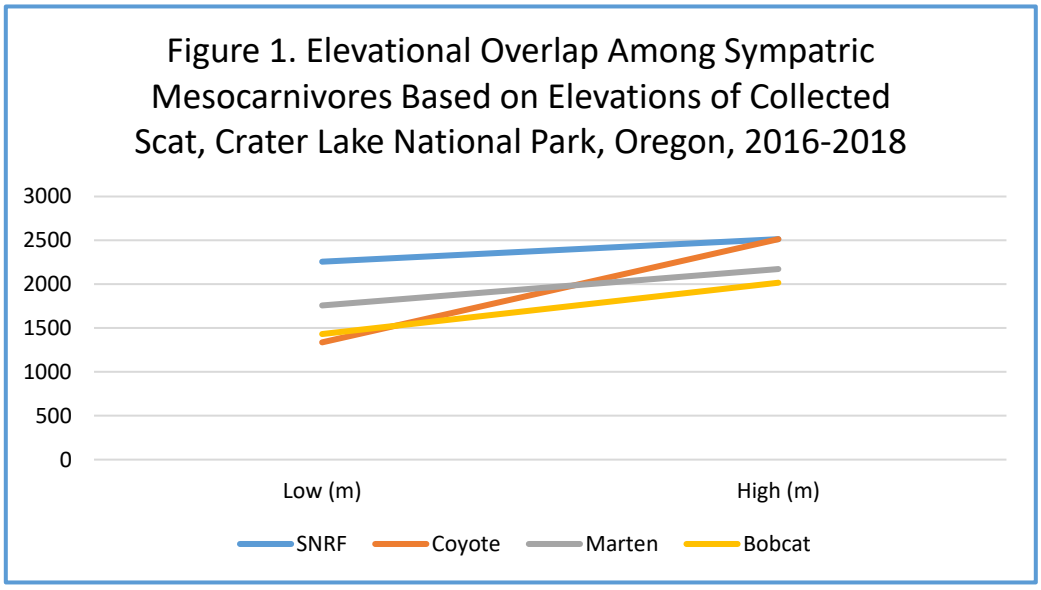
SNRF FOOD HABITS

The niche breadth analysis result (with 3 samples to date) for SNRF in Crater Lake National Park is 0.45. Values closer to 0 represent a highly specialized diet, values closer to 1 represent a highly generalized diet. Values at 0.5 represent a diet somewhat generalized and somewhat specialized. SNRF = 0.45 suggests a slightly specialized diet based on our present data- this might alter with more samples.

Food contents by percentage volume for SNRF shows primarily hair, secondarily bones and teeth, indicating that foxes we sampled in summer consumed mammals as a main food source.

Collected scat for SNRF in our study to date were found at elevation ranges from 2257m (7405ft.) - 2514m (8248ft.; Figure 1). This shows, as expected, coyotes are a possible direct competitor with SNRF into higher elevations, although fox movements likely include competition with marten and bobcat at lower elevations. As climate warms becoming more erratic, our study results may present information and ways to monitor impacts on SNRF and other sensitive species.

Figure 1. Scat elevations.



We will begin examining changes in elevational movement of species over the years of this study. Presentation of this information in graphic form will follow in successive reports.

The Red Fox Working Group directives advise drawing a rough perimeter circle of likely fox home ranges on a map, using a known SNRF scat as center to visualize boundaries of individuals thus directing to locations for applying intensive transect examinations. This allows for continual monitoring of known fox and locates new boundaries for discovering fox (Sacks and Quinn 2018). Site and boundary identification contribute to management decisions in the Park and use. (Map 1). It is interesting to note that if these are in fact actual home ranges of these SNRF, it is what one would expect to see. Intense transect application will continue searching these radius locations.

