Rulemaking Petition to List the Pygmy Rabbit (*Brachylagus idahoensis*) under the Endangered Species Act as an Endangered or Threatened Species and to Concurrently Designate Critical Habitat

NOTICE OF PETITION

Petition submitted to the U.S. Secretary of the Interior
Acting through the U.S. Fish and Wildlife Service

March 6, 2023

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Petitioners:

Western Watersheds Project
Center for Biological Diversity
WildEarth Guardians
Defenders of Wildlife

Submitted on Behalf of the Petitioners by:

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NOTICE OF PETITION

This is a formal petition to list the Pygmy rabbit (*Brachylagus idahoensis*) throughout its range[1] as endangered or threatened pursuant to the Endangered Species Act, 16 U.S.C. § 1531 et seq. (ESA), and to concurrently designate critical habitat.

Pursuant to Endangered Species Act ("ESA"), 16 U.S.C. § 1533(b) and 50 C.F.R. § 424.14(a), WWP et al. hereby petition the Secretary of the Interior, through the United States Fish and Wildlife Service ("FWS" or "Service"), to protect the pygmy rabbit as an endangered species or threatened species. This petition sets in motion a specific process, placing definite response requirements on the Service. 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… within 90 days after receiving the petition." 16 U.S.C. § 1533(b)(3)(A).

On November 8, 2022, Western Watersheds Project provided electronic notice of the pending petition to the state agencies affected by this action. Receipt of the document was confirmed by each state.[2]

WWP submits this petition on behalf of Center for Biological Diversity, Defenders of Wildlife, and WildEarth Guardians, and on behalf of the organizations' members, staffers, and supporters. The petitioners are individuals and conservation organizations with a deep interest

[1] This petition does not include the Columbia Basin population of pygmy rabbits, which is already protected under the ESA. 66 Fed. Reg. 231 (November 30, 2001).

[2] The following individuals confirmed their agency was in receipt of the document: Chuck Bonham (CA), Reid DeWalt (CO), Ed Schriever (ID), Hank Worsuch (MT), Tony Wasley (NV), Curt Melcher (OR), Christopher Keleher (UT), and Brian Nesvick (WY). We also provided notice to Marilet Zablan and Marjorie Nelson (FWS). Electronic confirmations available upon request.

in protection of biodiversity and sagebrush ecosystems. Failure to grant the requested petition will adversely affect the aesthetic, recreational, spiritual, commercial, research and scientific interests of petitioning organizations' members and of citizens of the United States. The public shows increasing demand for wildlife viewing opportunities, and increasing concern for biodiversity in general. The members of the petitioning organizations are concerned that the pygmy rabbit could be threatened by extinction throughout its range if action is not taken by the Service to perform a rigorous review of the current status of this species and current and future threats to its habitat, and act accordingly to swiftly offer protection under the ESA as either a Threatened or Endangered Species.

Submitted this 6th day of March, 2023.

Pursuant to 50 C.F.R. § 424.14(c), the names and addresses of Petitioners are:

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PETITION TO LIST THE PYGMY RABBIT (*BRACHYLAGUS IDAHOENSIS*) AS THREATENED OR ENDANGERED

INTRODUCTION

Western Watersheds Project, Defenders of Wildlife, Center for Biological Diversity, and WildEarth Guardians respectfully request that the Secretary of the Interior, acting through the U.S. Fish and Wildlife Service ("Service"), list the pygmy rabbit (*Brachylagus idahoensis*) as "threatened" or "endangered" under the U.S. Endangered Species Act ("ESA") (16 U.S.C. §§ 1531-1544). We are also requesting that critical habitat be designated for this species. *See* 16 U.S.C. § 1533(a)(3); 50 C.F.R. § 424.12.

The pygmy rabbit is a small leporid that is an extreme specialist in sagebrush habitat. It is found in the Great Basin and adjacent intermountain areas of the western United States, from southeastern Oregon and southern Idaho to southwestern Montana and south-central Wyoming, to extreme northwestern Colorado and southwestern Utah, and to Central Nevada and eastern California. 75 Fed. Reg.at 60519 (September 30, 2010) (Estes-Zumpf et al. 2014).[3] [4]

The species is highly dependent on sagebrush for virtually all of its winter diet and for cover from predators, and requires deep soil sites for construction of burrows. The pygmy rabbit and its requisite big sagebrush (*Artemisia tridentata*) habitats have suffered significant declines, especially in recent decades. Future habitat degradation and loss is predicted, primarily due to an increase in fire frequency in sagebrush habitat in the western portion of the species' range, which is both driven and compounded by climate change and increases in cheatgrass (*Bromus tectorum*). Added to this is the recent evidence of Rabbit Hemorrhagic Disease Virus Serotype 2 (RHDV2) within the range of the pygmy rabbit, which we fear is now affecting populations that are already starting to lose habitat connectivity due to habitat loss, degradation and fragmentation, thus diminishing the chances of "rescue effects" from adjacent populations if one population winks out due to RHDV2. In addition to these threats, livestock grazing is nearly ubiquitously influential throughout the range of the species and also compounds and worsens the currently out-of-balance fire and cheatgrass cycle. Climate change, warming and increased drought are also acting synergistically with all the above threats to pygmy rabbits across the range.

