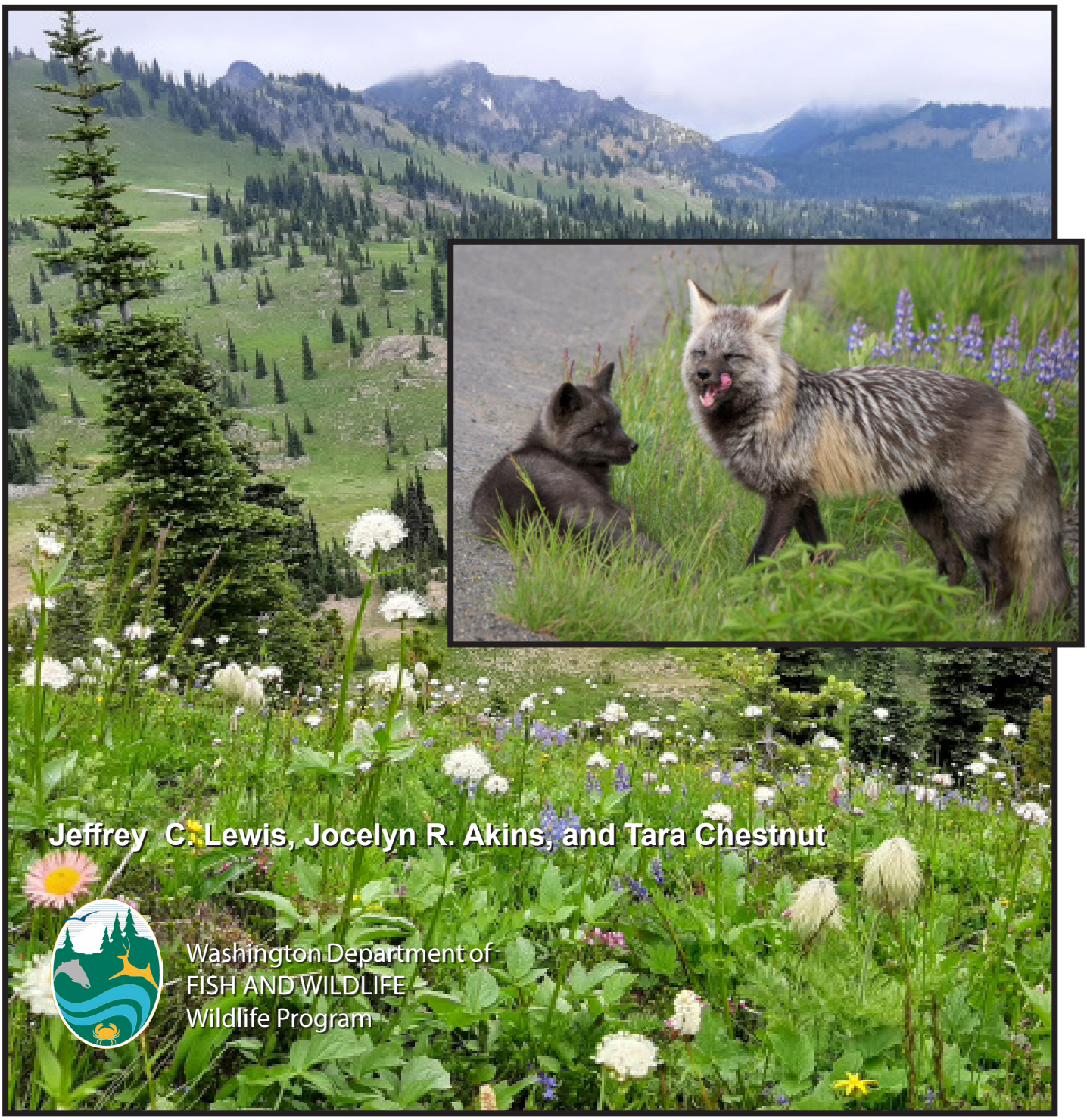
STATE OF WASHINGTON September 2022

Status Report for the Cascade Red Fox



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Washington Department of
FISH AND WILDLIFE
Wildlife Program

The Washington Department of Fish and Wildlife maintains a list of endangered, threatened, and sensitive species (Washington Administrative Codes 220-610-010 and 220-200-100). In 1990, the Washington Wildlife Commission adopted listing procedures developed by a group of citizens, interest groups, and state and federal agencies (Washington Administrative Code 220-610-110). These procedures include how species listings will be initiated, criteria for listing and delisting, a requirement for public review, the development of recovery or management plans, and the periodic review of listed species.

The Washington Department of Fish and Wildlife is directed to conduct reviews of each endangered, threatened, or sensitive wildlife species at least every five years after the date of its listing. The reviews are designed to include an update of the species status report to determine whether the status of the species warrants its current listing status or deserves reclassification. The agency notifies the general public and specific parties who have expressed their interest to the Department of the periodic status review at least one year prior to the five-year period so that they may submit new scientific data to be included in the review. The agency notifies the public of its recommendation at least 30 days prior to presenting the findings to the Fish and Wildlife Commission. In addition, if the agency determines that new information suggests that the classification of a species should be changed from its present state, the agency prepares documents to determine the environmental consequences of adopting the recommendations pursuant to requirements of the State Environmental Policy Act.

The draft periodic status review for the Cascade Red Fox was reviewed by species experts and was available for a 90-day public comment period from 18 February through 19 May 2022. All comments received were considered during the preparation of this revised final periodic status review. The Fish and Wildlife Commission voted on 23 September 2022 to classify the Cascade Red Fox as endangered in Washington.

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Cover photo of foxes by Anthony Carado; background photo from Sourdough Ridge Trail, Mt. Rainier National Park by Derek Stinson.