STUDENT PARTICIPATION

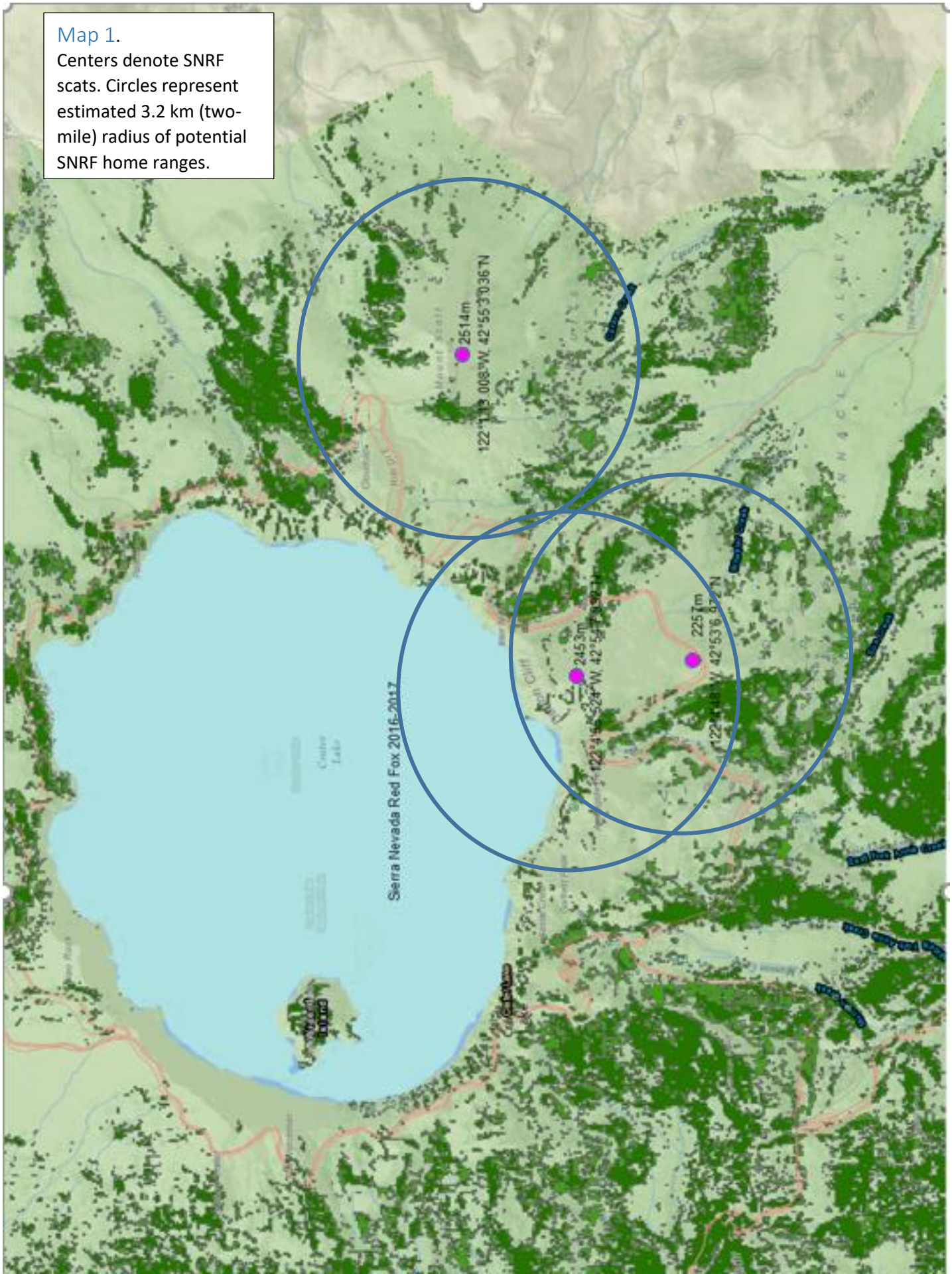
Oregon State University Cascades student participation in our study is a growing avenue for students to create resume experience, interact professionally while honing and developing necessary skills for sound wildlife science application. Research procedures become real to our students and they recognize the reality of various forces at work against best practices in wildlife stewardship, while accepting the challenge to excellence.

Each year students from the season, relate anecdotes to us how this study boosted their advancement into professional jobs and graduate school, furthered OSU research projects, and confidence building. They express to us the concept we strive to engender during their tenure, that wildlife ecosystems are most efficient, healthy and valuable to people and to other wildlife if they are functioning at optimal levels, and such is the job of all wildlife and resource professionals.