As described in the original pygmy rabbit listing petition in 2003, populations of pygmy rabbit occupy a geographic range estimated at 10% of the species' known historic range, which

[3] A complete description of pygmy rabbit range, distribution, and natural history was provided in the September 2010 "Not Warranted" determination. *See* 75 Fed. Reg. 60516-60561 (September 30, 2010).

[4] At the outset, petitioners wish to be clear that this request for ESA listing does not include pygmy rabbits in the Columbia Basin Distinct Population Segment. 66 Fed.Reg. 231 (November 30, 2001).

spanned over 100 million acres of the American West. Existing larger populations are often isolated from one another. Stochastic events, disease, and continued disturbance will further fragment its range and limit post-disturbance recovery from satellite populations.

Herein we demonstrate that the pygmy rabbit is at risk of extinction (e.g. endangered) or at risk of becoming endangered (e.g. threatened) in all or a significant portion of its range. There is evidence that shows pygmy rabbit populations are in decline, that its habitat is disappearing, that it is threatened with emergent diseases, and there are no adequate regulatory mechanisms in place to ensure its long-term survival. The pygmy rabbit must be listed under the Endangered Species Act in light of these threats.

I. LEGAL REQUIREMENTS OF THE ENDANGERED SPECIES ACT

The Service is required to make listing determinations "solely on the basis of the best scientific and commercial data available to [it] after conducting a review of the status of the species and after taking into account" existing efforts to protect the species without reference to the possible economic or other impacts of such a determination. 16 U.S.C. § 1533(b)(1)(A); 50 C.F.R. § 424.11(b), "[R]equiring that agency decisions be made on the "best scientific and commercial data available", rather than absolute scientific certainty, is in keeping with congressional intent…to require the FWS to take preventive measures *before* a species is "conclusively" headed for extinction." *Defs. of Wildlife v. Babbitt*, 958 F. Supp. 670, 679–80 (D.D.C. 1997).

After receiving a petition to list a species, the Secretary is required to determine "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). Such a finding is termed a "90-day finding." A positive 90-day finding leads to a status review and a determination whether the species will be listed, to be completed within twelve months. 16 U.S.C. § 1533(b)(3)(B). A negative initial finding ends the listing process, and the ESA authorizes judicial review of such a finding. 16 U.S.C. § 1533(b)(3)(C)(ii). The applicable regulations define "substantial information," for purposes of consideration of petitions, as "credible scientific or commercial information in support of the petition's claims such that a reasonable person conducting an impartial scientific review would conclude that the action proposed in the petition may be warranted." 50 C.F.R. § 424.14(h)(1)(i).

The Secretary must "list" a species under the Endangered Species Act if the species is endangered or threatened based upon one or more of the following factors:

(A) The present or threatened destruction, modification, or curtailment of habitat and range;
(B) Overutilization for commercial, recreational, scientific, or educational purposes;
(C) Disease or predation;
(D) The adequacy of existing regulatory mechanisms; or
(E) Other natural or manmade factors affecting its continued existence.

16 U.S.C. § 1533(a)(1).

II. THE SETTING: THE SAGEBRUSH SEA

The pygmy rabbit is an obligate species of the sagebrush ecosystem, a vast landscape covering portions of thirteen states in the American West. Sagebrush (*Artemisia spp*.) is the largest arid/semi-arid vegetation type in North America, dominating more than 600,000 km^2 (118.6 million acres or almost 250,000 mi^2) of the western United States and Canada. Sagebrush ecosystems are characterized by arid and semi-arid climates with lower annual precipitation, ranging from about 13 cm to 51 cm (5–20 in) per year (Rotler et al. 2015).

The ecology and management of the "sagebrush sea" has received significant scientific attention in recent years due to the closely-watched decline of the greater sage grouse (*Centrocercus urophasianus*), but this fragile landscape also provides habitat for more than 350 species of plants and animals that depend on this ecosystem for all our part of their life cycles (Hanser and Wiechman 2020). The conservation and restoration of this ecosystem have come into sharp focus as the multiple stressors – including fire, invasive species, human development, livestock grazing, energy development, drought and climate change – have resulted in greater degrees of fragmentation, amplification of degradation, and declines in dependent wildlife populations (Doherty et al. 2022).