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STATUS REPORT FOR THE

CASCADE RED FOX IN WASHINGTON

Photo by Anthony Carado © 2016

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TABLE OF CONTENTS

LIST OF FIGURES AND TABLES

EXECUTIVE SUMMARY

The Cascade red fox (*Vulpes vulpes cascadensis*) is a subspecies of red fox that historically occurred in subalpine meadow, parkland, upper montane forest, and alpine habitats of the Cascade Range of Washington and southern British Columbia. Lack of detections of Cascade red foxes in British Columbia in recent decades indicate that this species is now restricted to Washington. A southward range contraction appears to have occurred within Washington within recent decades, as the only known population now occurs in the South Cascades (south of the I-90 corridor). It now occurs within ≤ 50% of its historical range in the state.

The Cascade red fox is one of three subspecies of red foxes that occupy montane habitats in western North America. They are a smaller subspecies of red fox that has adapted to occupying cold high elevation environments year-round, where they use subalpine meadow, parkland, upper montane forest, and alpine habitats near the crest of the Cascade Range.

Our knowledge of the biology and ecology of the Cascade red fox is extremely limited. There are no estimates (historical or current) of total population size for the Cascade red fox in Washington. However, in the southern Cascades, a recent estimate indicated an effective population size of 16 foxes (95% CI 13.3-19.4), where effective population size can be thought of as the number of individuals in the population that produce the next generation. The apparent range contraction of the Cascade red fox over recent decades is likely to coincide with a lowering of overall abundance. Other aspects of the demography of the Cascade red fox (e.g., survival, fecundity, reproduction) are poorly understood.

There are a number of recognized threats that could affect the stability and persistence of the Cascade red fox population. These threats include small population size, limited genetic diversity, potential impacts of climate change (i.e., loss/fragmentation of habitat, increased predation/competition by coyotes as a result of a decreasing snowpack), potential impacts (e.g., competition, hybridization, disease transmission) of an invasion of non-native red foxes into their current range, and feeding of foxes by visitors at Mount Rainier National Park and other public areas.

Because its range appears to have contracted substantially, the Cascade red fox is now a Washington endemic, and is now confronted with a number of significant threats to its long-term viability. We therefore recommend that the Cascade red fox be listed as a Threatened Species in Washington State.

ACKNOWLEDGEMENTS

Keith Aubry, Ben Sacks, Stefanie Bergh, Jason Ransom, Scott Fitkin, Taylor Cotton, and Wendy Connally provided helpful suggestions on earlier drafts of this status review. Keith Aubry provided a wealth of insights on the historical and recent distributions, ecological relationships, and biology of the Cascade red fox and lowland red foxes that were invaluable as we drafted this review.

DESCRIPTION & LEGAL STATUS

The Cascade red fox (*Vulpes vulpes cascadensis*; Figure 1) is a native subspecies of red fox that occurs only in the Cascade Range of Washington and southernmost British Columbia (Aubry 1984; Sacks *and others* 2010). It is a Species of Greatest Conservation Need in the 2015 Washington State Wildlife Action Plan due to its endemic status, apparent range contractions, small population sizes, potential threat of climate change, and the limited amount of biological and ecological information available for both Cascade and lowland red foxes in Washington (Aubry 1983; WDFW 2015; Akins 2017; Akins *and others* 2018).

Figure 1. Cascade red fox (*Vulpes vulpes cascadensis*; cross color-phase; photo: Roy Morris).

The Cascade red fox is one of three subspecies of red fox native to montane ecosystems in the western United States. The other two subspecies are the Rocky Mountain red fox (*V. v. macroura*), which inhabits the Rocky Mountains and other ranges of Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming; and the Sierra Nevada red fox (*V. v. necator*) that inhabits the Cascade Range of Oregon, and the Cascade and Sierra Nevada Ranges of California (Aubry *and others* 2009; Sacks *and others* 2010). As a group, they represent the mountain subclade of red foxes and are ecologically, morphologically, and genetically distinct from other North American red foxes (Aubry *and others* 2009; Sacks *and others* 2010). The red, cross, and black color phases are common in Cascade red fox populations (Figure 2). Aubry (1983) provided the only data available on live weights for adult Cascade red foxes, including three females (3.1 to 3.7 kg) and three males (4.0 to 4.5 kg). These weights are similar to those of Sierra Nevada red foxes (Perrine 2005, Perrine *and others* 2010) and smaller than those of lowland red foxes.

Populations of non-native red foxes also occur in lowland areas of Washington due to translocations of red foxes into the state during historical times for fox-hunting, or animals that escaped or were released from fur farms (Aubry 1984; Witmer & Lewis 2001; Statham *and others* 2012). The genetic characteristics of these lowland red foxes indicates that they differ from the Cascade red fox and are descended from red foxes that originated in eastern Canada and Alaska (Aubry *and others* 2009; Sacks *and others* 2010; Statham *and others*

Figure 2. The Cascade red fox exhibits three common color phases including the red phase (left; photo by Cascade Carnivore Project), cross phase (center; photo by Anthony Carado) and black phase (right; photo by Anthony Carado).

2012). Although there is no evidence yet that lowland red foxes have dispersed into and occupied areas within the historical range of the Cascade red fox (Akins *and others* 2018), a potential invasion by non-native red foxes into its range could have negative consequences for the Cascade red fox. Conservation and management efforts are complicated by the similarity in appearance between Cascade and lowland red foxes in Washington; consequently, genetic data are required to distinguish the two forms.