CONTINUING STUDY OBJECTIVES

Incorporating our study data from a fox we discovered during two years of field collection and research, UC Davis SNRF researchers and noted geneticists for SNRF, Ben Sacks and Cate Quinn identified the Oregon southern population of SNRF. The southern population is un-hybridized, characterized as vulnerable and rarer than the northern population.

Sierra Nevada red fox geneticists and researchers Dr. Cate Quinn, Dr. Tim Hiller and Dr. Ben Sacks in their published report for Oregon Dept. Fish and Wildlife (ODFW) in 2017 entitled, *Distribution and Genetic Structure of the Sierra Nevada red fox in Oregon*, recommend: “Prioritize conservation of SNRF in the southern portion of the Cascades. Red fox in this region appear to be most vulnerable and to represent the most pristine remnant of SNRF ancestry of the Oregon Cascades.” These directives for ongoing SNRF research, management and stewardship guide our own research. Additionally, our research imperatives address two further directives of the abovementioned report: 1. “Intensive sampling to estimate abundance of foxes, particularly in the southern population.” 2. “Assess home range size, age-specific survival, density, and other demographic characteristics of SNRF through telemetry and intensive ecological study.”



Map 1.
Centers denote SNRF scats. Circles represent estimated 3.2 km (two-mile) radius of potential SNRF home ranges.

HABITAT SURVEYS

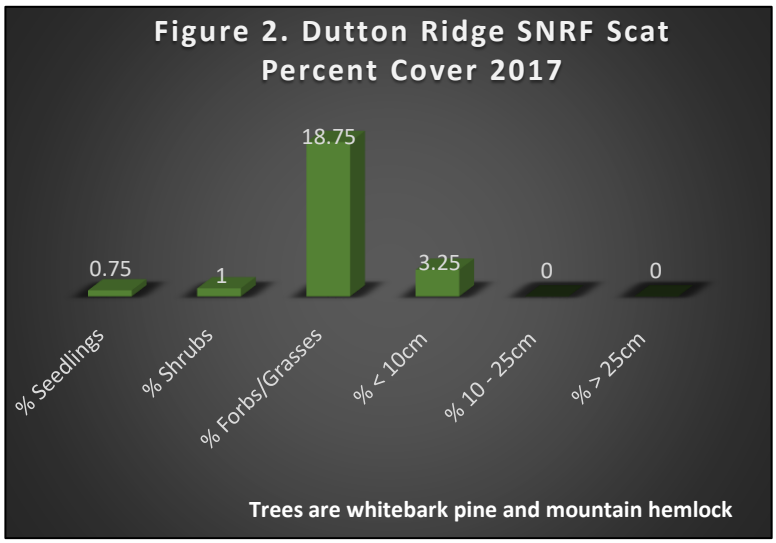
Habitat surveys of SNRF scat sites may provide guidance to fox choice of habitats. Our number of locations of SNRF scat are small but perhaps revealing. All three of our fox scat locations showed whitebark pine (*Pinus albicaulis*) and mountain hemlock (*Tsuga mertensiana*) as the tree species on site. (Figures, 2, 3 and 4). In two of the three sites, whitebark pine and mountain hemlock were almost 50 percent canopy cover. Canopy cover provided by trees less than 10cm dbh ranged from roughly 3 percent to 40 percent. Tree diameter at breast height, from 10cm to 25cm, was determined as almost 50 percent whitebark pine only on one fox site; trees this size were nonexistent on the other two sites.