Over the past two centuries, the extent and diversity of sagebrush systems throughout the West have diminished substantially. The spatial extent of the sagebrush sea has declined by approximately 50 percent since the arrival of European settlers in the 1800s (Schroeder et al. 2004, Homer et al. 2015). This decline is associated primarily with biome-level threats, including the degradation, conversion, and fragmentation of the sagebrush landscape due to agricultural development, pervasive livestock grazing, energy development, conifer expansion, and increased incidence of fire driven by increases in exotic annuals like cheatgrass (*Bromus tectorum*) (Davies et al. 2011, Doherty et al. 2022). All of these factors in combination have led to substantial decreases in functioning sagebrush habitat. In particular, anthropogenic impacts across the sagebrush sea have increased over the past four decades as population growth has increased in the Intermountain West (Leu and Hanser 2011) and the development of oil and gas reserves has accelerated (Holloran et al. 2010, Green et al. 2017, Haack 2021). In the recent Sagebrush Conservation Design report issued by the U.S Geological Survey (Doherty et al. 2022), the authors cited the rate of sagebrush habitat loss in the intermountain West at approximately 1.3 million acres a year, stating, "Given the pace and scale of the biome-level threats [to the Sagebrush biome], sustaining the diverse ecosystem services associated with the sagebrush biome involves moving…into the realm of proactive ecosystem management focused on lessening factors that are driving "**biome-wide collapse"** (emphasis added) (citing Boyd et al. 2014).

Current threats to the sagebrush sea are adding to the cumulative impacts of past activities that have already compromised the diversity and natural resilience of the sagebrush ecosystem on which so many sagebrush obligate species depend, including the pygmy rabbit. This situation is

now being compounded by a rapidly changing climate and the proliferation of exotic and invasive vegetation (Remington et al. 2021) as well as ongoing habitat loss and degradation resulting from a range of land use activities. Numerous modeling studies indicate that the combined effect of climate change, increased exotic annuals, and the increase in fire that result from that interaction, will lead to further decreases in sagebrush cover across the sagebrush sea (Remington et al. 2021).

III. NATURAL HISTORY, ECOLOGY AND HABITAT

Description and Taxonomy

The pygmy rabbit belongs to the mammalian order Lagomorpha. The pygmy rabbit was first described in 1891 as *Lepus idahoensis* (Merriam 1891), and later reclassified as *Brachylagus idahoensis* (Lyon) in 1904. In 1930, Grinnell placed this species in *Sylvilagus* (WDFW 1995), and this placement was confirmed by Hall (1951). *Brachylagus* became a subgenus within the genus *Sylvilagus* for 33 years until it was returned to the generic rank where it is today.[5] The pygmy rabbit has similar physical characteristics throughout its entire range, and there are no apparent subspecies (Green and Flinders 1980, Janson 2002).[6]

Reproduction and ontogeny

Pygmy rabbits born in the first litter of the year are capable of reaching adult size and reproducing near the end of their first breeding season although it was acknowledged this may be because of supplemental feeding and good body condition in a semi-captive setting (DeMay et al. 2016). Breeding appears to be highly synchronous (Wilde 1978). Photoperiod and vegetation conditions affect breeding in pygmy rabbits (Wilde 1978, 1981), with the quantity, quality and the timing important factors (Wilde 1981). The early availability of green vegetation in a drought year resulted in females conceiving a month earlier, and a period of June rain resulted in a sharp increase in juvenile growth rate (Wilde 1981). There is evidence of possible sex ratio alteration in response to harsh conditions, as more females were found in cohorts in a drought year (Wilde 1981).

Male sexual development begins in January, peaks in March and declines in June (WDFW 1995 citing Janson 1946 and Wilde 1978, Elias et al. 2006). Females excavate specialized natal burrows with only one entrance, where they give birth and nurse the young (1 – 2 times per day) at the ground surface in a small depression near the burrow's entrance, with the young returning to the burrow after nursing (Rachlow et al. 2005, Elias et al. 2006, 68 FR 43). The female may block this burrow entrance with loose soil in her absence (Rachlow et al. 2005, Elias

[5] However, recent genetic work (Cano-Sanchez et al. 2022) indicates that it is possible that Brachylagus is in fact a species within Sylvilagus as proposed by Grinnell et al. (1930).

[6] The genetic separation between Washington rabbits and other populations was described in the Emergency Listing rule. 66 Fed. Reg. at 231 (November 30, 2001). Inbreeding had already reduced genetic diversity of the Columbia Basin rabbits by the time genetic comparisons were made between Washington and other populations

et al. 2006, 66 FR 231). The gestation period is 27 to 30 days. There is an average of 6 young per litter – with a maximum of three litters per year. The young are altricial, but emerge from the burrow around 15 days after birth (Elias et al. 2006. Multiple paternity litters are possible (Falcón et al. 2011, DeMay et al. 2016). The young belong to recognizable cohorts, and individuals in succeeding cohorts are smaller in size, perhaps because later cohorts face poorer quality food (Wilde 1978). Growth rate of individual young was less in a drought year (Wilde 1978). In instances where a third cohort has been observed, survival of the third cohort has been poor (Wilde 1978). In general, juvenile survival is low - with greater than 50 percent mortality in the first 5 weeks of life (Wilde 1978).