DISTRIBUTION

Historically, the Cascade red fox occurred throughout the Cascade Range from southern Washington northward to southernmost British Columbia (Aubry 1983, 1984; Figure 3). A lack of recent detections in southern British Columbia (R. Weir, British Columbia Ministry of Environment, pers. comm.) suggests that this subspecies is restricted to the Cascade Range in Washington. Based on the distribution of recent verifiable detections of red foxes (Figure 4), the current range of the Cascade red fox in Washington is smaller than its historical range. It is now restricted primarily to Washington's southern Cascades (South

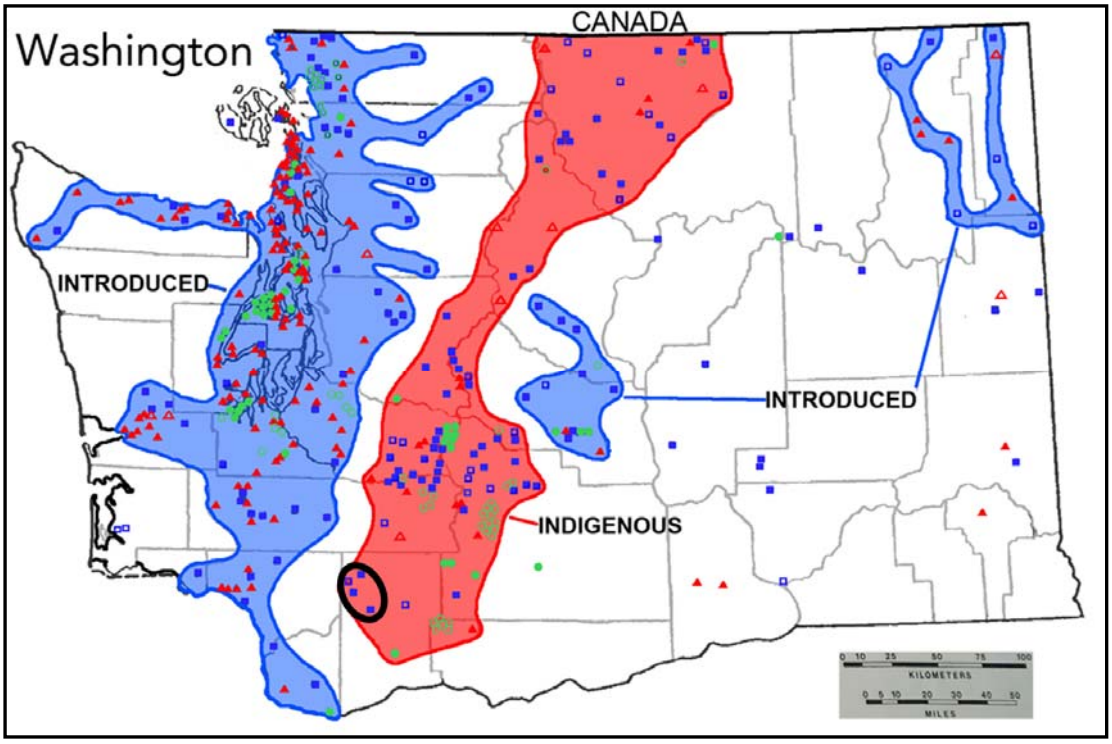

Figure 3. Historical range of the Cascade red fox as indicated by the red shading and labeled "indigenous" in the center of the map, with associated fox detections (modified from Aubry 1983, 1984; squares= sighting reports, triangles = trapping reports, circles = museum specimen records). Although Aubry (1983, 1984) reported unverified red fox detections in the vicinity of the Mount Saint Helen's National Volcanic Monument (i.e., the 4 points within the black oval), there is little historical and no recent verifiable detections to indicate that this area was part of the species' historical range (K. Aubry, pers. comm.; J. Akins unpublished data).

