BEFORE THE SECRETARY OF THE INTERIOR

PETITION TO LIST THE SOUTHERN CASCADES DISTINCT POPULATION SEGMENT OF THE SIERRA NEVADA RED FOX (*Vulpes vulpes necator*) UNDER THE ENDANGERED SPECIES ACT AND CONCURRENTLY DESIGNATE CRITICAL HABITAT

Courtesy of Ashley Vanderstar

CENTER FOR BIOLOGICAL DIVERSITY

February 8, 2024

NOTICE OF PETITION

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Pursuant to Section 4(b) of the Endangered Species Act ("ESA"), 16 U.S.C. § 1533(b); Section 553(e) of the Administrative Procedure Act, 5 U.S.C. § 553(e); and 50 C.F.R. § 424.14(a), the Center for Biological Diversity hereby petitions the Secretary of the Interior, through the United States Fish and Wildlife Service ("Service"), to protect the Southern Cascades Distinct Population Segment ("DPS") of the Sierra Nevada red fox ("SNRF" or "Fox") as endangered under the ESA.

The Service has jurisdiction over this petition. This petition sets in motion a specific process, placing definite response requirements. Specifically, the Service must issue an initial finding as to whether the petition "presents substantial scientific or commercial information indicating that the petitioned action may be warranted." 16 U.S.C. § 1533(b)(3)(A). The Service must make this initial finding "[t]o the maximum extent practicable, within 90 days after receiving the petition." *Id.*

Petitioner also requests that critical habitat be designated for the Southern Cascades DPS of the SNRF concurrently with the species being listed, pursuant to 16 U.S.C. § 1533(a)(3)(A) and 50 C.F.R. § 424.12.

Petitioner the Center for Biological Diversity ("Center") is a nonprofit, public interest environmental organization dedicated to the protection of imperiled species and the habitat and climate they need to survive through science, policy, law, and creative media. The Center is supported by more than 1.7 million members and online activists throughout the country. The Center works to secure a future for all species, great and small, hovering on the brink of extinction. The Center submits this petition on its own behalf and on behalf of its members and staff with an interest in protecting the Southern Cascades DPS of the SNRF and its habitat.

Submitted this February 8, 2024,

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Executive Summary

The Sierra Nevada red fox (*Vulpus vulpus necator*) is a critically endangered subspecies of red fox once found in high elevation areas from the southern Sierra Nevada through the Cascades in northern California and Oregon to Mt. Hood. Over the past century, the Fox's range has undergone a massive contraction. Today, the subspecies exists in just a handful of small, isolated populations. In California, exceedingly small populations of the Fox survive at Sonora Pass in the Sierra Nevada and in the area of Lassen Peak in the Cascades. In Oregon, small populations of SNRF have been documented in three areas, Crater Lake National Park, the Central Oregon Cascades, and Mt. Hood.

In 2015, the US Fish and Wildlife Service ("FWS")protected the remnant Sonora Pass population – which it designated as the Sierra Nevada distinct population segment – as an endangered species. The Service, however, found populations in northern California and Oregon, which were grouped together into a single Southern Cascades Distinct Population Segment (population herein referred to as "SNRF" or "FOX"), did not warrant listing based on lack of information on the number, size, and connectivity of populations, particularly in Oregon.

Since FWS's finding that the SNRF does not warrant listing, substantial new information has been collected on the Southern Cascades DPS indicating it is clearly facing threats and at risk of extinction, including new genetics analyses showing SNRF populations to be isolated, exceedingly small and threatened by low genetic diversity, and considerable survey effort confirming the Fox's loss from substantial portions of its range and providing further support for the small size and isolation of remaining populations. The SNRF also faces increased threats from recreation and associated development, increased frequency and intensity of fires, advancing climate change with little progress towards reducing emissions, and increased risk of mortality from vehicle strikes, predation, trapping and poisoning. Much of this new information was compiled in a multi-agency conservation strategy developed in 2022 (SNRFCAT 2022)

This petition seeks protection for the southern Cascades population of the Fox. The Fox is at risk of extinction due to its small, isolated populations, low genetic diversity, and low reproductive capability. This extinction risk is magnified by a host of additional threats, including climate change, coyote predation and competition, hybridization with non-native red foxes, recreation and associated development, poisoning, hunting and trapping, habitat loss, wildfire, disease, and vehicle strikes. Cumulatively, these threats put the SNRF at risk of imminent extinction across its range.

Introduction

The SNRF is one of three montane red fox subspecies found in the western United States that are uniquely adapted to live in cold, snowy environments. These adaptations include small body size, a thick coat and hair covering their foot pads in winter, which all facilitate over-snow travel (SNRFCAT 2022, pp. 35, 37). The two other subspecies are the Cascades red fox (*V. v. cascadensis*) found in Washington State and the Rocky Mountain red fox (*V. v. macroura*) found throughout the Rocky Mountains. All three subspecies are believed to have suffered declines due to a variety of threats.

Based on increased sightings in Yellowstone National Park, the Rocky Mountain red fox is believed to have increased in numbers in the last roughly 20 years (YNP 2020). One hypothesis for this increase is that the reintroduction of wolves led to a decline in coyotes to the benefit of the Fox (YNP 2020) In

support of this hypothesis, Newsome and Ripple (2014, p. 1) documented that at a continental scale, red Fox were more abundant than coyotes in the presence of wolves, whereas coyotes were more abundant in the absence of wolves. Numerous other studies have documented competitive exclusion of red foxes by coyotes at local scales. If this hypothesis is accurate, facilitating and allowing wolf recovery in the Oregon Cascades may be an important step in the recovery of SNRF.

To ensure the survival and recovery of the SNRF, it needs further monitoring and research, and protection of its habitat, particularly den sites, from recreation and associated development, trapping, road traffic, poisons, livestock grazing and other disturbance. In addition, if we don't soon reduce greenhouse gas emissions and protect more of the natural world, the Fox and many thousands of other species will be at increased risk of extinction.

Listing History

The Center for Biological Diversity (Center) submitted a petition on April 27, 2011, to the US Fish and Wildlife Service (Service) requesting that the SNRF be listed as an endangered or threatened species and that critical habitat be designated under the Endangered Species Act (ESA or the Act) (Center 2011). The petition also requested evaluation of populations in the Cascade and Sierra Nevada Mountain ranges as potential DPS. On January 3, 2012, the Service published a positive 90-day finding (77 FR 45) that the petition presented substantial information, indicating that listing may be warranted.

On January 15, 2013, the Center provided notice of its intent to sue the Service for failing to make required findings on the petition to list the SNRF. Pursuant to a stipulated settlement agreement, the Service issued a 12-month finding on October 8, 2015 (80 FR 60990). The Service concluded that there are two valid DPSs for the SNRF – the Southern Cascades DPS and the Sierra Nevada DPS. Both the Southern Cascades and Sierra Nevada segments of the SNRF's range are discrete and significant based on marked physical separation and genetic variation. The 12-month finding also concluded that: 1) listing the entire SNRF subspecies was not warranted; 2) listing the Southern Cascades DPS was not warranted; and 3) listing the Sierra Nevada DPS was warranted, but precluded by higher priority listing actions.

The Sierra Nevada DPS of the SNRF was placed on the candidate species list and remained there until the Service issued a proposed rule on January 8, 2020, to list it as an endangered species under the Act. Following a legal challenge filed by the Center on April 15, 2021, the listing for the Sierra Nevada DPS was finalized on September 2, 2021. The Service determined designation of critical habitat was not prudent based on the lack of threats to the population's habitat.

Existing protections are insufficient to ensure the survival of the SNRF. Although the Service's decision to list the Sierra Nevada DPS under the ESA was a good start, it is simply not enough. This vulnerable species needs protection across its range to help it withstand the many overlapping and growing threats to its survival. Accordingly, the Service should list the Southern Cascades DPS as an endangered species under the ESA and designate critical habitat.

Natural History

Description. The Sierra Nevada red fox is a small canine characterized by its slender body and legs, pointed ears, elongated snout, and a long, bushy, white-tipped tail (Aubry, 1997, p. 55). It is sexually dimorphic and typically smaller than lowland red fox subspecies. Males average 4.2 kg (9.3 lb.) and have a total body length up to 1040 mm (~41 in) while females average 3.3 kg (7.3 lb.) with a total body length up to 978 mm (38.5 in) (Perrine et al., 2010, p. 5). The SNRF can be distinguished further from other small canides by the black markings on the backs of its ears, black shins, and its distinctive, white-tipped tail (Statham et al., 2012, p. 123).

The SNRF occurs in three genetically-determined color phases – red, black/silver, and cross. In the most recognizable red phase, the fur is primarily yellowish to reddish brown, with contrasting white fur on the cheeks, chin, throat, and abdomen (Perrine et al., 2010, p. 5). In the black or silver phase, the fur is mostly black but can appear "frosted" due to occasional silver guard hairs. The cross phase, which is dominant among SNRF, exhibits characteristics of red and black/silver phases, including a gray-brown coat and black guard hairs. All color phases can occur in a litter, and white-tipped tails are common to all color phases (Aubry, 1983, p. 107).