Movement

Pygmy rabbits have a stance that is low to ground. This has been described as a relatively "slow, scampering gait" (Merriam 1891). Pygmy rabbits rely on their ability to maneuver through dense sagebrush, rather than on speed, to avoid predators (Green and Flinders 1980, WDFW 1995). This low scampering gait differs from the longer, higher jumps typical of other rabbits (Merriam 1891). Top running speed is estimated at 24 km per hour (Green and Flinders 1980, Janson 2002). Movement is usually confined to a small area around the burrow in winter, with longer movements in spring and summer (Green and Flinders 1980, McMahon et al. 2017).

Pygmy rabbits are slow and thus vulnerable in open areas. Extensive well-used runways interlace sage thickets and provide travel and escape routes (Green and Flinders 1980). Pygmy rabbits construct tunnels under snow cover (subnivean tunnels) for accessing food (sagebrush) when snow reaches sufficient depth (Katzner 1994). Pygmy rabbits may climb into shrubs to feed (Bailey 1936, Katzner 1994, Janson 2002). Pygmy rabbits typically remain in close proximity to burrows. Winter activity occurs within approximately 30 meters of burrows (Janson 2002).

Social Behavior and Interactions

Pygmy rabbits live in aggregations that some researchers call colonies. Within these aggregations, home ranges and use areas show some degree of overlap (Katzner 1994); however, pygmy rabbits are largely considered a solitary species (Green and Flinders 1980). Multiple pygmy rabbits may use a single burrow system concurrently regardless of season. During the breeding season, as many as 11 individuals have been captured at a single burrow system in a 5-day period (personal communication, Miranda Crowell, November 12 2022). Crowell has also observed multiple individuals using a single burrow system in winter (individuals distinguished by individually-unique PIT tags), and also observed two collared individuals flee into the same burrow system in November 2021. A pygmy rabbit has also been observed driving a young black-tailed jackrabbit (*Lepus californicus*) out of an occupied burrow (Janson 2002). Janson also noted that two males were present in separate branches of the same burrow along with a young rabbit, indicating possible tolerance of rabbits in separate tunnels. Some males had apparent fight scars on their sides. When captive adults were placed in the same pen, they were very intolerant, and fought or killed one another. However, there

appeared to be tolerance for young – an adult male placed with six young pygmy rabbits did not harm them until stressed for food (Janson 2002).

Pygmy rabbits have alarm vocalizations/alert calls when they are frightened (Green and Flinders 1981). These vocalizations may be a strategy for pygmy rabbit signaling in brushy habitats, where visual signals (like the tail alarm signals of desert cottontails, *Sylvilagus audubonii*) would not be effective. The adaptive advantages of giving alarm calls would be greatest in social settings where closely related individuals could respond by flight (Green and Flinders 1981).

Periods of Activity

Pygmy rabbits have been described as crepuscular, most active at dawn and dusk (Janson 1946), or sometimes described as active throughout the day or night (Larrucea and Brussard 2009, Lee et al. 2010, Milling et al. 2017). Larrucea and Brussard (2008) found activity was highest in mid-morning, likely due to rabbits avoiding effects of temperature and wind velocity. They also found overall, year-round activity was highest in the morning a few hours on either side of sunrise, but in winter, dusk activity was much higher than any other season, likely because of relatively warmer temperatures (Larrucea and Brussard 2008). Milling et al. 2017 documented that winter activity increases as temperatures increase. During the summer, pygmy rabbits spend much of the day lying in the shade of sagebrush near their burrows, and feeding at intervals (Janson 2002, Milling et al. 2018). Most researchers report inactivity in the early afternoon, and during the hottest periods of the day.

Diet

Pygmy rabbits, like other rabbits, consume fecal and cecal pellets, especially when under food stress (Katzner and Parker 1997). Leporids reingest hard and soft feces. Soft feces are reingested directly from the anus. Leporids deprived of soft feces suffer malnutrition (Hirowaka 2001). Hard feces are the pellets typically observed in the field. Reingestion of daytime hard feces promotes food digestibility, and the temporary use of night-time hard feces allows leporids to go without food for some time (Hirowaka 2001), thus providing behavioral flexibility (Hirowaka 2001). Due to this reingestion, leporids can live on fibrous, low-quality grasses and leaves and woody parts of plants. Smaller herbivores like leporids need to assimilate higher energy per unit capacity of the digestive tract than do larger mammals, and do this by quickly excreting poorly digestible material (Hirowaka 2001). However, pygmy rabbits can tolerate plant secondary compounds found in sagebrush and voluntarily consume less fibrous diets in favor of higher quality sagebrush leaves, likely because they cannot digest fiber as well as other larger leporids (Camp et al. 2015, Crowell et al. 2018).