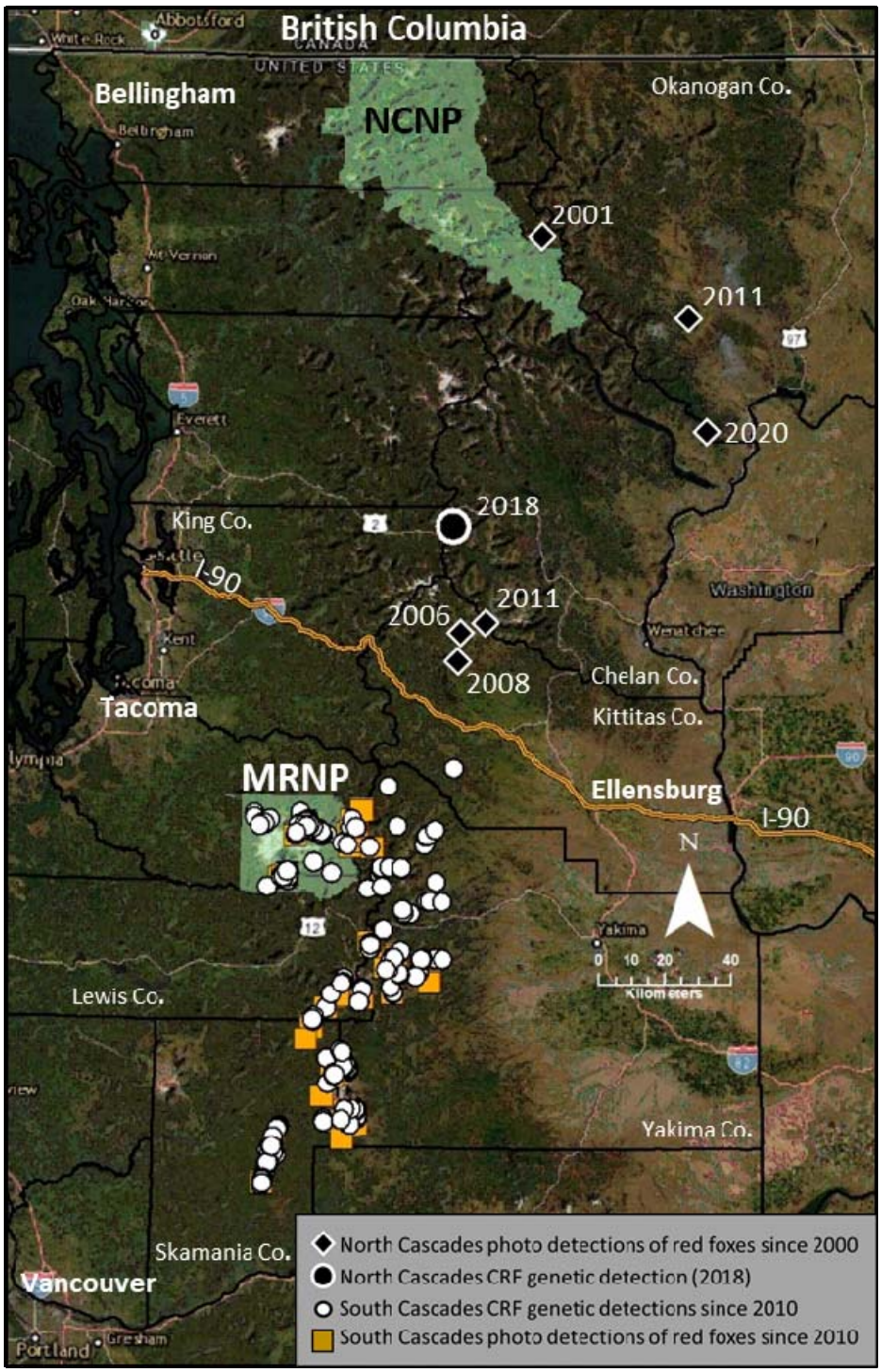

Figure 4. The recent distribution of verifiable detections of Cascade red foxes (via genetic analysis) and verifiable red fox detections (via photos) in the vicinity of the historical range of the Cascade red fox in Washington (Akins *and others* 2017; WDFW, unpubl. data; Cascade Carnivore Project, unpubl. data). NCNP = North Cascades National Park, and MRNP = Mount Rainier National Park.

Cascades) from the Indian Heaven Wilderness in central Skamania County and Mount Adams in western Klickitat County north through the Goat Rocks Wilderness and Mount Rainier National Park, and as far north as the Norse Peak Wilderness and Manastash Ridge in southwestern Kittitas County (Figure 4). Although Aubry (1983, 1984) reported 4 sightings of red foxes in the vicinity of Mount Saint Helens National Volcanic Monument, the lack of any verifiable detections in this area indicates that this was likely not part of the historical range of the Cascade red fox (K. Aubry, pers. comm.; Figure 3).

Although a small number (n = 5) of red foxes have been detected in the Cascades north of Interstate 90 (North Cascades) since 2001 at remote camera stations in Kittitas and western Okanogan Counties (Figure 4), a resident population of Cascade red foxes has not been detected north of I-90 since the 1980s. These few recent detections could represent resident or dispersing Cascade red foxes, or lowland red foxes making long-distance movements outside their current range. Cascade red foxes likely share several morphological features with other montane red foxes that make them distinct from lowland red foxes such as small body size and small toe pads with additional fur (Fuhrmann 2002; B. Sacks, unpublished data). In addition, they are restricted to high-elevation areas of the Cascade Range. However, genetic evidence is required to distinguish them from lowland red foxes with certainty. Since 2008, a number of carnivore surveys have been conducted in high-elevation habitats in the North Cascades Ecosystem (e.g., WDFW multispecies survey in 2015/2016; multi-agency carnivore surveys 2008-2016; Western States Wolverine Survey, winter 2016/2017 (Lukacs and others 2020, Lewis and others 2020); National Park Service/Washington State University/Cascades Carnivore Project surveys 2018-2019); however, no red foxes were detected during any of these surveys. The genetic detection of only one Cascade red fox and limited photo detections of red foxes (native or non-native) north of I-90 since 2000 suggests that any existing Cascade red fox populations in this region are few, small, and/or localized in remote areas where they would be difficult to detect. In contrast, surveys conducted in the southern Cascades, using similar survey methods, have regularly detected Cascade red foxes (Figure 4; Akins 2017; J. Akins, unpublished data; Lewis *and others* 2020; WDFW, unpublished data). To date, there is no evidence that lowland red foxes have become established within the historical range of the Cascade red fox (J. Akins, unpublished data) despite an extensive survey effort in the southern Cascades.

NATURAL HISTORY

Habitat Requirements

The Cascade red fox occurs year-round in subalpine meadow, parkland, upper montane forest, and alpine habitats near the crest of the Cascade Range. It appears to prefer open-forest habitats, more typically found on the eastern slope of the Cascade Range (Aubry 1984; Akins 2017), as it is a cursorial predator that can effectively hunt in relatively open habitat conditions. Despite the often extreme climatic conditions that occur throughout much of their range during the winter, the Cascade red fox is active throughout the year and does not migrate seasonally. Thus, they must make a living in some of the harshest winter conditions for any mammal in the Cascades. Neither Cascade nor lowland red foxes are known to occur in dense mid-elevation forests on the western slope of the Cascades.

In the South Cascades, Akins (2017) found that Cascade red fox occupancy was greatest in areas characterized by high elevations near timberline, late persistent spring-snow, non-forest or open-forest cover, and subalpine parkland and upper montane forest habitats. When considering only Cascade red fox presence data, Akins (2017) found that foxes were also closely associated with colder environments, landscapes with low to moderate slopes, and higher levels of precipitation in March.

Gene flow within the southern Cascades population appears to be most influenced by land cover type and to a lesser degree by elevation (Akins 2017). Gene flow was facilitated by the connectivity of subalpine parkland and upper montane forest habitats and hindered somewhat by alpine land-cover and hindered substantially more by mid-elevation forests (Akins 2017). Roads and rivers did not significantly influence patterns of gene flow.