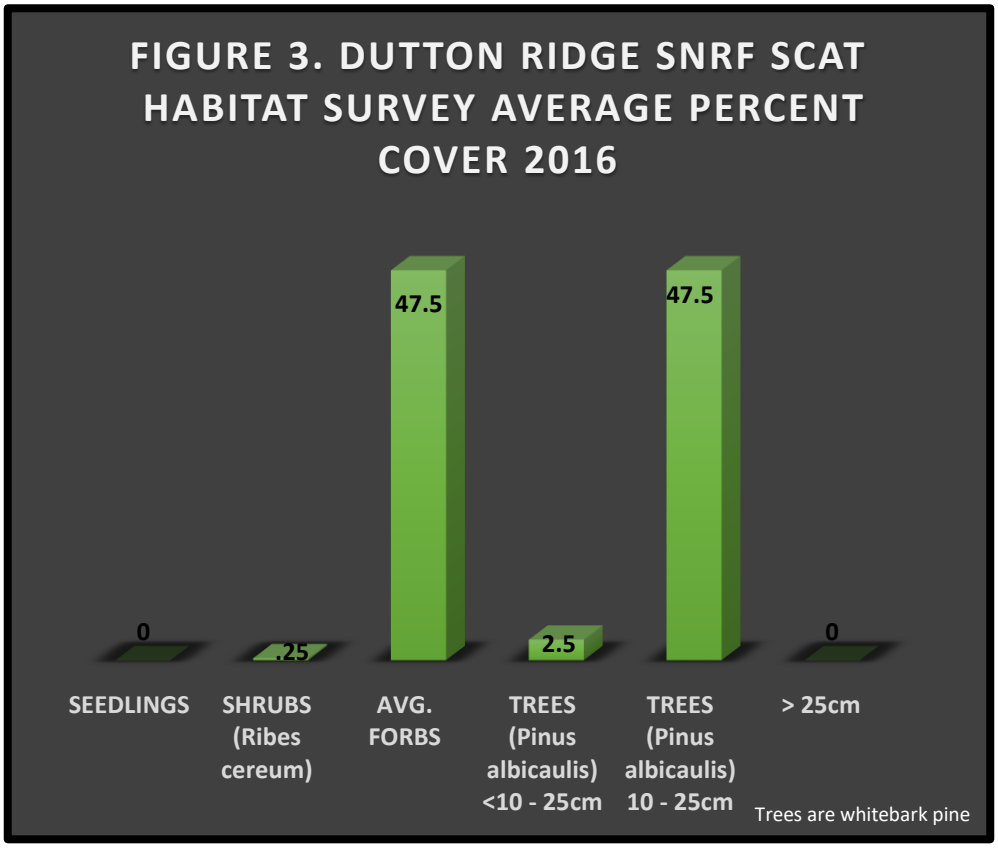
Whitebark pine is a highly nutritious food source for bear and other wildlife. The large seeds from cones offer vital nourishment. High elevation red fox scat was comprised of these seeds during a winter study in the Yellowstone area, it is a great squirrel food source as well and middens were being raided by foxes. In another winter of the study no seeds were detected which may relate to whitebark pine cone cycles or other factors unknown (Cross, 2015).

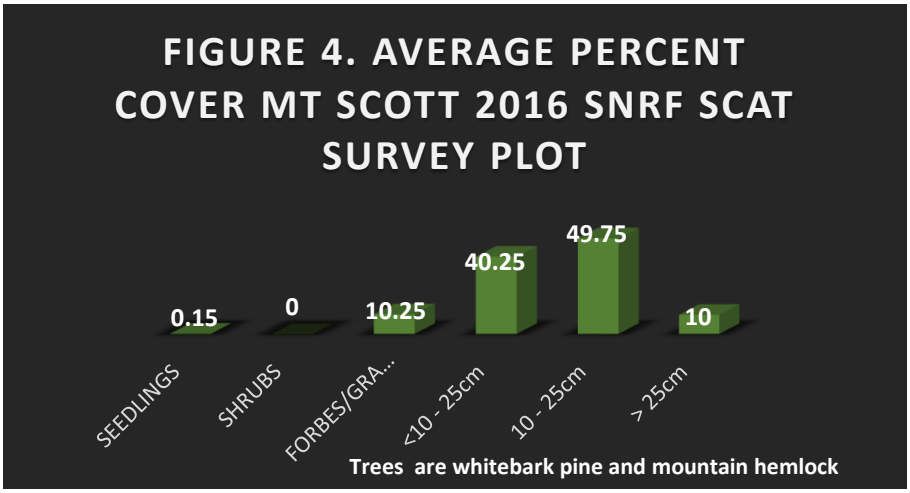
We are attempting to acquire adequate habitat data from SNRF and other target species for statistically meaningful answers. Following are charts depicting SNRF scat sites and random paired SNRF scat sites including percent cover and tree species over the study longevity. In future we will break down type of tree species as to percent cover as well.