Along with other montane subspecies, the SNRF has special adaptations to the cold (Sacks et al., 2010, p. 1524). These adaptations include a thick and deep winter coat and small toe pads covered in dense fur to ease movement over snow (Grinnell et al., 1937, pp. 377-378).

Taxonomy

The SNRF (*Vulpus vulpus necator)* is in the Kingdom Animalia, Class Mammalia, Order Carnivora and Family Canidae. It is one of three of North America's ten red fox subspecies that reside in high elevation areas. It is also one of three closely related western montane red fox subspecies, including the Cascade red fox (*Vulpes vulpes cascadensis*), which occurs in the Washington Cascades, north of the Columbia River, and Rocky Mountain red fox (*Vulpes vulpes macroura*), which occurs in the Rockies and other mountainous areas of Idaho, Montana, Wyoming, Utah, Colorado, New Mexico, Nevada, and Eastern Oregon (Aubry, 1997, p. 55; Perrine et al., 2010, p. 5).

Montane red foxes inhabit high-elevation alpine and subalpine environments and are phylogenetically, morphologically, and ecologically distinct from other red foxes in North America. These montane subspecies, including the SNRF, descend from Nearctic foxes that crossed the Bering Land Bridge from Asia into North America around 200,000 years ago (Aubry et al. 2009, pp. 2679–2682; Perrine et al. 2010, p. 5. Warming temperatures and glacial retreat around 10,000 years ago drove western Nearctic fox populations to the cold, snowy mountains of the continental United States (Perrine et al. 2007, p. 1089).

Clinton Merriam first described the SNRF as *Vulpes necator* in 1900 (Merriam, 1900, pp. 662, 664). In 1936, all North American red fox species and subspecies were redesignated as subspecies of *Vulpes fulva,* making the SNRF *Vulpes fulva necator* (Bailey 1936, pp. 272, 317). However, in 1957, Churcher redesignated all North American red foxes as *Vulpes vulpes* (Churcher 1959, p. 519), making the SNRF (*Vulpes vulpes necator*). Today, the scientific community continues to recognize the SNRF as a subspecies (Lariviére & Pashitschniak-Arts 1996, pp. 1–2; Aubry 1997, p. 55; Sacks et al. 2010, p. 1542).

The Service has concluded that there are two valid DPS of the SNRF – the Southern Cascades DPS and the Sierra Nevada DP (USFWS, 2015). The Southern Cascades DPS includes the Cascade Mountains of Oregon, from the Columbia River south into the California Cascades around Lassen Peak, including the area of Mt. Shasta, and extending slightly into the Trinity Mountains. The Sierra Nevada DPS includes the upper elevations of the Sierra Nevada Mountain Range, from Tulare to Sierra Counties.

The National Marine Fisheries Service ("NMFS") and the Service published a joint Policy Regarding the Recognition of Distinct Vertebrate Population Segments Under the Endangered Species Act ("DPS Policy") on February 7, 1996 (61 FR 4722). Under the policy, a population qualifies as a DPS only if it is both discrete and significant. If the population segment qualifies as a DPS, it is then evaluated to determine whether it is endangered or threatened. In its 2015 analysis, the Service found that both the Southern Cascades and Sierra Nevada segments of the SNRF's range are discrete and significant, based on marked physical separation and genetic variation. The Service also found that the loss of either the Sierra Nevada segment or the Southern Cascades segment of the SNRF's range would create a significant gap in the geographic range of the subspecies.

Genetics

Recent genetic studies have clarified the taxonomic status of several closely related red fox subspecies and their respective ranges. Indeed, the range of the Cascade red fox was previously thought to include the Oregon Cascades, but genetic comparisons have confirmed that red foxes of the Oregon Cascades are SNRF (Sacks et al. 2010, p. 1536). SNRF and the Cascade red fox are separated by the Columbia River, which serves as a barrier to interbreeding.

Among SNRF populations, Quinn et al. (2022, p. 10) found they are isolated, genetically distinct and depauperate of diversity. The Mt. Hood population shows more genetic diversity, but primarily because of intermixing with low elevation foxes showing markers of Rocky Mountain red foxes (Quinn et al., 2017, p. 3). Genetic analysis shows populations that are not only isolated, but exceedingly small with the southern Oregon Cascades populations having an estimated effective population size of just 14 adults, the Lassen population having less than 10 adults and the Mt. Hood population having just 48 adults (Quinn et al. 2017, p. 3; Quinn et al. 2022, p. 10)

Life History and Demographics

The SNRF likely shares a similar reproductive biology with other North American red fox subspecies (Aubry 1997, p. 57). Accordingly, SNRF is believed to be monogamous and breeds in late winter through early spring. (Aubry 1997, p. 57). The gestation period for other red fox subspecies is 51 to 53 days, with kits born later in the spring between March and May (Perrine et al. 2010, p. 14). Den sites for SNRF include natural openings in rock piles and earthen tunnels (Grinnell et al. 1937, p. 394; SNRFCAT 2022, p. 57). Red fox pups are usually weaned by 8 to 10 weeks of age and begin exploring their parents' home range in the summer when they reach 12 weeks (Grinnell et al. 1937, p. 394; SNRFCAT 2022, p. 57).

SNRF litters average two to three pups (Perrine 2005, pp. 152–153). This low reproductive capacity makes recovery from population decline more challenging than for lowland-dwelling red foxes. SNRF pups typically disperse in the early fall when fully grown (Perrine et al. 2010, pp. 14–15). While dispersal distances have not been documented for SNRF, one study found juvenile male red foxes in the American Midwest dispersed 30 km (18.6 mi) on average, while juvenile females dispersed an average of 10 km

(6.2 mi) (Statham et al. 2012, p. 130). A few young red foxes (5 percent) dispersed over 80 km (50 mi) in their first year (Statham et al. 2012, p. 130).

SNRFs occupy very large home ranges (2,200-13,500 hectares), reflecting the scarcity of food in alpine environments (SNRFCAT 2022, pp. 57-58). In the Lassen population, summer home ranges averaged 2,564 hectares (ha) (6,336 acres (ac)), with individual home ranges ranging from 262 ha (647 ac) to 6,981 ha (17,250 ac) (Perrine 2005, pp. 2, 159). Winter home ranges were even larger, averaging 3,255 ha (8,042 ac), and ranging from 326 to 6,685 ha (806 to 16,519 ac) (Perrine 2005, p. 159).

Because no studies have documented age-specific mortality rates, demographic structure, longevity, or sex ratios within SNRF populations, little is known about SNRF demographics (Perrine et al. 2010, p. 18). Likewise, it is difficult to extrapolate this information from other red fox subspecies because heavy hunting and trapping pressure on those subspecies likely skew the results (Perrine et al. 2010, p. 18). However, three SNRFs identified in the Lassen population lived at least 5.5 years (CDFW 2015, p. 2).

Observed mortality causes for SNRF include predation, trapping, vehicle strikes, and poisoning (SNRFCAT, 2022, p. 38). Natural sources of SNRF mortality include predation by larger carnivores including wolves, mountain lions, bobcats, and coyotes (SNRFCAT, 2022, p. 38). Other mortality factors include diseases such as rabies, distemper, canine hepatitis, parvovirus, toxoplasmosis, leptospirosis, tularemia and encephalitis (SNRFCAT, 2022, p. 38). Sarcoptic mange is often fatal to red foxes (Balwin, 2011, p. 1). Parasites, including ticks, fleas, trematodes, nematodes, protozoans and heartworms, can also plague red foxes (SNRFCAT, 2022, p. 84.).

Contemporary research has confirmed the cause of death for 11 SNRF to date: 1 in the Lassen population from predation by a domestic dog, 2 in the Central Cascades study area from potential predation (1 suspected coyote predation and 1 suspected bobcat predation), 1 in the Central Cascades study area from trapper by-catch, and 7 from vehicle strikes (1 in the Sonora Pass study area, 1 in the CLNP study area, and 5 (3 juveniles, 1 adult, and 1 individual of unknown age) in the Central Cascades study area (SNRFCAT, 2022, p. 38). One red fox found within historical SNRF habitat in the Central Cascades study area in 2019 may have died from rodenticide via secondary poisoning, but definitive determination of the cause of death was not possible (SNRFCAT, 2022, p. 38).

Range and Distribution

Historic. SNRF historically ranged from the southern Sierra Nevada Mountains north through the Cascade Mountains south of the Columbia River. In the Cascade Mountains, the SNRF historically ranged from northern California near Mt. Lassen, Mt. Shasta, and the Trinity Mountains north through the Cascade Mountains to the Columbia River (86 FR 41743). In the Sierra Nevada Mountains, the SNRF historically ranged from Tulare Country north through California and far-western Nevada to Sierra County (86 FR 41743). There is no evidence that SNRF occurred in California's coast range or the lowlands of the state (Zielinski, 2005, p. 1385).