Denning Habitat

Without telemetry studies, dens are difficult to locate in remote, mountainous terrain where Cascade red foxes typically occur. Several dens have been documented near human habitation in Mount Rainier National Park and at Crystal Mountain Resort (Aubry 1983; J. Akins & T. Chestnut, unpublished data.). These dens were all located at the upper elevation extent of montane forests near timberline.

Diet and Foraging

Aubry (1983) conducted the only study of the food habits of the Cascade red fox and found that Cascade red foxes at Mount Rainer National Park and the surrounding area fed predominantly on mammals (57.2% of food items), but also plants (mainly berries; 19.9 %), insects (16.6%), and birds (4.5%; Aubry 1983). While mammals made up over half of the diet in summer (53.1% of food items), they represented a large majority of the winter diet (89.4%). Snowshoe hares (*Lepus americanus*), pocket gophers (*Thomomys talpoides*), and voles (Myodes, *Phenacomys* or *Microtus spp*.) were the most common mammals found in Cascade red fox scats.

Cascade red foxes occur in cold landscapes that contain deep snowpacks from early winter to late spring (Akins 2017), and many of the mammalian species in their diet occupy subnivean spaces. Thus, these foxes require access to these spaces when hunting many of their primary prey species during winter. A soft snowpack facilitates access to these subnivean prey, whereas snow consolidated by rain-on-snow events makes access more difficult or impossible, given the fox's foraging behavior. Because our understanding of the winter diet is limited to one study (using 59 scats; Aubry 1983), it is unclear if Cascade red foxes rely heavily upon larger prey such as snowshoe hares and ungulate carcasses, particularly mountain goats, during winter.

Reproduction and Survival

Little is known regarding reproduction of the Cascade red fox. Since 2011, 4 litters of 1-3 pups (observed) were documented within or near Mount Rainier National Park, including pups seen as early as 12 May (3 very small pups) and as late as 8 August (J. Akins & T. Chestnut, unpublished data). Aubry (1983) radio-

collared and tracked a subadult (<1 year old) female that was subsequently observed with a litter of 3 pups the following summer, at 1 year of age.

POPULATION AND HABITAT STATUS

Habitat Occupancy in Washington

Although there have been several detections of individual red foxes since 2000 within the portion of their range North of I-90 (Figure 4), no resident populations are currently known to exist within this portion of their historical range. The occupancy analysis conducted by Akins (2017) provided an assessment of habitats that may be suitable for Cascade red fox occupancy in the North Cascades Ecosystem, and these areas represent high priority locations to conduct future surveys to determine whether Cascade red fox populations occupy these areas. Resident populations of Cascade red foxes occur within its historical range south of I-90, from Mount Rainier National Park and the Goat Rocks Wilderness Area, south from the Goat Rocks to Mount Adams and the Indian Heaven Wilderness Area (Figure 4).

Population Trend and Viability

There are no population estimates available for the Cascade red fox in Washington. However, the significant range contraction from its historical to its current range (Aubry 1983, 1984; Akins 2017) is likely to coincide with lower overall abundance. This range contraction could also affect the viability of the fox population in the southern Cascades, which was recently estimated as having an effective population size (N_e) of 16 foxes (95% CI 13.3-19.4; Akins *and others* 2018), where effective population size can be thought of as the number of individuals in the population that produce the next generation (Pearson 2013). Given the small effective size of the only known population, and the possible extirpation or isolation of subpopulations to the north of I-90, the short-term stability of extant populations is of great concern, and the long-term viability of the subspecies in Washington State is completely unknown.

FACTORS AFFECTING CONTINUED EXISTENCE

Climate Change

Several direct effects of climate change that are evident in montane habitats (Monzón *and others* 2011) are likely to affect both the Cascade red fox and its prey. Montane habitats have risen in temperature during the winter in recent decades, resulting in declines in annual snowpack as winter precipitation falling as rain is occurring more often than it did historically (Kullman 2001; Mote *and others* 2005; Parmesan 2006; Stewart 2009). Many landscape-scale ecological processes are driven by snow conditions, including the development of alpine meadows and subalpine parklands (Henderson 1973; Rochefort *and others* 1994). Persistent snow cover during a significant portion of the year contributes to the development of the habitat conditions that support many of the prey species on which the fox relies, whereas climatic warming results in meadows

being invaded by conifer species (Millar *and others* 2004). For example, warming promotes the upslope migration of conifers and reduces the areal extent of subalpine parklands (Franklin *and others* 1971). This encroachment has been exacerbated by the suppression of wildfires in areas that historically had regular fire intervals or were managed by indigenous peoples using fire treatments (Helms 1987; Miller & Halpern 1998; Coop & Givnish 2007; Halpern *and others* 2010). In addition, variation in winter snowpack affects the distribution and abundance of many prey species (Korslund & Steen 2006; Pauli *and others* 2013). Snow supports an array of subnivean prey that remain active throughout the winter under a deep, insulating snow layer. Changes within the snowpack can adversely affect prey abundance and accessibility as environmental conditions within the subnivean zone are altered (Pauli *and others* 2013). When rain-on-snow events occur during winter in the mountains, the snowpack compresses and hardens, reducing or eliminating access for mesocarnivores to the subnivean zone. Higher temperatures and associated drought can result in the mortality of trees in subalpine areas. For example, during summer, drought conditions and a subsequent increase in high-elevation conifer disease has resulted in the loss of white-bark pine (*Pinus albicaulis*), subalpine fir (*Abies lasiocarpa*), and mountain hemlock (*Tsuga mertensiana*) from areas near timberline. These patchy, high-elevation copses of trees provide cover for prey such as snowshoe hares, and foraging habitat for foxes. The loss of mature high-elevation conifers may result in declines in prey availability for the Cascade red fox.