Some questions come readily to mind, do fox focus on available whitebark pine seeds as a food source? Does mountain hemlock provide any food source or other requirement for fox? Or Is there a correlation between dbh and site use for SNRF cover? A follow up in our study will review possible Park data regarding whitebark pine in CLNP.

Figure 2,3,4.
Percent cover.



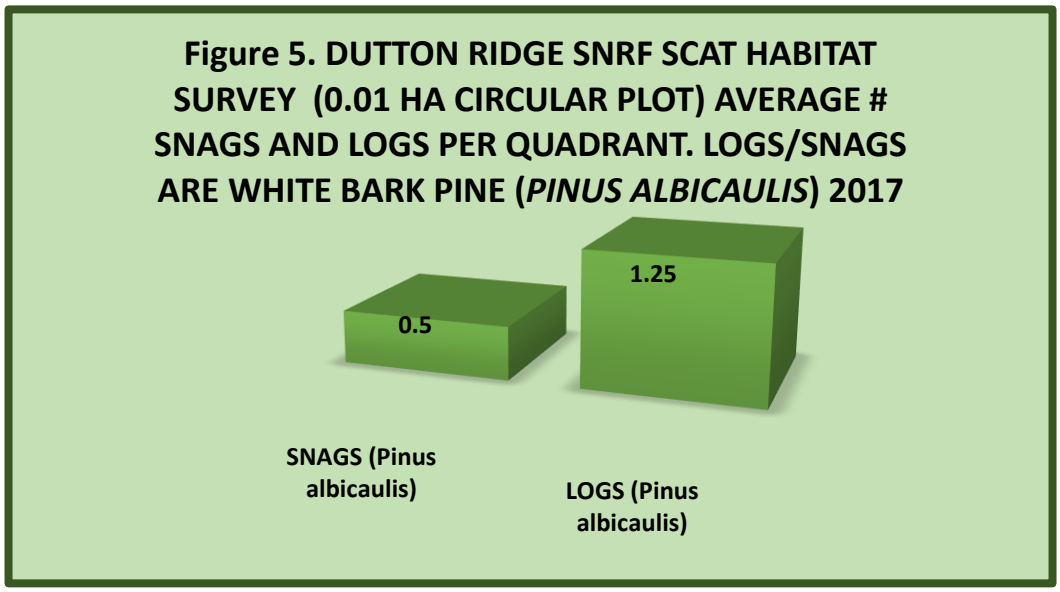


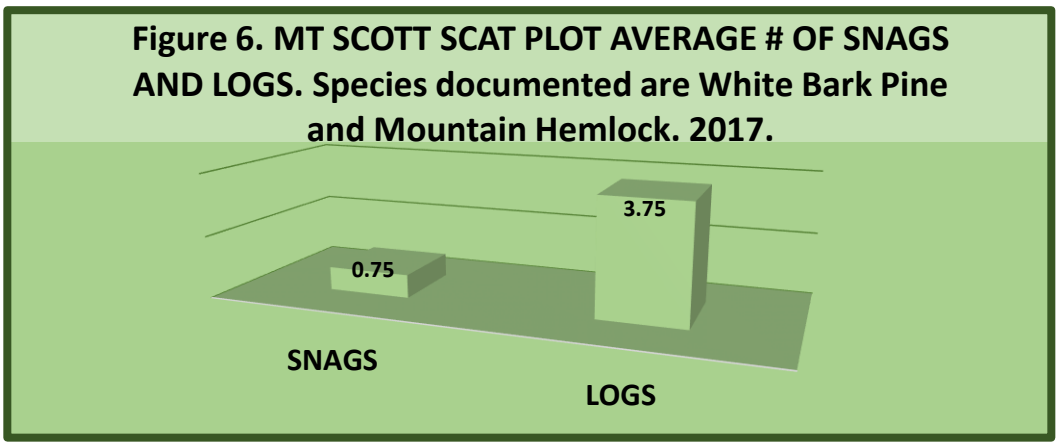


Habitat surveys for the Dutton Ridge SNRF scat collected in 2017, show no logs and no snags on site. Both SNRF