Current. Today, there are five identified SNRF populations – two in California and three in Oregon (SNRFCAT, 2022). Currently recognized populations include Sonora Pass, Lassen, Crater Lake, Central Oregon Cascades, and Mt. Hood with the latter four the subject of this petition. Due to a substantial loss of range to historic poisoning and trapping and habitat loss and fragmentation, these populations are isolated from one another and occupy a fraction of historic range (Figure 1, SNRFCAT, pp. 24, 25).

Estimated current distribution of the SNRF across its range, based on remote camera and scat surveys and detections from 1992 – 2020, relative to estimated historical distribution (SNRFCAT 2022, p. 25).

Almost all current SNRF populations are on Federal land. They are found in Yosemite, Lassen Volcanic, and Crater Lake National Parks. They are also found on the Stanislaus, Lassen, and Humboldt-Toiyabe National Forests in California, and in Umpqua, Willamette, Deschutes, and Mt. Hood National Forests in Oregon.

The two current California populations were occupied by SNRFs in the 1930s (Grinnell et al. 1937, pp. 381–382) and were again confirmed as occupied in 1993 and 2010 (Perrine 2005, pp. 4, 167–168; Statham et al. 2012, p. 123). The three Oregon populations were first identified in 2012 and 2013.

Researchers including scientists at the California Department of Fish and Wildlife, the University of California, Davis, and Yosemite National Park modeled the potential distribution and abundance of the SNRF throughout its historical and contemporary ranges by conducting surveys 2009-2020. The study team, which also included scientists at the U.S. Forest Service, California Polytechnic State University, San Luis Obispo, and the Cascades Carnivore Project, was able to estimate the distribution of SNRFs by using data collected via remotely triggered cameras and other survey tools. The modeling approach predicted SNRF density based on the relationship between detection frequencies and environmental characteristics, allowing for the model to project those densities onto unsampled areas with similar land and vegetation features (Green, 2023, p. 820). Their model predicted a density of 1.06 (95% credible interval = 0.8–1.36) foxes per 100 km2 distributed throughout 22,926 km2 in three distinct regions of California and Oregon–Sierra Nevada, Lassen Peak, and Oregon Cascades. SNRFs were most likely to be found in areas with low minimum temperatures and high snow water equivalent.

Habitat Associations

The SNRF is found in montane, subalpine and alpine zones of the Sierra Nevada and Cascades, including meadows, forests and barren areas, with some variation among populations (SNRFCAT 2022, p. 53). The most detailed studies of the SNRF's habitat associations, to date, have been conducted in the Lassen Region.

Perrine (2005) used a combination of baited camera stations and telemetry to determine habitat utilization by SNRFs in the Lassen region, finding that SNRFs were restricted to the "region's highest elevations" (>1,300 m)(p. 1). Based on camera trap locations, Perrine (2005) documented positive associations in summer with elevation and highway extent (the latter likely due to sampling bias) and negative associations with the extent of shrub and herbaceous cover, which likely related to their selection for higher elevations, including open talus slopes and montane chapparal, rather than any true avoidance of shrub communities (Perrine, 2005, pp. 68, 75). In winter, detections were positively associated with the extent of forest comprised of large trees (>60 cm DBH) with >40% canopy closure (Perrine, 2005, pp. 68, 75). Benson et al. (2005) used snow tracks to infer the use of cover by SNRF in winter, similarly finding that SNRFs appeared to use forest cover more than expected based on the availability of these habitat types (p. 128). The use of mature forest in winter corresponded with an observed seasonal movement of SNRFs to mid-elevations during winter (Perrine 2005, p. 78).

The 2022 Conservation Strategy reported preliminary results from three collared SNRFs in the Lassen region, showing "habitat use consistent with that found in Perrine's (2005) study: regular use of high-elevation forests, subalpine woodlands, and barren areas near or above tree-line, and significant use of mid-elevation forests in the winter (SNRFCAT 2022, p. 55). Interestingly, one of the collared SNRFs occupied a heavily forested area of the Caribou Wilderness, which lacked extensive area above tree-line. Use of this area by SNRFs has been confirmed by camera traps and scat by the California Department of Fish and Wildlife (SNRFCAT 2022, p. 55)

The fox's preference for mature closed canopy forests in the Lassen population during winter may be due to: (1) lessened snow depth and consequent ease of travel; (2) availability of sheltered day-rest

areas formed by downed woody debris or low-hanging conifer boughs; or (3) increased access in day-rest areas to prey living below the snow (Benson et al. 2005, p. 128; Perrine 2005, pp. 78, 80–81; Perrine et al. 2010, pp. 19, 29). Having traveled to lower elevations for any of the reasons discussed above, SNRFes may also make greater use of closed canopy forests at those elevations because that habitat provides greater visual cover and presents greater obstacles to any coyotes that might chase them (Benson et al. 2005, p. 128; Perrine et al. 2010, p. 29).

As elsewhere in the range, SNRFs in Oregon have typically been observed in meadows and forests in subalpine and alpine areas. Preliminary analysis from a four-year radio-collar study conducted by the Oregon Department of Fish and Wildlife in the Central Cascades suggested that GPS-collared individuals selected for subalpine mountain hemlock woodlands and alpine-montane grasslands (SNRFCAT 2022, pp. 55-56).

Rangewide, Green et al. (2023, p. 820) found that SNRFs were "most likely to be found in areas with low minimum temperatures and high snow water equivalent," confirming the proclivity of the species to occupy alpine and subalpine areas.

The SNRF is a nocturnal or crepuscular opportunistic predator and forager. Its diet varies seasonally with food availability and is primarily composed of small rodents, but includes snowshoe hare, birds, fish and insects (SNRFCAT 2022, p. 41). The diet of SNRFs also includes deer carrion (*Odocoileus hemionus*) (particularly in winter and spring), and manzanita berries (*Arctostaphylos nevadensis*) (particularly in fall) (Perrine et al. 2010, pp. 24, 30, 32–33). Cross & Crabtree (2021, p. 2) observed Rocky Mountain red foxes feeding on whitebark pine seeds from squirrel middens. It's unknown if these seeds are also a food source for SNRF, but if it is, the loss of this tree species, which is itself now listed as threatened, is another threat to the species.

Status and Trend

Although once found throughout the Sierra Nevada and Cascade Mountain ranges south of the Columbia River, the SNRF is now one of the rarest mammals in California and Oregon. Their abundance and distribution declined dramatically in the last century. Today, there are only a handful of remnant populations. California has only two known populations of SNRF, with likely fewer than 30 individuals each (SNRFCAT 2022, p. 73). Information on the status of populations in Oregon has grown in recent years and similarly indicates small, isolated populations facing the same threats as in California.

Population declines in the last century are evidenced by historic trapping and sighting data. In California, trapping data shows that SNRF numbers fell considerably in the mid-1900s with the average annual harvest of SNRF pelts in California having declined from the 1920s (21 pelts per year) to the 1940s and 50s (6.75 pelts per year) (Grinnell et al. 1937, p. 389; Perrine 2005, p. 154). Likewise, sightings became rare after the 1940s with only 19 seen in California in both the 1950s and 1960s (USFWS, 2015, p. 33).

Likely causes of population decline for SNRF include widespread predator control programs, trapping, reduced prey populations resulting from historic meadow over-grazing, competition and predation from coyotes and other carnivores, and climate change effects, such as reduced snowfall.

Lassen Population. The Lassen population includes sightings in the Lassen Volcanic National Park, Lassen National Forest (including the Caribou Wilderness), and some small private inholdings used primarily as

timberlands (CDFW 2015, p. 2). A single SNRF was also sighted in 2013 by a camera trap near Humbug Summit, roughly 32 km (20 mi) south of the Lassen population (CDFW 2015, p. 2). No additional sightings in the area were obtained, despite use of multiple cameras over several months, so it is likely the single sighting was of a transient individual.

Using microsatellite DNA comparisons, Sacks et al. (2010, pp. 1532, 1536–1537) estimated that the effective size of the population at the Lassen population (referred to in the study as the modern Southern Cascades population) is 21 breeding individuals, with a 95 percent confidence interval of 13 to 34 breeding individuals (see also Statham et al. 2012, pp. 122, 123). More recently, Quinn et al. (2022, p.10) estimated the effective population as less than 10 adults.

Sacks et al. (2010, p. 1529) also estimated the effective population size of the population of the Lassen population by comparing mtDNA across both modern individuals and museum samples, resulting in an estimate with a 95 percent confidence interval of 0 to 40 breeding individuals. The authors (Sacks et al. 2010, p. 1536–1537) considered the microsatellite-based estimate of 21 to be the most robust, in part because this estimate was obtained solely from modern samples, rather than from comparisons with museum specimens whose genetic diversity might be underestimated using the sequencing methods available. Genetic evidence also indicates the population in the Lassen population markedly decreased in size (experienced a "population bottleneck") sometime between 1930 and 2000 (Sacks et al. 2010, pp. 1523, 1532, 1536).