Introduction of Non-native Red Foxes

Because of the presence of non-native red fox populations in many low-elevation areas adjacent to the Cascade Range in Washington, it is possible that lowland red foxes could invade habitats occupied by Cascade red foxes. Dispersal of lowland red foxes into these areas could have several negative impacts to Cascade red foxes. These include hybridization resulting in the loss of specialized genotypes and declines in fitness, disease transmission, and resource competition; it could also reduce the effectiveness of the ecosystem functions provided by the Cascade red fox (Sacks *and others* 2011). There is currently no evidence that lowland red foxes are present in areas occupied by Cascade red foxes; however, surveys that are designed to obtain genetic samples are needed to determine whether this has changed recently in the South Cascades or the extent to which this may have occurred in the North Cascades. Information on the distribution and genetic make-up of non-native foxes in Washington would aid in such an effort. Unfortunately, we lack critical information on the potential threats they represent and the measures that could be employed to address those threats.

Demographic and Genetic Factors

The Cascade red fox may be at risk due to its small demographic and genetic effective population size. It is also possible that the population in the southern Cascades is largely disjunct from any existing populations in the North Cascades. Akins *and others* (2018) indicated that the population of Cascade red foxes is characterized by a small effective population size of 16 foxes, which reflects extremely low genetic diversity. Additionally, based on comparison to the genetic diversity of the 8 red foxes from ~3 decades earlier (Sacks *and others* 2010), this population appears to have declined since then. Based on its current effective population size, this population could face inbreeding depression in the future, as was documented in a Sierra Nevada red fox population (Quinn *and others* 2019). Low genetic diversity additionally can reduce a

population's resilience and ability to adapt to environmental changes, such as those anticipated due to climate change.

Due to the difficulties of accessing the landscapes the Cascade red fox occupies, poaching, incidental capture by trappers, accidental killing by hunters, and roadkill mortality appear to have little impact on the stability of their populations. However, pups have been killed by vehicle collisions on several roadways that occur within Cascade red fox habitat (T. Chestnut, unpublished data). If these impacts become more significant in the future or if the size of the Cascade red fox population becomes substantially smaller, any additional mortality by these or other sources could have significant consequences for population persistence. The Cascade red fox is currently protected from in the Mt. Baker-Snoqualmie, Okanogan, Wenatchee, and Gifford Pinchot National Forests. Fortunately, the risk of capturing a Cascade red fox in a trap is low because of limited trapping efforts where Cascade red foxes occur, the low likelihood of a fox being captured in a box trap (due to their hesitancy to enter them), and the small size of the box traps that must now be used to capture Pacific martens (*Martes caurina*) in the Cascades. Since 2000, no trapper has reported harvesting a fox in the counties where the Cascade red fox is known to occur.

Invasion of Competitors

The coyote (*Canis latrans*) may be influencing fine-scale spatial and temporal patterns of Cascade red fox habitat use. As an intraguild competitor and predator, they are a significant limiting factor for red fox populations elsewhere (Voigt & Earle 1983; Sargent 1982; Gosselink *and others* 2007). In Washington, coyotes were historically absent or occurred only at low elevations in arid areas east of the Cascade Range (Hody & Kays 2018), where snowfall was low compared to in the mountains. However, three factors may have promoted the expansion of coyotes within and beyond their distribution, including into higher elevations of the Cascades. First, the gray wolf (*Canis lupus*) was eliminated from nearly all of its range in the contiguous US by the mid-1900s (McIntyre 1995; Laliberte & Ripple 2003), thereby removing the most significant predator and competitor of the coyote and enabling a dramatic expansion within and outside the coyote's range. Second, increased winter recreation may facilitate the upslope movement of coyotes into Cascade red fox habitat as coyotes are able to travel more easily along ski and snowmobile tracks (Gese *and others* 2013). Third, changes to snowpack in the mountains caused by reduced snow fall or increased rain-on-snow events (Cohen *and others* 2015) have potentially increased the ease of travel for coyotes at higher elevations where deep snow conditions were more typical (Sheldon *and others* 2011).

Coyote occupancy of higher elevation landscapes in the Cascade Range was documented at 14 of 25 stations (56%) established as part of the Western States wolverine survey in the winter of 2016/2017 (Lewis *and others* 2020). Coyotes do not possess the same morphological adaptations for deep snow as the Cascade red fox, yet coyotes now occur in montane habitats where they were historically absent (Perrine *and others* 2010; C.B. Quinn, University of California, Davis, unpublished data; J.R. Akins, unpublished data). Wolverine survey stations are also effective at detecting Cascade red foxes, but they were only detected at five stations in the southernmost Cascades during that survey. Deep snow may have previously kept Cascade red fox and coyote populations separated during winter but snow-packing by winter recreationists and below average snowfall in certain regions may be making Cascade fox habitats both more accessible and more suitable to coyotes. During summer, coyotes have always been able to access high-elevation montane habitats, but

available information indicates that they move to lower elevations during the winter (K. Aubry, personal observation).

Several wolf packs now occur in the north Cascades (WDFW *and others* 2019), and the natural recolonization of wolves in Washington may reduce coyote populations within the historical range of the Cascade red fox. Although the population center for the Cascade red fox is located in the South Cascades where the gray wolf has not yet recolonized, wolf occupancy in the North Cascades could result in a reduction in coyote numbers that could facilitate the recolonization or expansion of Cascade fox populations in this portion of their historical range.