Studies in Washington and across Idaho document that sagebrush comprises up to 99% of the winter diet of pygmy rabbit, and up to 51% of the spring and summer diet (Green and Flinders 1980, Thines et al. 2004, Crowell et al. 2018), based on fecal pellet analysis. In spring and summer, grasses comprised 39 - 53%, and forbs comprised 10 - 33% (Green and Flinders 1980, Thines et al. 2004). Bluebunch wheatgrass (*Pseudoroegneria spicata*) and bluegrass (*Poa spp.*)

were eaten in greater proportion than their occurrence in the environment (Green and Flinders 1980). Pygmy rabbits preferentially select native grasses as forage during spring and summer, compared to other grasses (68 FR 430). In winter, pygmy rabbits consumed 1 – 18% grasses and 1 – 12% forbs (Thines et al. 2004, Crowell et al. 2018). Pygmy rabbits do not require free water. Morning activity may allow them to obtain moisture from dew, and pygmy rabbits have been observed eating snow (Katzner 1994).

Habitat Requirements

Pygmy rabbits inhabit the high desert country of the arid interior West, in climates with harsh extremes of hot and cold seasonal variation in temperature (Merriam 1891, Noy-Meir 1974, Katzner 1994). Like sage grouse, pygmy rabbits appear to avoid steep slopes – possibly related to increased vulnerability to predation from avian predators that can employ topography to surprise prey in steep terrain. Weiss and Verts' (1984) survey of pygmy rabbit sites substantiated the many previous observations that the pygmy rabbit inhabited dense stands of sagebrush or islands of dense shrubs (citing Orr 1940, Janson 1946). Recent research (Camp et al. 2012, Crowell et al. 2016) suggests that utilizing vegetation structure that provides high concealment may be a strategy for avoiding predators.

The observations by researchers that sagebrush is typically the dominant component of pygmy rabbit habitat has persisted through the present, and reinforces the fact that the pygmy rabbit is a sagebrush obligate species. While pygmy rabbits will also utilize habitats that include greasewood (*Sarcobatus vermiculatus*), rabbitbrush (*Chrysothamnus spp.*), and juniper (J*uniperus spp.*), these species tend not to dominate pygmy rabbit habitat. The three widespread subspecies of big sagebrush found across the range of the pygmy rabbit are Basin big sagebrush (*Artemisia tridentata s*sp*. tridentata*), Wyoming big sagebrush (*A. t*. *wyomingensis*) and mountain big sagebrush (*A. t. vaseyana*). Basin big sagebrush typically grows on deep, well-drained soils, Wyoming big sagebrush on moderately deep to shallow soils, and mountain big sagebrush grows at higher elevation sites where soil moisture is available most of the growing season. In general, pygmy rabbits prefer sagebrush sites with relatively higher cover, structural diversity, density and height of shrubs (Larrucea and Brussard 2008a, Camp et al. 2012, McMahon et al. 2017). Patches of dead or "decadent" sagebrush seem to pose no problem for the rabbits in terms of preferred sites (Katzner 1994, Katzner and Parker 1997).

Pygmy rabbit winter habitat use focuses on dense, tall sagebrush stands with high structural diversity which tend to accumulate more snow (Katzner 1994, Katzner and Parker 1997). Snow cover provides a more constant environment during cold winters, as well as protection from predators and thermal extremes (Katzner 1994, Katzner et al. 1997). In winter, pygmy rabbits are typically found within a 30-meter (98 feet) radius of their burrows (Green and Flinders 1980, Katzner 1994, Janson 2002). Spring and summer home ranges are considerably larger (Orr 1940,, Janson 2002, Heady and Laundré 2005, 68 FR 43) and males use larger home ranges

than females (Sanchez and Rachlow 2008).[7] Summer habitat selection by pygmy rabbits tend to incorporate sandy soils; structurally diverse stands of shrubs; relatively higher (compared to non-occupied summer sites) cover, height and density of total live shrubs, including big sagebrush; and relatively greater abundance of forbs (Heady et al. 2001). Summer habitat usually includes scattered low earth mounds where available (or, "mima mounds," – named after the Mima prairie in Washington). Mima mounds are found in deeper soils that support big sagebrush, and are typically surrounded by a matrix of low sagebrush.