More recent surveys confirm a small Lassen population with the 2022 conservation assessment characterizing the population as "extremely small, likely comprising fewer than 30 individuals" (SNRFCAT 2022, p. 72). The assessment also notes that the population is isolated by at least 270 km and that habitat is "spatially constrained, making the population highly vulnerable to localized environmental stochasticity" (SNRFCAT 2022, p. 72)

Oregon Populations. Based on surveys conducted between 2011-2016 and unverified sightings going back to 1985, Quinn et al. (2018, p. 351) modeled the potential distribution of SNRF in Oregon with the highest performing models including minimum January temperatures and land-cover type and all models predicting an area with a high probability of occupation along the high-elevation portion of the Cascade Crest. This area is continuous except for a break between Mt. Hood and Mt. Jefferson (Quinn et al. 2018, p. 351) Although the predicted area is continuous between the Central Cascades and Crater Lake National Park, there are no sightings south of Willamette Pass, indicating the two populations are potentially isolated (Quinn et al. 2018, p. 359, figure 6).

SNRFCAT (2022, p. 73) determined that the Crater Lake National Park population is "likely extremely small given the scarcity of recent photographic and scat detections." Quinn et al. (2017, p. 3) estimated the effective population size for Mt. Hood to be just 48 adults. Genetic samples from the Central Cascades, as well as Crater Lake, showed low heterozygosity and a small genetic population size, suggesting the potential for genetic drift and inbreeding depression.

Conservation Status and Warranted ESA Protection

Under the ESA, 16 U.S.C. § 1533(a)(1), FWS is required to list the Southern Cascades DPS of the SNRF if it is in danger of extinction or likely to become endangered in all or a significant portion of its range. In

making such a determination, FWS must analyze the SNRF's status considering five statutory listing factors:

> (1) the present or threatened destruction, modification, or curtailment of its habitat or range;
> (2) overutilization for commercial, recreational, scientific, or educational purposes;
> (3) disease or predation;
> (4) the inadequacy of existing regulatory mechanisms; or
> (5) other natural or manmade factors affecting its continued existence.
> 16 U.S.C. § 1533(a)(1)(A)-(E); 50 C.F.R. § 421.11(c)(1)-(5).

All five of these factors threaten the Southern Cascades DPS of the SNRF. The SNRF is threatened by habitat destruction and modification, overutilization, disease and predation, the inadequacy of existing regulatory mechanisms, and other factors including small population size, restricted breeding range, recreation, and climate change. Threats to the SNRF considering each of these factors are discussed in detail below. Given its small population size, restricted range, and increasing threats to their survival, the Southern Cascades DPS clearly warrants protection under the Endangered Species Act.

The SNRF is vulnerable to extinction due to a number of factors, including but not limited to small population size, population isolation, low genetic diversity, competition from coyotes and gray foxes, climate change, trapping, recreation, disease, rodenticide poisoning, vehicle strikes and habitat degradation and destruction from development, logging and livestock grazing. In combination, these threats necessitate protection of the Cascades population of the SNRF as an endangered or threatened species under the Endangered Species Act.

(1) the present or threatened destruction, modification, or curtailment of its habitat or range;

Recreation. The SNRF occurs in areas where recreation and associated development has been rapidly increasing for decades, including Mt. Hood, the Three Sisters Wilderness and Mt. Bachelor in Central Oregon, and Crater Lake National Park and Lassen Volcanic National Park with particularly dramatic increases during the COVID 19 pandemic and remaining steady since. SNRFCAT (2022, p. 82), for example, report that visitation to the Deschutes National Forest, which contains most of the habitat for the Central Oregon population, has increased by 60% since 2014. Crowding in the Three Sisters Wilderness has grown so much in recent years that the Forest Service had to institute a permit system for hikers and campers. The Deschutes is also currently planning to add 54 miles of trail to the Sisters Ranger District, which overlaps considerably with SNRF habitat (Sisters Trail Additions and Realignment Project, https://www.fs.usda.gov/project/deschutes/?project=64457). These trail additions are being done under a categorical exclusion, meaning there will be little analysis of impacts to the Fox.

Likewise, SNRFCAT (2022, p. 81) noted that annual visitors to Lassen Volcanic National Park increased from 374,911 in 2000 to 517,039 in 2019, and that visitor numbers in Crater Lake National Park increased from 426,883 in 2000 to 704,512 in 2019. National Park Service staff estimated that more than 95% of visitor use in Crater Lake occurs within SNRF habitat and that several SNRF individuals were frequently observed in some of the most populated areas (SNRFCAT 2022, p. 81)

Recreation has a range of impacts on the SNRF. It is a known source of habitat destruction and fragmentation through building of roads, trails, ski-runs, cabins and lodges (SNRFCAT 2022, p. 80). Construction and operation of Mt. Hood Meadows, Timberline and Mt. Bachelor ski areas, for example, almost certainly caused a loss of habitat for the SNRF. Human use of recreation areas in turn can lead to

avoidance of areas by SNRFs or alternately habituation to people that increases mortality to vehicle strikes, dog attacks and exposure to poisons (SNRFCAT 2022, pp. 80-81, see further discussion of these impacts below). Recreation such as ski areas and snow mobile trails can also lead to declines in prey for the SNRF by compacting snow and reducing space for subnivean activity by small mammals. Loss of prey may be further impacted by introduction of invasive species and trampling of meadows in high-use areas (SNRFCAT 2022, pp. 80-81) Finally, use of ski and snow-mobile trails in winter may facilitate movement of coyotes and non-native red foxes into the SNRF's habitat through creation of trails of compacted snow with concurrent impacts from competition, predation and hybridization (SNRFCAT 2022, pp. 80-81; Perrine et al. 2010, p. 28).

An analysis of the Lassen National Forest's travel management plan confirms these impacts, stating: "SN red fox are thought to be very susceptible to indirect effects of human activities in their high elevation habitats," including "[h]igher road densities and increased human activity" that could "facilitate dispersal of non-native red foxes into historic SN red fox range," as well as "favor coyote expansion into remote areas," and "scrap food and trash which cause SNRF to develop begging habitats and thereby increasing the probability of conflict with humans, pet dogs, etc." (Lassen National Forest 2009, p. 507).

Livestock Grazing. Livestock grazing is thought to impact the SNRF through reductions in prey, tree encroachment into meadows and in particular through use of poisons to remove small mammals or predators (Perrine et al. 2010, p. 29; USFWS 2015, p. 30; SNRFCAT 2022, p. 88). Known active livestock grazing allotments are currently limited to seven allotments on the Lassen National Forest (USFWS 2015, p. 31). The Lassen National Forest concluded these allotments are impacting the SNRF, concluding "historic and present grazing has affected SNRF foraging habitat," noting that "[l]ow prey availability is thought to cause larger territory size, low-density distribution, low reproductive success and low survival rates" (Lassen National Forest 2009, p. 506).

Logging, Salvage and Fuels Treatment. SNRFCAT (2022, p. 86) concluded that silvicultural treatments are "uncommon in alpine and subalpine zones" and thus unlikely to impact the "majority" of the SNRF's habitat. The SNRF, however, uses montane forests that are subject to silvicultural treatments in the Central Cascades and on the Lassen National Forest, where it was found to utilize mature, closed-canopy forests at mid-elevations particularly during winter (Perrine 2005, p. 1) and where some evidence indicates the SNRF avoids forest openings potentially as a predator avoidance strategy (Benson et al. 2005, p. 128, SNRFCAT 2022, p. 87).

SNRFCAT (2022, p. 87) identified impacts to prey abundance as the most likely impact of logging on the SNRF, concluding based on a review of available studies that "timber harvest, fuels reduction, vegetation treatments, and fires that remove understory structures are likely to have a greater adverse impact on SNRF prey species," as compared to treatments that maintain understory vegetation and landscape heterogeneity.

Increased likelihood of fires followed by intensive salvage logging likely poses the greatest threat to the SNRF with large fires having burned in both the Central Cascades and Lassen in recent years. The 2021 Dixie Fire, for example, was the largest recorded fire in California history and burned portions of Lassen Volcanic National Park and the Caribou Wilderness, including much of the area where the SNRF is found. The Lassen National Forest plans to conduct extensive salvage and live-tree logging in the perimeter of the Dixie Fire, including areas to the east of the Park where the SNRF occurs (see Lassen National Forest, n.d., *Dixie Postfire Restoration and Recovery*). This project includes use of herbicides to control understory vegetation in support of tree growth, which is particularly concerning for the SNRF. The

Forest Service has not yet specified where treatments will occur, but if they occur where SNRFs are present both the logging and herbicide use are likely to have negative impacts. It is noteworthy that scoping documents for the project do not mention or consider the SNRF.