Fox Feeding by Visitors to National Park Sites, Ski Areas, and Wilderness Areas

Several habituated and food-conditioned foxes have been frequently observed in subalpine areas including Mount Rainier National Park, Crystal Mountain and White Pass Ski Areas, and on Mount Adams. Mount Rainier National Park is a large, protected area that provides substantial expanses of habitat for the Cascade red fox (Akins *and others* 2018), and many park visitors have been able to observe Cascade foxes at close range at Longmire, Narada Falls, Paradise (Jenkins *and others* 2016) and Sunrise (T. Chestnut, pers. comm.). Although the Park discourages visitors from feeding any wildlife, it has been difficult for the Park Service to completely stop the feeding of Cascade foxes in the Park. While fox-feeding does facilitate very close viewing of this fascinating carnivore, it also places foxes at risk of conflicts with park visitors, conflicts with a visitor's pet, visitor-caused mortality (accidents, roadkill mortality), and disease transmission. Dogs are prohibited from most areas of the park, yet some visitors ignore this prohibition. Dogs that accompany park visitors defecate and urinate in areas where foxes are frequently fed by park visitors; such activities can result in the transmission of several diseases from domestic dogs to Cascade red foxes. Fox-feeding can also be harmful to foxes because it promotes a dependency on human foods; in addition, it is inconsistent with the mission of the National Park Service to maintain the integrity of natural ecosystems and promote the enjoyment of natural ecosystems by park visitors.

MANAGEMENT ACTIVITIES

Population Monitoring

Prior to field studies conducted by Jocelyn Akins during the previous decade (Akins 2017, Akins *and others* 2018), there was little or no information about methods that could be used to survey or monitor Cascade fox populations in high-elevation habitats of the Washington Cascades. However, numerous incidental detections of Cascade foxes at camera stations set for other species demonstrated that remote-camera surveys can be effective for detecting Cascade red foxes. Surveys targeted specifically for Cascade red foxes began in 2008, when the Cascade Carnivore Project began survey efforts in the southern Cascades of Washington. These surveys and monitoring efforts led to the implementation of a doctoral study on the Cascade red fox in the south Cascades (Akins 2017; Akins *and others* 2018). Survey and monitoring efforts

included trail and area surveys to collect DNA (from urine and scats), and camera and hair-snare surveys in areas of potential habitat where fox presence was unknown (Figure 5). To gain new information about the occurrence of Cascade red foxes in the north Cascades, camera surveys and scat searches on trails were conducted by the Cascades Carnivore Project in collaboration with WDFW, National Park Service, and U.S. Forest Service within their historical distribution beginning in 2013 (Figure 5). Baited camera stations and scat searches along trails were deployed on the Cle Elum and Wenatchee River Ranger Districts during Summer 2013, Winter 2017/18, Summer 2018, Winter 2018/19, and Summer 2019. Additional surveys that deployed unbaited camera stations along trails were conducted in North Cascades National Park and in the Pasayten Wilderness during Summer 2018 and 2019. Altogether, these efforts yielded only a single Cascade red fox detection in the Stevens Pass area just south of Highway 2, based on DNA from a scat and an accompanying photograph. This strongly suggests that Cascade red fox populations in the northern Cascade Range may have been reduced to a few very small and isolated populations or extirpated altogether.

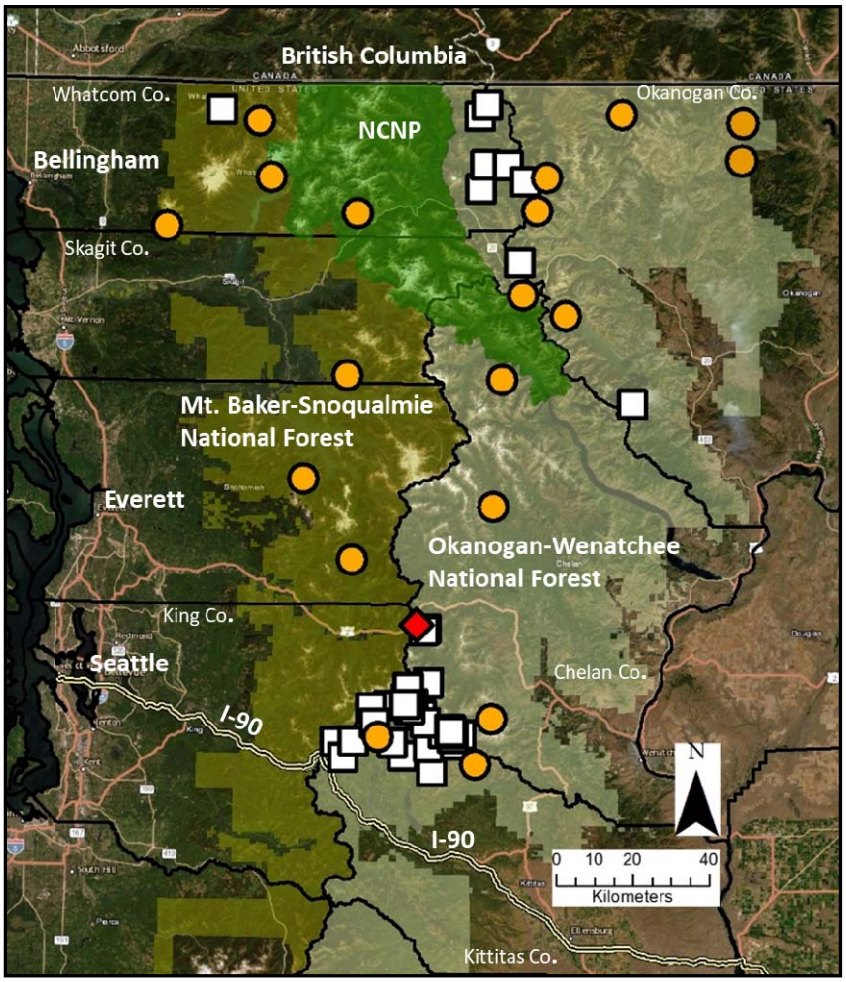

Figure 5. Locations of remote camera stations deployed in the North Cascades Ecosystem by the Cascades Carnivore Project and cooperators from 2013 to 2019 (white squares; n = 46) and in winter of 2016-2017 by the Washington Wolverine Survey (orange circles; n = 19). No Cascades red foxes were detected at these stations. The red diamond indicates a Cascade red fox detection that was determined via DNA analysis of a scat collected near Steven's Pass by J. Akins in August of 2018.