There are specific habitat requirements for burrows, including relatively soft, deep soils (Weiss and Verts 1984) that enable easier excavation. Such soils are found throughout the Intermountain West and Great Basin on alluvial fans, and in areas of deposition of windblown loess soils, intermittent draws, flats and lower sidehills bordering and intermingling with riparian areas. Pygmy rabbits dig clumped burrows – usually in aggregations in areas of suitable soils (Weiss and Verts 1984, Wilson et al. 2012). Extensive subnivean burrows are dug in winter (Katzner 1994, Janson 2002). Pygmy rabbits dig their own burrows, unlike other North American rabbits (Borell and Ellis 1934), but have also been observed to use burrows of other species like badgers (*Taxidea taxus*) (Janson 2002). Typically, the entrance of a burrow will be concealed at the base of a sagebrush plant.

In general, burrows are built most often in areas with relatively high cover, structural complexity, density and height of sagebrush, and with a high forb content (Wilson et al. 2012). In Oregon, researchers documented shrub cover at burrow sites to be 28.8% (Weiss and Verts (1984); in Washington, 32.7% (Gahr 1993); in Wyoming, 42.9% (Katzner 1994); and in Idaho 46% (Green and Flinders 1980).

Other small mammals may also use pygmy rabbit burrows as refuges. Cameras placed at burrows have recorded sage thrasher (*Oreoscoptes montanus*), sagebrush sparrow (*Artemisiospiza nevadensis*), black-tailed jackrabbit, mountain cottontail (*Sylvilagus nuttallii*), Townsend's ground squirrel (*Urocitellus townsendii*), least chipmunk (*Neotamias minimus*), Ord's kangaroo rat (*Dipodomys ordii*), western harvest mouse (*Reithrodontomys megalotis*), deer mouse (*Peromyscus maniculatus*), long-tailed weasel (*Mustela frenata*), and badgers (Larrucea and Brussard 2009). Janson (2002) reports dormant sagebrush lizards and Uinta ground squirrels found in the same burrows used by pygmy rabbits.

Specialized Strategies for Coping with Extremes of High Desert Climates

Subnivian and subterranean burrow use, behavioral modifications, and habitat selection are important energy conservation strategies for winter survival by the pygmy rabbit (Katzner 1994). The pygmy rabbit is North America's smallest leporid, and one of the smallest leporids in the world, yet it endures harsh winters while subsisting on a diet of 99% sagebrush (Katzner 1994, Thines et al. 2004, Crowell et al. 2018). It has no known torporous or food-caching abilities. Rabbits lack extensive fat reserves so they have little resistance to winter fasting and

[7] Estimates for summer home range includes 2.7 ha (6.7 acres) for adult females, 20.2 ha (49.9 acres) for males, and 7.1 ha (17.5 acres) for juveniles (WDFW 1995).

undernutrition. Pygmy rabbits have the greatest surface area to volume ratio (and thus heat loss) of any rabbit species in their known geographic range. (Katzner 1994, Katzner et al.1997). They use energy conservation rather than acquisition as a strategy (Thomas 1987). Other lagomorph species have a variety of physiological and behavioral adaptations (low conductance, low winter metabolism, food caching) to cope with winter extremes. In contrast, pygmy rabbits have behavioral adaptations, such as increasing activity with increasing temperatures at the coldest times of day (night, dawn, dusk), basking in the afternoon sun, and resting within 1 m of burrow entrances (Milling et al. 2017). Burrow microclimates provide the combined benefits of warmer burrow environments and easy access to food. When winter snow accumulation is minimal, rabbits cannot feed in subnivean burrows and must expose themselves for prolonged periods to colder thermal environments and predation (Katzner 1994, Katzner et al. 1997). When out of burrows, pygmy rabbits assume a rounded posture, and rest in thermally sheltered microsites such as the leeward side of shrubs, with southern exposures (Katzner 1994). Rabbits will tend to establish trails quickly after snowfall, and may also conserve energy by repeated use of the same trail (Katzner 1994).

In summer, pygmy rabbit activity was shown to be independent of ambient temperature, but they tended to select rest sites under shrubs rather than retreating to burrows due to cooler temperatures above ground in the shade of shrubs (Milling et al. 2017). Pygmy rabbits were also more likely to be captured at dawn when summer temperatures were cooler, likely because they were seeking shelter in burrows to buffer against these cooler temperatures (Crowell et al. 2020).

Predation

Pygmy rabbits have evolved with many strategies to avoid predation. Pygmy rabbits have good camouflage that can aid with quietly evading predation while nestled up under a shrub. The large size of auditory bullae in the pygmy rabbit indicates reliance on hearing, and a keen sense of hearing enables pygmy rabbits to hear the approach of ground predators, and to detect wing noise and other auditory cues from raptors.