(2) overutilization for commercial, recreational, scientific, or educational purposes;

Hunting and Trapping. In combination with historic predator eradication programs, trapping likely contributed to the SNRF's decline in distribution and abundance (Perrine 2005, p. 154; Perrine et al. 2010, p. 17). Grinnell et al. (1937, p. 389) estimated the annual take to be roughly 21 animals (Grinnell et al. 1937, pp. 396–397, 389). This had declined to roughly two SNRFs taken from the mountains annually by 1974 when California prohibited trapping of the SNRF out of concern over observed declines in both individuals taken and sightings (Perrine et al. 2010, p. 17; California Code of Regulations (CCR) Title 14 § 460; USFWS 2018, p. 11). In 1980, the SNRF was listed as threatened under the California Endangered Species Act (USFWS 2018, p. 11).

In Oregon, all wild red foxes are classified as furbearers, and all forms of take and associated penalties are defined in state statutes and rules (Oregon Administrative Rule (OAR) 635-050-0050; Oregon Revised Statutes (ORS) Chapters 496, 498). Hunting and trapping of red fox has been governed by furbearer regulations since 1978. Those regulations allow licensed hunting and trapping of red foxes, including with use of dogs (OAR 635-050-0045(1), (8)). This applies to all fox in Oregon except in Crater Lake National Park, where hunting and trapping is prohibited.

The Oregon Department of Fish and Wildlife (ODFW) maintains trapping records by county, without recording exact location or elevation or attempting to identify subspecies, so harvest of SNRF cannot be distinguished from harvest of lowland foxes (USFWS 2015, p. 34). According to ODFW, trapping accounted for 92% of the total harvest of red foxes statewide from 1989–2017 with an average of 20 foxes taken annually from all 12 counties, which encompass the historical range of SNRF in Oregon (SNRFCAT 22, p. 85). Recent information obtained from the ODFW indicates SNRF have been trapped in Deschutes, Douglas, and Lane Counties (Personal communication, Derek Broman, October 27, 2023).

USFWS (2018, p. 34) concluded that hunting and trapping are a "low-level impact" to the subspecies as a whole, causing mortality of small numbers of individuals. Even small numbers of SNRFs killed in traps or by hunters, however, can contribute to extinction risk when populations are small, isolated and facing other sources of mortality, as is the case with the Sierra Nevada red fox (SNRFCAT 2022, p. 89).

(3) disease or predation;

Disease. While systematic testing of the SNRF has not taken place, disease is among the plausible explanations for historical declines in SNRF populations, along with over-harvest and exposure to toxins used for predator control (SNRFCAT 2022, p. 84). Diseases most likely to have population-level effects on the SNRF include sarcoptic mange, canine distemper, and rabies (Perrine et al. 2010, pp. 17, 28). Sarcoptic mange is a skin disease transmitted by a parasitic mite, that leads eventually to weight loss and death (Baldwin n.d.). Major outbreaks leading to losses or near losses of entire populations of red fox populations have been documented in Bristol, England in 1994 (Baldwin n.d.), and in northern Sweden in the late 1970s and early 1980s (Danell & Hörnfeldt 1987, p. 533). Canine distemper is a highly contagious viral disease attacking the animal's central nervous system that has a high mortality rate for red foxes (Granberry 1996, p. 2). Rabies is a viral disease of the central nervous system, usually

transmitted by bite (CDC 2013, p. 1). Death rate for red foxes infected by rabies is high, even when receiving low dilutions of the virus (Black & Lawson 1970, p. 311).

Planning is underway to conduct serology and PCR testing for canid infectious diseases on samples from the SNRF captured during 2018–2020 in the Lassen study area (SNRFCAT, 2022, p. 84). Increased development and recreation in areas where the SNRF occurs increases risk of disease transmission from dogs and is a substantial concern for the survival of the species.

Predation. As a small predator, the SNRF is subject to predation by coyotes, bobcats, dogs and likely other big predators like mountain lions and gray wolves (SNRFCAT 2022, p. 83). To date, just three "contemporary" predation events of the SNRF have been documented, including by coyote, bobcat and domestic dog (SNRFCAT 2022, p. 83) These small numbers, however, likely don't reflect the true impact of larger predators, particularly coyotes, on the SNRF. Instead, coyotes impact the SNRF through alteration of their use of space and prey resources, potentially resulting in lower fecundity or recruitment (Perrine, 2005, p. 193; SNRFCAT 2022, p. 83).

Perrine (2005, p. 194) studied the diets and distribution of SNRFs and coyotes in the Lassen area, finding that the two species segregate by elevation, and that this segregation is likely driven by antagonistic behavior by the larger coyote and mediated by seasonal patterns of food availability and snow depth. During the summer, the competition with coyotes and the availability of prey drive SNRFs to higher elevations, where coyotes are sparse (Perrine 2005, p. 194) In the winter months, SNRFs in the Lassen area descend to mid-elevations in search of food in areas where the deep snow makes travel particularly difficult for coyotes.

This dependence on mid-elevation areas free of coyotes during winter may make this population particularly vulnerable to changes in snowpack related to climate change. All populations of the SNRF, however, are vulnerable to any factor that allows coyotes to populate high elevation areas, including climate change and anthropogenic actions that provide pathways for coyotes to travel in the winter, such as development and snow mobile trails.

One factor that could mitigate the impact of coyotes on the SNRF is the restoration of wolves to the Cascades. Newsome and Ripple (2014, p.1) found that wolves suppress coyotes to the benefit of foxes, finding that at a continental scale where wolves were present, foxes outnumbered coyotes, but where they were absent, the opposite was true. Likewise, the reintroduction of wolves to Yellowstone National Park led to a reduction of the coyote population and increased sightings of foxes, suggesting a potential population increase (see YNP 2020).

(4) the inadequacy of existing regulatory mechanisms;

Remaining populations of the SNRF primarily occur on federal public lands, including two national parks. Yet, the SNRF is not adequately protected from a number of threats to its survival, including recreation and associated development, roads, trapping, and climate change. The U.S. Forest Service, National Park Service and states of California and Oregon all share management authority for the SNRF and its habitat.

The U.S. Forest Service. The SNRF primarily occurs on three national forests, the Mt. Hood, Deschutes and Lassen National Forests. Forest Plans for the Mt. Hood and Deschutes were created well before (1989-1990) it was known there was a unique, montane subspecies of fox in the Cascades. Likewise, the

Northwest Forest Plan was adopted in 1994 before there was knowledge of the SNRF and thus there are no special management requirements for the species on these two Forests.

The forest plan for the Lassen National Forest does briefly discuss the SNRF but only to conclude that "[l]ittle is known about the life cycle of this SNRF," that "it seems to be rather general in its habitat requirements," and ultimately that "[f}orest management will probably not affect the range or distribution of the Sierra Nevada red fox, and no special management will be required" (Lassen National Forest 1992, p. 3-44).

Perhaps most significantly given the serious impacts of recreation and associated development on the SNRF, a travel management plan for the Deschutes National Forest completed in 2011 does not include discussion of impacts to the SNRF or adopt any measures to protect the species (Deschutes National Forest 2011). Likewise, the Mt. Hood National Forest completed a "roads analysis report" in 2015 that identified potential impacts to the SNRF, but the Forest has yet to develop a plan that could mitigate impacts (Mt. Hood National Forest 2015, p. 59).

The Lassen National Forest's travel management plan was enacted in 2010 and does include measures to lesson impacts to the SNRF (Lassen National Forest 2010). According to the plan, the Forest Service must analyze activities within 5 miles of any verified detection to determine if the SNRF will be affected (Lassen National Forest 2009, p. 460). If any such activities are identified, the plan requires application of "a limited operating period from January 1 to June 30 to avoid adverse impacts to potential breeding (Lassen National Forest 2009, p. 460) The plan unfortunately does not specify what types of activities will be restricted.

This plan was modified in 2022 to better consider the impacts of over-snow vehicles and ultimately to reduce impacts by restricting snow mobiles or snow cats to specific routes. According to the FEIS for the modification, the plan reduced the potential for impacts, including "noise and increased human presence, injury or mortality of individuals, habitat modification, or snow compaction near denning sites," from 32 to 27 percent of identified suitable habitat for the SNRF on the Forest (Lassen National Forest, 2022, p. 512). The Lassen is thus a step-ahead of the other two national forests despite the passage of more than a decade since the SNRF was identified to occur within their bounds. Even on the Lassen, however, the plan allows for impacts to more than a quarter of identified habitat for this critically small and imperiled population.

None of the three national forests have specific provisions to protect the SNRF from other threats, including logging, livestock grazing, domestic dogs or a number of others.

The National Park Service. Lassen Volcanic National Park adopted a general management plan in 2003, which includes no discussion of the SNRF or any measures to protect it (LVNP 2003). The Park receives approximately 500,000 visitors a year and includes trails (including one to the summit of Lassen Peak), campgrounds, cabins, visitor centers and roads to support this many visitors to a relatively small park (106,000 acres, see LVPN, n.d., *Lassen Volcanic National Park Introduction*).