sites from previous years did host snags and logs. (Figure 5,6). Perhaps this may suggest that fox presence is not as much for cover as for food? Too early to know statistically but three samples allow us moving in that direction, especially given that our fox numbers are likely very small.

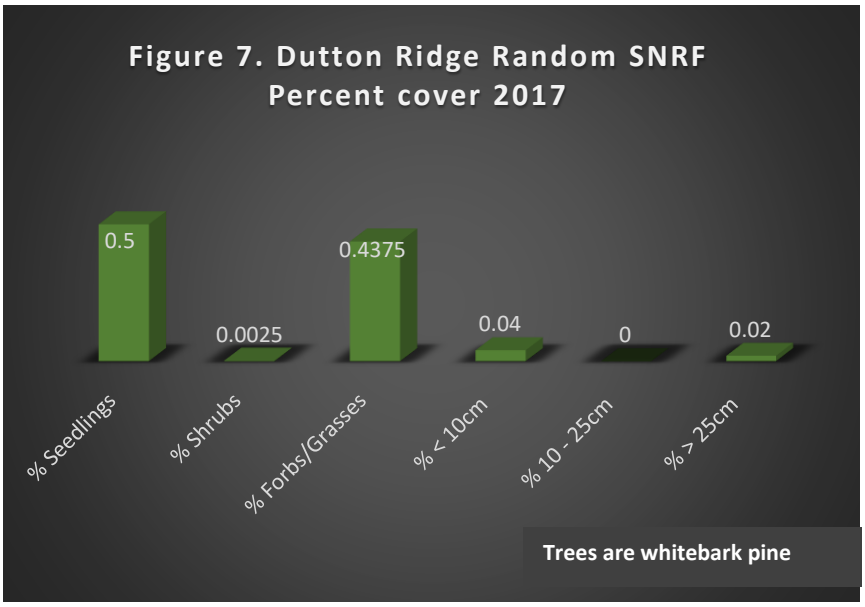
Random percent cover (Figure 7,8, and 9) is provided for comparisons to where fox scats were not found in random sites paired near each scat site.

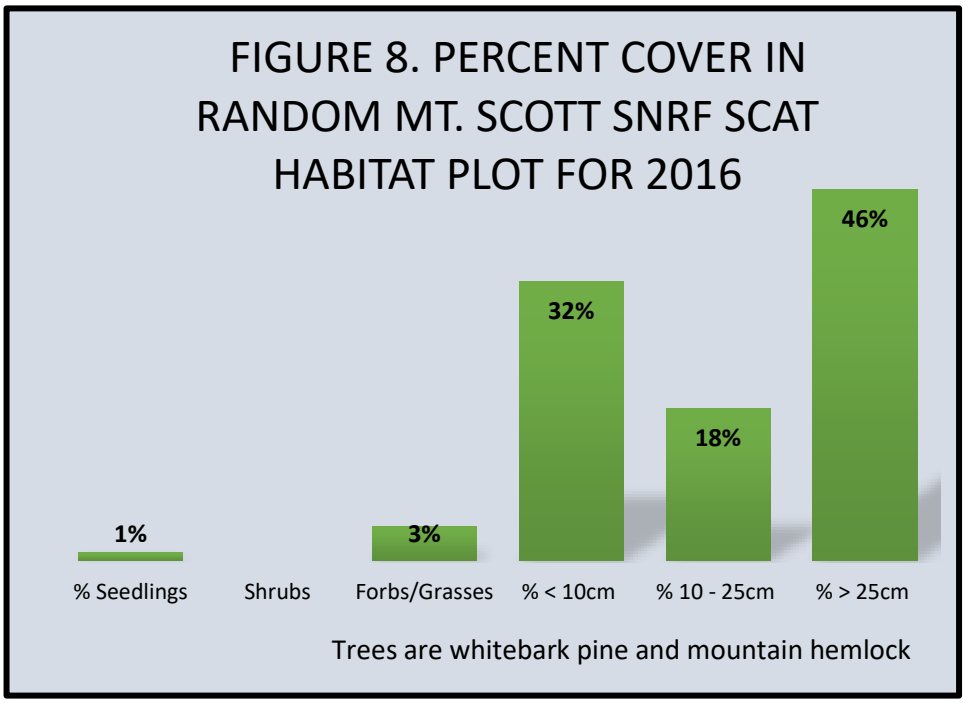
Figures 5,6. Percent cover logs and snags.