Research

A study of the food habits of Cascade red foxes is currently underway by the Cascade Carnivore Project and Mount Rainier National Park, based on genetic metabarcoding to identify the remains of prey species in the scats of Cascade red foxes (also determined genetically). This study is intended to describe the seasonal diets of the Cascade red fox, and to determine if their primary prey species are vulnerable to anticipated climate change impacts, which could affect the viability of Cascade red fox populations. In addition, research is also underway by the Cascade Carnivore Project and the National Park Service to develop a population estimate of Cascade red foxes within Mount Rainier National Park and surrounding areas.

CONCLUSIONS AND RECOMMENDATIONS

Within Washington, surveys designed to detect Cascade red foxes as well as those that can incidentally detect them have been deployed across >75% of the historical range in Washington. Where they occur, Cascade red foxes can be readily detected with a number of existing survey methods. Based on substantial survey effort across its historical range since 2008, the Cascade red fox has been found only in Washington, and within ≤ 50% of its historical range in the state. A small reproductive population currently occupies a portion of its historical range in Washington's southern Cascade Range. This population is composed of individuals connected throughout this region with dispersal occuring over large distances. It does however have a very low genetic effective population size of 16 individuals, indicating its low genetic diversity. Beyond the threats of small population size, the Cascade red fox may be threatened by the effects of climate change, including increased predation and competition that results from improved habitat conditions fro coyotes (i.e., less snowpack) and greater coyote abundance, and loss and fragmentation of the subalpine-parkland and open-forest habitats occupied by the Cascade red fox. The Cascade red fox may also be vulnerable to hybridization, resource competitition, and disease transmission that could result from non-native red fox invasion into their range.

As a result of range contraction, the Cascade red fox is now limited to a small area within Washington, and is confronted with a number of significant threats to its long term viability. Uncertainty remains around the threats of increased predation and competition by coyotes, interbreeding by non-native red foxes, and habitat loss and fragmentation due to climate change. Based on these existing conservation concerns and uncertainties we recommend that the Cascade red fox be listed as a Threatened Species in Washington.

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i. Independent peer review; review is overseen by an independent third party.
ii. Internal peer review; review by staff internal to WDFW.
iii. External peer review; review by persons that are external to and selected by WDFW.
iv. Open review; documented open public review process that is not limited to invited organizations or individuals.
v. Legal and policy document; documents related to the legal framework for WDFW, including but not limited to: (A) federal and state statutes, (B) court and hearings board decisions, (C) federal and state administrative rules and regulations; and (D) policy and regulatory documents adopted by local governments.
vi. Data from primary research, monitoring activities or other sources.
vii. Records of best professional judgement of WDFW employees or other individuals.
viii. Other: sources of information that do not fit into one of the categories identified above. http://www.env.gov.bc.ca/soe/indicators/plants-and-animals/print_ver/2012_Grizzly_Bear_Population_Status_BC.pdf

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APPENDIX A. Public Comments

WDFW received nine comments during the 90-day public comment period. Three strongly supported the recommendation to list the Cascade red fox as threatened. Three supported protection of Cascade red foxes via greater predator control efforts. One individual reported that they obtained a photo detection of a red fox. No mention of support for or against listing. One individual noted that they would regularly see red foxes many years ago but have not seen one in a very long time. No mention of support for or against listing. One individual expressed doubt about the status review findings because of an abundance of red foxes observed in northwestern Oregon (not Washington). No mention of support for or against listing.

Washington State Status Reports, Periodic Status Reviews, Recovery Plans, and Conservation Plans

Periodic Status Reviews

2022 Brown Pelican
2022 American White Pelican
2022 Cascade Red Fox
2022 Snowy Plover
2021 Gray Whale
2021 Humpback Whale
2021 Greater Sage-grouse
2020 Mazama Pocket Gopher
2019 Tufted Puffin
2019 Oregon Silverspot
2018 Grizzly Bear
2018 Sea Otter
2018 Pygmy Rabbit
2017 Fisher
2017 Blue, Fin, Sei, North Pacific Right, and Sperm Whales
2017 Woodland Caribou
2017 Sandhill Crane
2017 Western Pond Turtle
2017 Green and Loggerhead Sea Turtles
2017 Leatherback Sea Turtle
2016 Canada Lynx
2016 Marbled Murrelet
2016 Peregrine Falcon
2016 Bald Eagle
2016 Taylor's Checkerspot
2016 Columbian White-tailed Deer
2016 Streaked Horned Lark
2016 Killer Whale
2016 Western Gray Squirrel
2016 Northern Spotted Owl
2015 Steller Sea Lion

Status Reports

2019 Pinto Abalone
2017 Yellow-billed Cuckoo
2015 Tufted Puffin
2005 Mazama Pocket Gopher, Streaked Horned Lark, and Taylor's Checkerspot
2005 Aleutian Canada Goose
1999 Northern Leopard Frog
1999 Mardon Skipper
1999 Olympic Mudminnow
1998 Margined Sculpin
1998 Pygmy Whitefish
1997 Olive Ridley Sea Turtle
1997 Oregon Spotted Frog

Recovery Plans

2020 Mazama Pocket Gopher
2019 Tufted Puffin
2012 Columbian Sharp-tailed Grouse
2011 Gray Wolf
2011 Pygmy Rabbit: Addendum
2007 Western Gray Squirrel
2006 Fisher
2004 Sea Otter
2004 Greater Sage-Grouse
2003 Pygmy Rabbit: Addendum
2002 Sandhill Crane
2001 Lynx
1999 Western Pond Turtle

Conservation Plans

2013 Bats

Status reports and plans are available on the WDFW website at:
http://wdfw.wa.gov/publications/search.php