Crater Lake National Park adopted a general management plan in 2005 and like Lassen, did not consider impacts to the SNRF or adopt measures to protect them (CLNP 2005). Crater Like also receives approximately 500,000 visitors per year in its 160,000 acres. In addition to the associated infrastructure to support this visitation, the Park allows snow mobile use on a nine-mile road. Thus, there is a strong

potential for impacts to the SNRF from recreation and associated development and currently no regulations in place to protect the SNRF from these impacts on either park.

Oregon and California. The states of Oregon and California manage very little if any habitat for the SNRF. They do, however, regulate hunting and trapping, including for the SNRF, and are responsible for many of the roads in the state, including some that have the potential to impact the SNRF.

Trapping of the SNRF has been illegal since 1974 in California and the species has been listed under the California Endangered Species Act since 1980, making take of the SNRF illegal (SNRFCAT 2022, p. 30). As noted above, however, trapping and hunting of SNRFes remains legal in Oregon with no special protections for the Sierra Nevada red fox and it's likely that small numbers of the SNRF are taken annually. The exception to this is in Crater Lake National Park where all trapping and hunting is prohibited. If the SNRF is protected under the Endangered Species Act, trapping and hunting of the SNRF would be prohibited for the Central Oregon and Mt. Hood populations as well.

The states of California and Oregon maintain and manage roads that bisect the SNRF's habitat, including California state route 44, which cuts through habitat of the Lassen population and the Cascade Lakes Highway, which cuts through the Central Oregon population and has been the source of 5 mortalities of the SNRF by vehicle strikes in recent years. The states set the speed limits on these roads and maintain them without consideration of the SNRF.

Private Lands. According to SNRFCAT (2022, p. 74) "privately owned or leased resorts and cabins exist in SNRF habitat in both Oregon and California," and provide a source of rodenticide poisoning of the SNRF. California banned the use of first-generation anticoagulant rodenticides in Assembly Bill 1322 on October 23, 2023, which followed a similar bill banning second-generation anticoagulants in 2020. Oregon currently allows the sale and use of anticoagulant rodenticides, no efforts are underway to ban them and they are widely available.

EPA and U.S. Fish and Wildlife Service. As discussed below, climate change is a serious threat to the continued existence of the Sierra Nevada red fox, yet regulations to limit greenhouse gas emissions in the U.S. have not been enacted by the EPA. The U.S. Fish and Wildlife Service has also long maintained that the Endangered Species Act does not apply to emission of greenhouse gases despite the clear impact of continued emissions on numerous endangered and threatened species. This lack of regulation is a serious threat to the survival of the SNRF and many more species.

(5) other natural or manmade factors affecting its continued existence.

Rodenticides. Commonly used rodenticides are a threat to the SNRF and can be purchased off the shelf in hardware and home goods stores in Oregon (most rodenticides were banned in California). In 2011, a SNRF killed by vehicle strike from the Sonora Pass population was found to have a second-generation anticoagulant rodenticide in its liver and in 2019, a radio collared SNRF was found dead in the Central Cascades study area with rodenticide levels in its liver above the toxicity level for dogs (SNRFCAT 2022, p. 74).

There are a number of privately-owned or leased land, cabins and resorts within SNRF habitat in both California and Oregon which present potential avenues for rodenticide exposure (SNRFCAT 2022, p. 74). Another source is illegal cannabis cultivation sites, which often use rodenticides. According to SNRFCAT

(2022, p. 74), while cannabis cultivation is more common at lower elevations than those occupied by the SNRF, it may still occur in SNRF habitat.

The SNRF may face a higher risk than other predators or scavengers (e.g., birds) because pocket gophers are an important food year-round (Perrine 2005). Furthermore, they routinely dig gophers out of their burrows, making it likely that they would also be able to access poisoned carcasses and residual traces of bait belowground. The risk may be higher with the use of anticoagulant rodenticides, such as diphacinone (most commonly used first-generation anticoagulant and banned for personal use in California, Oct. 2023). As a first-generation anti-coagulant, diphacinone has relatively low toxicity to rodents and requires multiple applications to ensure effective treatment. These baits typically are applied aboveground, and evidence suggests that secondary poisonings are possible if a predator consumes the gastrointestinal tract or cheek pouches of poisoned rodents (Perrine 2005). These treatments are usually applied at recreation sites, such as campgrounds, which may increase the exposure to human-habituated red foxes.

Vehicle Strikes. A number of instances of the Sierra Nevada red fox being killed by vehicles have been documented in the past 20 years and present an additional threat to the survival of the species. SNRFCAT (2022, p. 95) notes that SNRFs have been killed by vehicle strikes in the Central Cascades, Crater Lake National Park and Lassen, as well as noting that "it is possible that mortalities associated with vehicle strikes occur but are not reported in areas where SNRF habitat intersects roads elsewhere in Oregon and California."

As noted above, vehicle traffic has increased dramatically in the SNRF's habitat, increasing the risk of mortality to vehicle strikes. To address this threat, SNRFCAT (2022, p. 95) recommended assessing the efficacy of road signs, speedbumps or other measures to alert visitors to wildlife crossing areas and encourage slower traffic, but to date there is no indication such measures have been taken in Central Oregon, Mt. Hood or elsewhere in the SNRF's range.

Given the critically small size of the SNRF's population, direct mortality due to vehicle strikes is a threat to the species continued existence, particularly when considered with other threats.

Habituation. According to SNRFCAT (2022, p. 80), habituation of the SNRF to human food sources, including begging behavior, has been documented in California in the Lassen and Sonora Pass study areas and in Oregon at such locations as the Hoodoo ski resort, Mt. Bachelor ski resort, and Mt. Hood Meadows ski resorts. Such habituation exposes the SNRF to additional mortality from vehicle strikes, exposure to poisons, dog attacks and transmission of disease from infected pets. The availability of human food can also increase the encroachment of coyotes, which compete with and prey on the SNRF.

SNRFCAT (2022, p. 82) notes an increase in requests for USFS special use permits for events, which can bring large numbers of people, dogs, food, and trash onto National Forest lands and into the SNRF's habitat. According to the report, approximately 600 special use permits are issued annually on the Deschutes National Forest (which overlaps the Central Cascades study area), and events occur there frequently, year-round (SNRFCAT 2022, p. 82). Data reported in the Conservation Strategy based on an ongoing collaring study in the Central Cascades study area suggests that the SNRF utilizes areas of developed, high-intensity recreation at all times of year, following human activity by shifting from ski resorts in winter to nearby campgrounds during the spring, summer, and fall (SNRFCAT 2022, p. 82)

Again, the small size of the SNRF's population means that any added mortality is cause for concern.

Wildfire. Based on the potential for high intensity fires to "remove vegetation for periods of several years or more, thereby lowering or eliminating the prey base in those areas," the Service determined wildfire to constitute a "low-level impact" to the SNRF "currently and into the future" (USFWS 2015, p. 30). The Service identified potentially damaging fires that had occurred on Mt. Hood and Lassen (USFWS 2015, p. 30). There have also been a number of recent, large fires in the Central Cascades, including the Peats Lake Fire in 2023.

Considerable evidence suggests fire has increased in recent years due both to past fire suppression, which has led to an increase in fuel loads (note, however, that the upper montane forests utilized by the SNRF had longer fire return intervals and thus are likely to have been impacted by suppression to a lesser degree), and climate change (Taylor 2000, p. 87; Bekker & Taylor 2010, p. 59; Mallek et al. 2013, pp. 13, 15; Cansler & McKenzie 2014, p. 1037). Halofsky et al. (2020, p. 1) conclude that large, severe fires are likely to continue to increase in the future under all climate scenarios and that fuels treatments are not likely to be effective in the high elevation forests where the SNRF occurs. Given this, the Service's low-level impact is a likely serious concern in the future.

Hybridization. Hybridization with non-native red foxes is a threat to the SNRF through outbreeding depression and genetic swamping. USFWS (2015, p. 42) noted that breeding with non-native red foxes, particularly those with fur-farm ancestry, could lead to reductions in survival or reproduction through loss of local adaptations like the SNRF's small body size, thick coat and dense fur covering the toe-pads, which all allow it to survive in winter at high elevations. Genetic swamping could lead to replacement of the SNRF's unique alleles and thereby cause its extinction by changing it to what amounts to a new species (USFWS 2015, p. 42)

In a comprehensive analysis of genetic structure of red foxes in the western United States, Quinn et al. (2022, p. 10) found that SNRF's in Lassen, Crater Lake and Central Oregon represented the historic native population, but that SNRF's on Mount Hood showed some introgression with low-elevation foxes, including some admixture with fur-farm foxes, that the authors stated reflected recent gene flow. It is unclear whether this gene flow is ongoing, but there is no evidence to suggest that it is not.

The SNRF has avoided hybridization with low-elevation foxes likely in large part to its unique adaptations to living in high-elevation environments. Under all current climate change scenarios, hybridization is likely to become a more serious threat to the continued existence of the SNRF.