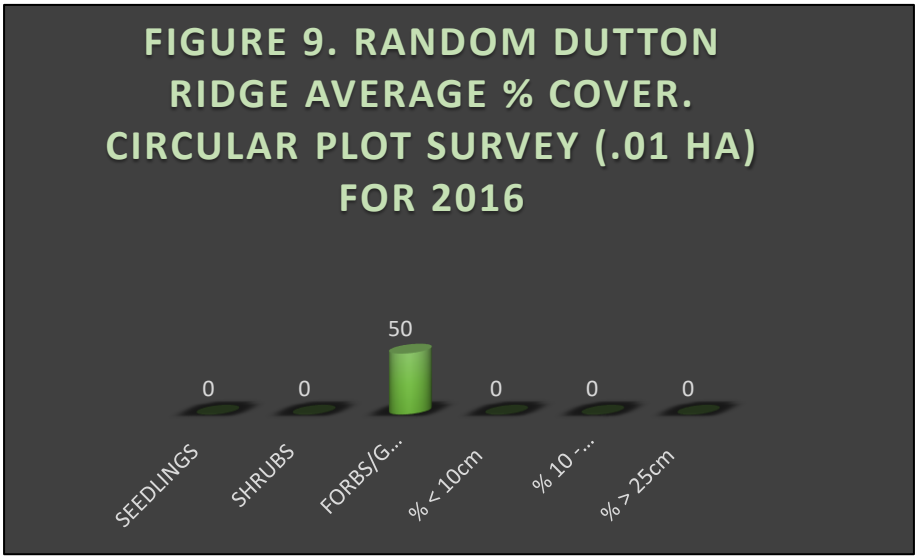




Figures 7,8,9. Random Percent Cover







CONCLUSIONS

CLNP high elevation SNRF of the southern population of the Oregon Cascades are clearly elusive and secretive. This is an animal that hid itself from view for over 100 years before being rediscovered and then first and only by camera. Thus, more fox than we've encountered seem likely evading us in the Park as well. Nonetheless, it is almost certainly a very small population that experts believe is at risk.

In personal Communication with Dr. Cate Quinn, she affirms that the most reliable evidence to date points to a small population in the Park and it's unclear to the degree that these foxes are isolated or connected to the southern population. She stresses that affirming their abundance as well as genetic linkage is paramount for a successful beginning of a conservation strategy for these Park foxes.

As we are making valuable inroads into a greater understanding of SNRF status, genetic linkage and hybridization, Cate underscores it is especially vital for our study's continuation for monitoring and detection of Park fox and for the southern cascades SNRF.

The genetics lab is running our scat samples a second time which may pick up fox, as 2017 second sample run did; but for 2018 the first run detected no SNRF. To this finding, Cate Quinn commented if we end with no detections of SNRF this year "I think it's arguably even more important to continue monitoring. Essentially, the question you posed, are they just undetected or absent? I think it's hard to say from an absence of scats whether that means an absence of foxes."

As we mused these questions, our own list read that finding no SNRF in the Park this year could mean:

a. Fox declining,
b. Fox moved,
c. Fox are there with no detections.

In agreement with Dr. Quinn, we feel determined this study is fundamental for southern SNRF stewardship and must continue. We are fortunate to have student support for field efforts giving us a main reason for our ability in continuing such labor-intensive research. Students in turn gain great experience and proficiency. We will continue as our resources allow.