The long-tailed weasel is a principal predator of the pygmy rabbit (*Mustela frenata*) (Janson 1946, Wilde 1978, Green and Flinders 1980, Price and Rachlow 2010, Price et al. 2010). Raptors including hawks and owls are also important predators on pygmy rabbits (Katzner 1994). Other predators include the coyote (*Canis latrans*), gray fox (*Urocyon cinereoargenteus*), badger, skunk (*Mephitis spp*.), bobcat (*lynx rufus*), golden eagle (*Aquila chrysaetos*), and possibly rattlesnakes (*Crotalus spp.*) and gopher snakes (*Pituophis catenifer*) (Wilde 1978, Janson 2002, Larrucea and Brussard 2009). Predation rates are highest in spring and fall (Sanchez 2007); predation is the highest cause of mortality for pygmy rabbits (Crawford et al. 2010.)

Pygmy rabbits have evolved a special adaptation for thwarting weasel predation. Weasels can readily enter burrows. The weasel killing technique consists of biting a victim on the back of its neck, or strangulation (Rauscher 1997 and Janson 2002). Although pygmy rabbit burrows usually have multiple entrances, they may dig dead-end burrow tunnels where they may wedge

themselves, facing inwards with only their backs exposed to weasels. This thwarts weasels trying to bite their necks (Rauscher 1997, Janson 2002).

Multiple burrow tunnel entrances/exits may help pygmy rabbits escape badger predation (Bailey 1936, Janson 2002). Burrow diameters are smaller than a badger's body size, so while a badger is digging down to capture a rabbit, the rabbit can escape out of another entrance.

Rabbits had lower perceived predation risk when closer to a burrow entrance or when concealment cover was higher (Camp et al. 2012, Crowell et al. 2016), which resulted in a flight response when a threat was closer and thus more likely to attract the attention of the threat. In contrast, when rabbits had increased levels of visibility, they tended to exhibit a flight response when a threat was further away (Camp et al. 2012).

IV. DISTRIBUTION AND POPULATION STATUS

C. H. Merriam considered the pygmy rabbit a "characteristic" small mammal across the sagebrush country of Idaho and Nevada (Merriam 1891), and it has been described by others as "once common", or "not uncommon" (Anthony 1913), and "coincident with the distribution of sagebrush … homogeneous and widespread throughout the northern Great Basin" (Davis 1939). But within the past 50 years, it has progressively vanished from vast areas of the sagebrush sea. By 1990, numbers of rabbits were believed to be declining in all known populations (Dobler and Dixon 1990). The pygmy rabbit was first proposed for listing under the Endangered Species Act (ESA) in 1991. *See* Candidate Notice of Review, 56 Fed. Reg. 58804, 58807 (Nov. 21, 1991). Nevertheless, in 2010, the Service found the species was "not warranted" for listing under the ESA. Not Warranted Finding, 75 Fed. Reg. 60516-60561 (Sept. 30, 2010).

Today, the pygmy rabbit is patchily distributed throughout the Great Basin and adjacent intermountain areas of the western U.S, from southeastern Oregon and southern Idaho to southwestern Montana and south-central Wyoming and northwestern Colorado, to southwestern Utah, and to Central Nevada and eastern California. 75 Fed. Reg. at 60519 (September 30, 2010)[8] (Figure 1). The literature indicates that pygmy rabbits have never been evenly distributed across their range (Bailey 1936, Janson 1940, Holt 1975), but there are indications that distribution has become even patchier across the range today (personal communication, Janet Rachlow, University of Idaho Moscow, August 29, 2022). The current range-wide status of pygmy rabbit, as can best be ascertained through a limited number of occupancy surveys[9], has not improved since the 2010 Not Warranted finding. Instead, the evidence suggests that the species' range, population, and stability has continued to decline.

[8] A complete description of pygmy rabbit range, distribution, and natural history was provided in the September 2010 "Not Warranted" determination. *See* 75 Fed. Reg. 60516-60561 (September 30, 2010).

[9] As the Service knows, occupancy surveys are preferable to attempting to ascertain numbers of pygmy rabbits through things like active burrow counts - which cannot be directly related to the number of individuals in a given area, as some individuals may maintain multiple burrows (as many as 10), while some burrows are shared by individuals. 68 Fed. Reg. at 43 (November 30, 2001).