Climate Change. Through changes in temperature, snow cover, vegetation, prey availability and potential increased presence of coyotes and non-native red foxes, climate change is likely to have profound, negative impacts on the SNRF. SNRFCAT (2022, p. 46) noted a strong relationship between SNRF occupancy and minimum temperature, snow-water equivalent and the amount and duration of snow cover. Given that climate change has and is expected to continue to impact these environmental variables in the wrong direction, it is highly likely that suitable habitat for the SNRF will shrink (SNRFCAT 2022, p. 46)

Over the last 50 years, global warming has caused increases in surface air temperatures that have led to substantial decreases in June snow cover across the globe, which reflects both glacier retreat and declining spring snowpacks (IPCC 2019, p. 6). In the Cascades, both snow-water equivalent and spring snowpack extent and depth have declined and are expected to continue to decline (Mote 2003, p. 3; Casola et al. 2008, p. 2758). Warmer temperatures and declining snowpack are in turn leading to

changes in vegetation with tree-line moving up and alpine meadows declining (Fagre et al. 2003, p. 263). Peterson et al. (2014, p. 107) found that across all climate scenarios, "species distribution models project that the suitable climate available for most key subalpine species will be moderately reduced to nonexistent by the end of the century."

Combined climactic and vegetation changes are leading to shifts in the ranges of small mammals that serve as prey for the SNRF and could limit food availability and will likely facilitate movement of coyotes, gray foxes and low-elevation, non-native red foxes into the SNRF's habitat with concurrent negative impacts (Moritz et al. 2008, p. 261; Perrine et al. 2010, p. i; Rowe et al. 2014, p. 1; Santos et al. 2017, p. 1; SNRFCAT 2022, p. 76). Ultimately, SNRFCAT (2022, p. 91) concludes that "climate change is expected to continue to alter vegetation communities and the depth and persistence of snowpacks" in the SNRF's habitat and that if "prey populations are sensitive to these changes, food availability for SNRF could decline and the potential for competition with sympatric carnivores could increase."

Inherent Vulnerability of Small Populations. It's long been recognized that small populations, particularly if isolated, are inherently at greater risk of extinction due to a variety of factors, including inbreeding depression, additive mortality, genetic swamping, disease and demographic and environmental stochasticity (see references in SNRFCAT 2022, p. 72). All populations of the SNRF are isolated from one another and small. This leaves the SNRF vulnerable to extinction independent of added mortality due to poisoning, vehicle strikes, disease or predation, and habitat loss due to development and climate change. Considering all of these factors together, however, the SNRF is exceedingly vulnerable to extinction.

Request for Critical Habitat Designation

We urge the Service to designate critical habitat for the Southern Cascades DPS of the SNRF concurrent with its listing. Critical habitat as defined by Section 3 of the ESA is: (i) the specific areas within the geographical area occupied by a species, at the time it is listed in accordance with the provisions of section 1533 of this title, on which are found those physical or biological features (I) essential to the conservation of the species and (II) which may require special management considerations or protection; and (ii) the specific areas outside the geographical area occupied by the species at the time it is listed in accordance with the provisions of section 1533 of this title, upon a determination by the Secretary that such areas are essential for the conservation of the species. 16 U.S.C. § 1532(5).

Congress recognized that the protection of habitat is essential to the recovery and/or survival of listed species, stating that: "classifying a species as endangered or threatened is only the first step in ensuring its survival. Of equal or more importance is the determination of the habitat necessary for that species' continued existence… If the protection of endangered and threatened species depends in large measure on the preservation of the species' habitat, then the ultimate effectiveness of the Endangered Species Act will depend on the designation of critical habitat." H. Rep. No. 94-887 at 3 (1976).

Critical habitat is an effective and important component of the ESA, without which the SNRF's chance for survival significantly diminishes. According to the recent study done by Oregon State University's Institute for Natural Resources, a conservation objective facilitated by designating critical habitat could include increasing connectivity between SNRF population areas in the form of land use decisions that limit habitat fragmentation when projects, like highway expansion, recreational development, and housing subdivisions. Other actions that could benefit the SNRF include lowering

vehicle speed limits, building wildlife crossing infrastructure, and reintroducing SNRFes in some areas to increase populations and genetic diversity (Green et. al., 2023).

Petitioners therefore request that the Service propose critical habitat for the species concurrently with its listing.

Conclusion

In this petition, we have carefully assessed the best scientific and commercial information available regarding the historic, present, and future threats faced by the Southern Cascades DPS of the SNRF and have determined that the species is in danger of extinction throughout its range, as well as in significant portions. The ESA requires that the Service promptly issue an initial finding as to whether this petition "presents substantial scientific or commercial information indicating that the petitioned action may be warranted." 16 U.S.C. § 1533(b)(3)(A).

There is no question that protecting the Southern Cascades DPS of the SNRF is warranted under the Act, as it is endangered by all five of the factors for consideration of listing. There are no existing regulatory mechanisms which are adequate to protect the Southern Cascades DPS of the SNRF. The Service must act promptly to protect this species and to designate critical habitat in order to prevent its extinction and protect its disappearing habitat. Listing the Southern Cascades DPS of the SNRF as endangered is the only way to ensure the continued existence of this species.

Literature Cited

Aubry, K. B. (1983). *The Cascade red fox: Distribution, morphology, zoogeography, and ecology* [Doctoral dissertation, University of Washington]. University Microfilms International.

Aubry, K. B. (1997). The Sierra Nevada Red Fox (*Vulpes vulpes necator*). In J. E. Harris, & C. V. Ogan (Eds.), *Mesocarnivores of Northern California: biology, management, and survey techniques, workshop manual* (pp. 55–61). Humboldt State University. The Wildlife Society, California North Coast Chapter.

Aubry, K. B., Statham, M. J., Sacks, B. N., Perrine, J. D., & Wisely, S. M. (2009). Phylogeography of the North American red fox: vicariance in Pleistocene forest refugia. *Molecular Ecology, 18*, 2668–2686.

Bailey, V. (1936). The red fox in America. *Nature Magazine, 28*(5), 26–272.

Baldwin, M. (n.d.). *Mange in the Red Fox.* Wildlife Online. https://www.wildlifeonline.me.uk/articles/view/mange-in-the-red-fox

Bekker, M. F., & Taylor, A. H. (2010). Fire disturbance, forest structure, and stand dynamics in montane forests of the southern Cascades, Thousand Lakes Wilderness, California, USA. *Écoscience, 17*(1), 59-72.

Benson, J. F., Perrine, J. D., Golightly, R. T., & Barrett, R. H. (2005). Use of Cover and Response to Cover Type Edges by Female Sierra Nevada Red Foxes in Winter. *Western North American Naturalist, 65*(1), 127–130.

Black, J. G., & Lawson, K. F. (1970). Sylvatic Rabies Studies in the Silver Fox (*Vulpes vulpes*). Susceptibility and Immune Response. *Canadian Journal of Comparative Medicine, 34*, 309–311.

Bluewater Network. (2002). *Snowmobile Position Paper.* https://www.activetwa.org/uploads/2/2/7/6/22767404/snowmobile_impacts-blue_water_network.pdf.

California Department of Fish and Wildlife. (2020, March 4). *Comments on Proposed Endangered Species Status for Sierra Nevada Distinct Population Segment of Sierra Nevada Red Fox*. https://www.regulations.gov/document/FWS-R8-ES-2019-0006-0034.

Cansler, A. C., & McKenzie, D. (2014). Climate, fire size, and biophysical setting control fire severity and spatial pattern in the northern Cascade Range, USA. *Ecological Applications, 24*(5), 1037–1056.

Casola, J. H., Cuo, L., Livneh, B., Lettenmaier, D. P., Stoelinga, M. T., Mote, P. W., & Wallace, J. M. (2008). Assessing the Impacts of Global Warming on Snowpack in the Washington Cascades. *Journal of Climate, 22,* 2758–2772.

Center for Biological Diversity. (2011). *Petition to List the Sierra Nevada Red Fox (*Vulpes vulpes necator*) as Threatened or Endangered Under the Endangered Species Act*

Centers for Disease Control and Prevention (CDC). (2022, December 8). *Rabies.* National Center for Emerging and Zoonotic Infectious Diseases (NCEZID), Division of High-Consequence Pathogens and Pathology (DHCPP). https://www.cdc.gov/rabies/index.html.

Churcher, C. S. (1959). The Specific Status of the New World Red Fox. *Journal of Mammalogy, 40*(4), 513–520.

Cross, P. R., & Crabtree, R. L. (2021). Recent findings suggest adding red fox (*Vulpes vulpes*) to climate-threatened whitebark pine (*Pinus albicaulis*) trophic system. *Canadian Journal of Zoology, 99*(7), 618–623.

Danell, K., & Hörnfeldt, B. (1987). Numerical responses by populations of red fox and mountain hare during an outbreak of sarcoptic mange. *Oecologia, 73*, 533–536.