Continuing and additional study points includes:

1. Monitoring known fox population areas, applying intensive walking transects of possible home range sites, while mapping estimated home range perimeters to discover new SNRF.

2. We will persist pressing to unexplored high elevations as able. Much of this region is isolated with reach to the Park. It is slow terrain.

3. Traversing pathways to and between areas that are not always accessible using trails, walking ridge to ridge; saddles and maintaining follow up in areas where fox was seen.

4. Inviting public involvement in our study with a brochure guiding visitors who use high elevation trails while in SNRF southern population habitat in or near the Park, to email photos, digital GIS points, elevation, longitude and latitude information if they encounter or see a fox. We will follow up with scat searches. (Figure 10).

Figure 10. SNRF Sighting Help Form.

BE PART OF OUR OSU CASCADES RESEARCH ON THE SIERRA NEVADA RED FOX!

WE'RE ASKING FOR THOSE VISITING CRATER LAKE NATIONAL PARK, MT. THIELSEN WILDERNESS AREA AND THE WILLLAMETTE PASS REGION TO NOTIFY US IF YOU SEE A FOX WHILE OUT RECREATING.

WE ARE WILDLIFE BIOLOGISTS CONDUCTIING A LONG-TERM FOX STUDY TO BETTER UNDERSTAND THE RARE, NEWLY DISCOVERED SOUTHERN CASCADES SIERRA NEVADA RED FOX POPULATION.

UNLIKE THE MORE NORTHERN SIERRA NEVADA RED FOX IN THE BEND REGION AND NORTH, THIS FOX IS DIRECTLY DECENDED FROM ANCIENT ICE AGE FOX WITH **NO** HYBRIDIZATION. IF YOU SEE ONE OF THESE FOXES, IT IS A RARE SIGHTING AND A PRIVILEGE.

WE ARE COLLECTING SCAT FOR GENETIC AND FOOD HABITS INFORMATION AND FINDING THESE SCATS IS LIKE FINDING A NEEDLE IN A HAYSTACK! SIGHTING TIPS HELP US TO NARROW OUR SEARCH AREAS. THEREFORE, IF YOU THINK YOU SEE A FOX IN THESE AREAS ABOVE, HERE'S THE DATA YOU COULD GATHER FOR US.

GRAB YOUR CELL PHONE AND SNAP A PHOTO, AS CLOSE UP AS POSSIBLE. THEN USING YOUR CELL PHONE TAKE THE GPS COORDINATES.

LONGITUDE_____

LATITUDE_____

ELEVATION_____

LOCATION NAME_____

DATE_____

ANY NOTES: WEATHER, CIRCUMSTANCE, FOX BEHAVIOR ETC.

PLEASE EMAIL THIS FORM COPY FILLED IN TO: Daniel.gumtowfarrior@osucascades.edu.

With accelerating climate warming, a species as the SNRF likely dependent on high elevations for what it requires, may recede into extinction. Troubling, if one ponders this little fox managed forwarding its pure genes intact and surviving over roughly 10,000 years, while under our watch it is now facing a change so cataclysmic, it could cease existence. Humanity will also realize dire impacts.

Temperatures, habitat, defensive manifestations of living in such warming places all will be impacted. As able, our study attempts to monitor changes and climate impacts for the southern SNRF population. These impacts may occur from increased competition with the fox for various reasons – perhaps simply food and space made available to competitors by receding snowline or easy year-round access.

As we secure funding to continue this study we are expanding investigation with mapping known and unknown populations, including and moving beyond Park boundaries to additional high elevations nearby to commence in 2019. We feel very positive this will further advance understanding of SNRF in the southern population. Discovering new fox or perhaps clarifying movements of individuals already encountered, carry great informational weight.

This food habits study by design is incorporating new information encountered into new SNRF research. We are following formats suggested by the newly formed Sierra Nevada red Fox Working Group of scientists and fox experts.

We are distributing a public form to out door visitors to fox areas for information on the southern fox population. Promoting stewardship for this little fox these forms will be available for distribution at OSU as we seek further circulation avenues.

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