Deschutes National Forest. (2010). *Final Environmental Impact Statement – Travel Management Project: Deschutes National Forest, Ochoco National Forest, and Crooked River National Grassland, Deschutes, Jefferson, Crook, Klamath, Lake, Grant and Wheeler Counties, Oregon.* USDA Forest Service, Region 6.

Deschutes National Forest. (2011). *Record of Decision - Travel Management Project: Deschutes National Forest, Ochoco National Forest, and Crooked River National Grassland, Deschutes, Jefferson, Crook, Klamath, Lake, Grant and Wheeler Counties, Oregon*. USDA Forest Service, Region 6.

Fagre, D. B., Peterson, D. L., & Hessl, A. E. (2003). Taking the pulse of mountains: Ecosystem responses to climatic variability. *Climatic Change, 59*, 263–282.

Green, D. S., Martin, M. E., Matthews, S. M., Akins, J. R., Carlson, J., Figura, P., Hatfield, B. E., Perrine, J. D., Quinn, C. B., Sacks, B. N., Stephenson, T. R., Stock, S. L., & Tucker, J. M. (2023). A hierarchical modeling approach to predict the distribution and density of Sierra Nevada Red Fox (*Vulpes vulpes necator*). *Journal of Mammalogy, 104*(4), 820–832.

Grinnell, J., Dixon, J. S., & Linsdale, J. M. (1937). *Fur-bearing Mammals of California: Their Natural History, Systematic Status, and Relations to Man* (Vol. 1). University of California Press.

Halofsky, J. E., Peterson, D. L., & Harvey, B. J. (2020). Changing wildfire, changing forests: the effects of climate change on fire regimes and vegetation in the Pacific Northwest, USA. *Fire Ecology, 16,* 4.

IPCC. (2019). *IPCC Special Report on the Ocean and Cryosphere in a Changing Climate* (H.-O. Pörtner, D. C. Roberts, V. Masson-Delmotte, P. Zhai, M. Tignor, E. Poloczanska, K. Mintenbeck, A. Alegría, M. Nicolai, A. Okem, J. Petzold, B. Rama, & N. M. Weyer, Eds.). Cambridge University Press.

Lariviére, S., & Pasitschniak-Arts, M. (1996). Vulpes vulpes. *Mammalian Species, 537*, 1–11.

Lassen National Forest. (1992). *Land and Resource Management Plan.* USDA Forest Service, Pacific Southwest Region.

Lassen National Forest. (2009). *Final Environmental Impact Statement – Motorized Travel Management: Lassen National Forest, Butte, Lassen, Modoc, Plumas, Shasta, Tehama and Siskiyou Counties, California.* USDA Forest Service, Pacific Southwest Region, R5-MB-207.

Lassen National Forest. (2010). *Record of Decision – Motorized Travel Management: Lassen National Forest, Butte, Lassen, Modoc, Plumas, Shasta, Tehama and Siskiyou Counties, California*. USDA Forest Service, Pacific Southwest Region, R5-MB-207.

Lassen National Forest. (n.d.). *Dixie Postfire Restoration and Recovery*. USDA Forest Service. https://www.fs.usda.gov/project/lassen/?project=63425.

Lassen Volcanic National Park. (2003). *General Management Plan.* U.S. Department of the Interior, National Park Service, Pacific Great Basin Support Office.

Lassen Volcanic National Park. (n.d.) *Lassen Volcanic National Park Introduction.* National Park Service, U.S. Department of the Interior. https://www.nps.gov/lavo/learn/kidsyouth/upload/Lassen-Volcanic-National-Park-Introduction.pdf

Mallek, C., Safford, H., Viers, J., & Miller, J. (2013). Modern departures in fire severity and area vary by forest type, Sierra Nevada and southern Cascades, California, USA. *Ecosphere, 4*(12), 153.

Merriam, C. H. (1900). Preliminary revisions of the North American red foxes. *Proceedings of the Washington Academy of Sciences, 2*, 661–676.

Moritz, C., Patton, J. L., Conroy, C. J., Parra, J. L., White, G. C., & Beissinger, S. R. (2008). Impact of a century of climate change on small-mammal communities in Yosemite National Park, USA. *Science, 322*(5899), 261–264.

Mote, P. W. (2003). Trends in snow water equivalent in the Pacific Northwest and their climatic causes. *Geophysical Research Letters, 30*, 1601.

Mt. Hood National Forest. (2015). *2015 Travel Analysis Report.* USDA Forest Service.

Newsome, T. M., & Ripple, W. J. (2014). A continental scale trophic cascade from wolves through coyotes to foxes. *Journal of Animal Ecology, 84*(1), 49–59.

Oregon Department of Fish and Wildlife. (2022). *Oregon Furbearer Trapping and Hunting Regulations: July 1, 2022 through June 30, 2024*. https://www.dfw.state.or.us/resources/hunting/small_game/regulations/docs/furbearer_regulations.pdf.

Perrine, J. D. (2005). *Ecology of Red Fox (*Vulpes vulpes*) in the Lassen Peak Region of California, USA* [Doctoral dissertation, University of California, Berkeley].

Perrine, J. D., Pollinger, J. P., Sacks, B. N., Barrett, R. H., & Wayne, R. K. (2007). Genetic evidence for the persistence of the critically endangered Sierra Nevada red fox in California. *Conservation Genetics, 8*, 1083–1095.

Perrine, J. D., Campbell, L. A., & Green, G. A. (2010). *Sierra Nevada Red Fox (*Vulpes vulpes necator*): A Conservation Assessment.* U.S. Department of Agriculture.

Peterson, D. W., Kerns, B. K., & Dodson, E. K. (2014). *Climate Change Effects on Vegetation in the Pacific Northwest: A Review and Synthesis of the Scientific Literature and Simulation Model Projections* (General Technical Report No. PNW-GTR-900). USDA Forest Service, Pacific Northwest Research Station.

Quinn, C. B., Hiller, T. L., & Sacks, B. N. (2017). *Distribution and Genetic Structure of the Sierra Nevada red fox in Oregon.* Prepared for Oregon Department of Fish and Wildlife.

Quinn, C. B., Akins, J. R., Hiller, T. L., & Sacks, B. N. (2018). Predicting the Potential Distribution of the Sierra Nevada Red Fox in the Oregon Cascades. *Journal of Fish and Wildlife Management, 9*(2), 351–366.

Quinn, C. B., Preckler-Quisquater, S., Akins, J. R., Cross, P. R., Alden, P. B., Vanderzwan, S. L., Stephenson, J. A., Figura, P. J., Green, G. A., Hiller, T. L., & Sacks, B. N. (2022). Contrasting genetic trajectories of endangered and expanding red fox populations in the western U.S. *Heredity, 129*, 123–136.

Rowe, K. C., Rowe, K. M. C., Tingley, M. W., Koo, M. S., Patton, J. L., Conroy, C. J., Perrine, J. D., Beissinger, S. R., & Moritz, C. (2014). Spatially heterogeneous impact of climate change on small mammals of montane California. *Proceedings of the Royal Society B: Biological Sciences, 282*(1799), 20141857.

Sacks, B. N., Statham, M. J., Perrine, J. D., Wisely, S. M., & Aubry, K. M. (2010). North American montane red foxes: expansion, fragmentation, and the origin of the Sacramento Valley red fox. *Conservation Genetics, 11*, 1523–1539.

Santos, M. J., Smith, A. B., Thorne, J. H., & Moritz, C. (2017). The relative influence of change in habitat and climate on elevation range limits in small mammals in Yosemite National Park, California, U.S.A. *Climate Change Responses, 4*, 7.

Sierra Nevada Red Fox Conservation Advisory Team (SNRFCAT). (2022). *A Conservation Strategy for the Sierra Nevada Red Fox*. California Department of Fish and Wildlife, Oregon Department of Fish and Wildlife, U.S. Fish and Wildlife Service, National Park Service, USDA Forest Service.

Statham, M. J., Rich, A. C., Lisius, S. K., & Sacks, B. N. (2012). Discovery of a remnant population of Sierra Nevada red fox (*Vulpes vulpes necator*). *Northwest Science, 86*(2), 122–132.

Taylor, A. H. (2000). Fire regimes and forest changes in mid and upper montane forests of the southern Cascades, Lassen Volcanic National Park, California, U.S.A. *Journal of Biogeography, 27,* 87–104.

U.S. Fish and Wildlife Service. (2015, August 14). *Species Report: Sierra Nevada Red Fox (*Vulpes vulpes necator*).*

U.S. Fish and Wildlife Service. (2018). *Species Status Assessment Report for the Sierra Nevada Distinct Population Segment of the Sierra Nevada Red Fox*. USFWS Region 8.

Yellowstone National Park. (2020, October 21). *Red Fox.* National Park Service. https://www.nps.gov/yell/learn/nature/red-fox.htm.

Zielinski, W. J., Truex, R. L., Schlexer, F. V., Campbell, L. A., & Carrol, C. (2005). Historical and contemporary distributions of carnivores in forests of the Sierra Nevada, California, USA. *Journal of Biogeography, 32*, 1385–1407.