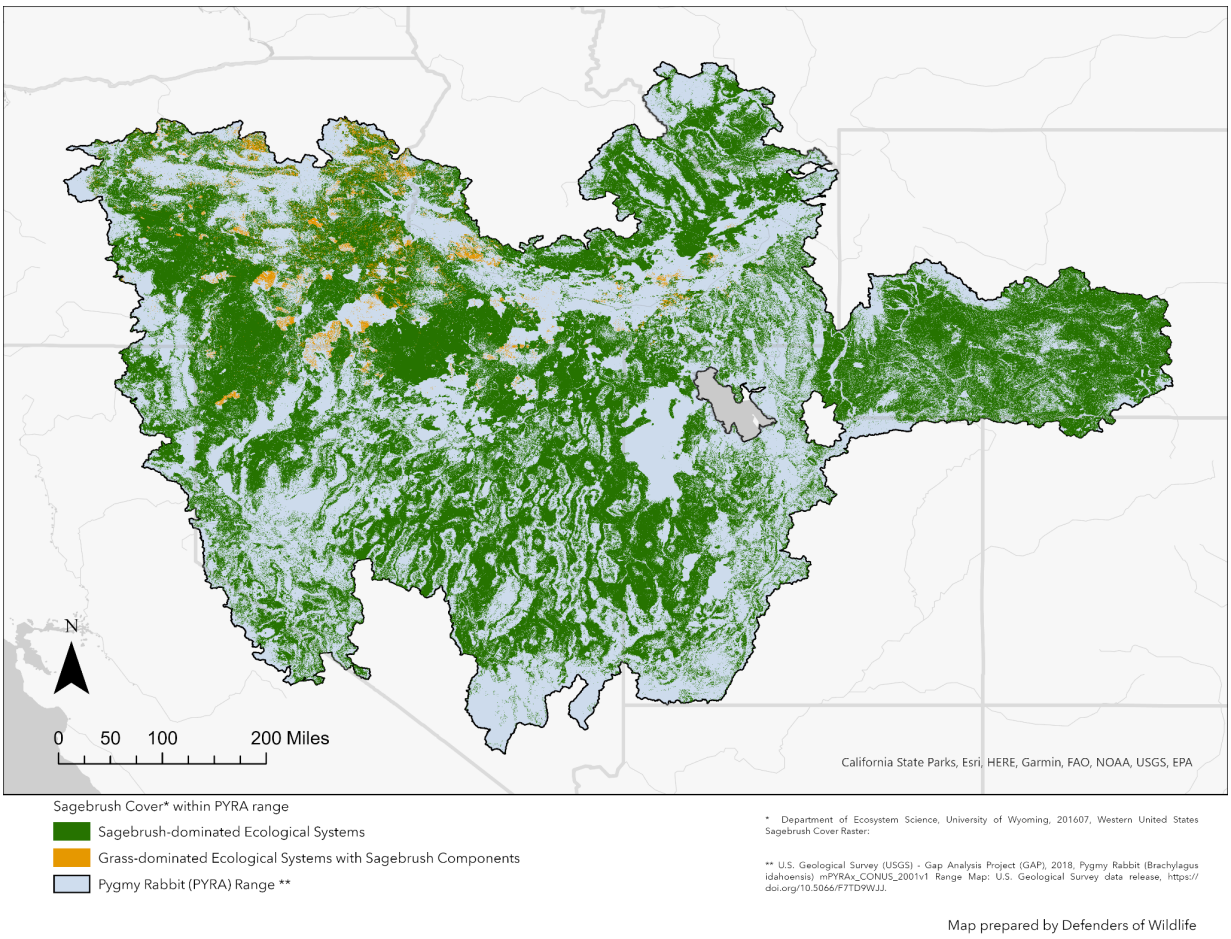

Figure 1. The range of the pygmy rabbit, as defined by the U.S Geological Survey's GAP analysis. Sagebrush cover mapped by the Department of Ecosystem Science, University of Wyoming.[10]

Based on Smith et al.'s (2019)[11] highest ranking pygmy rabbit habitat model, we delineated four primary pygmy rabbit "strongholds." (Figure 2) Each of these core areas can be considered a significant portion of range for the purpose of an ESA listing determination.

We note here that the 2010 Not Warranted finding included scant details about the data used by the Service to estimate Wyoming, Utah, and Montana's average occupancy rates between 2000 and 2010. This makes it difficult to compare the 2010 findings with the occupancy data of

[10] U.S. Geological Survey (USGS) - Gap Analysis Project (GAP), 2018, Pygmy Rabbit (*Brachylagus idahoensis*) mPYRAx_CONUS_2001v1 Range Map: U.S. Geological Survey data release, https://doi.org/10.5066/F7TD9WJJ

[11] Smith et al. (2019), used 10,420 records of pygmy rabbit occurrence across its range (outside Washington state), to estimate minimum occupied area (MOA) and to create an inductive species distribution model for pygmy rabbits across their full geographic range. They used the program Maxent to build models of varying complexity, incorporating topographic, vegetation, fire, climate, and soil information. The pygmy rabbit MOA is estimated at 28,367 km^2, with concentrations in four distinct core areas.

collected since then. We also note that since the 2010 finding, efforts to quantify pygmy rabbit populations have been infrequent and inconsistent. Information provided below reflects our best effort to understand the current trends.

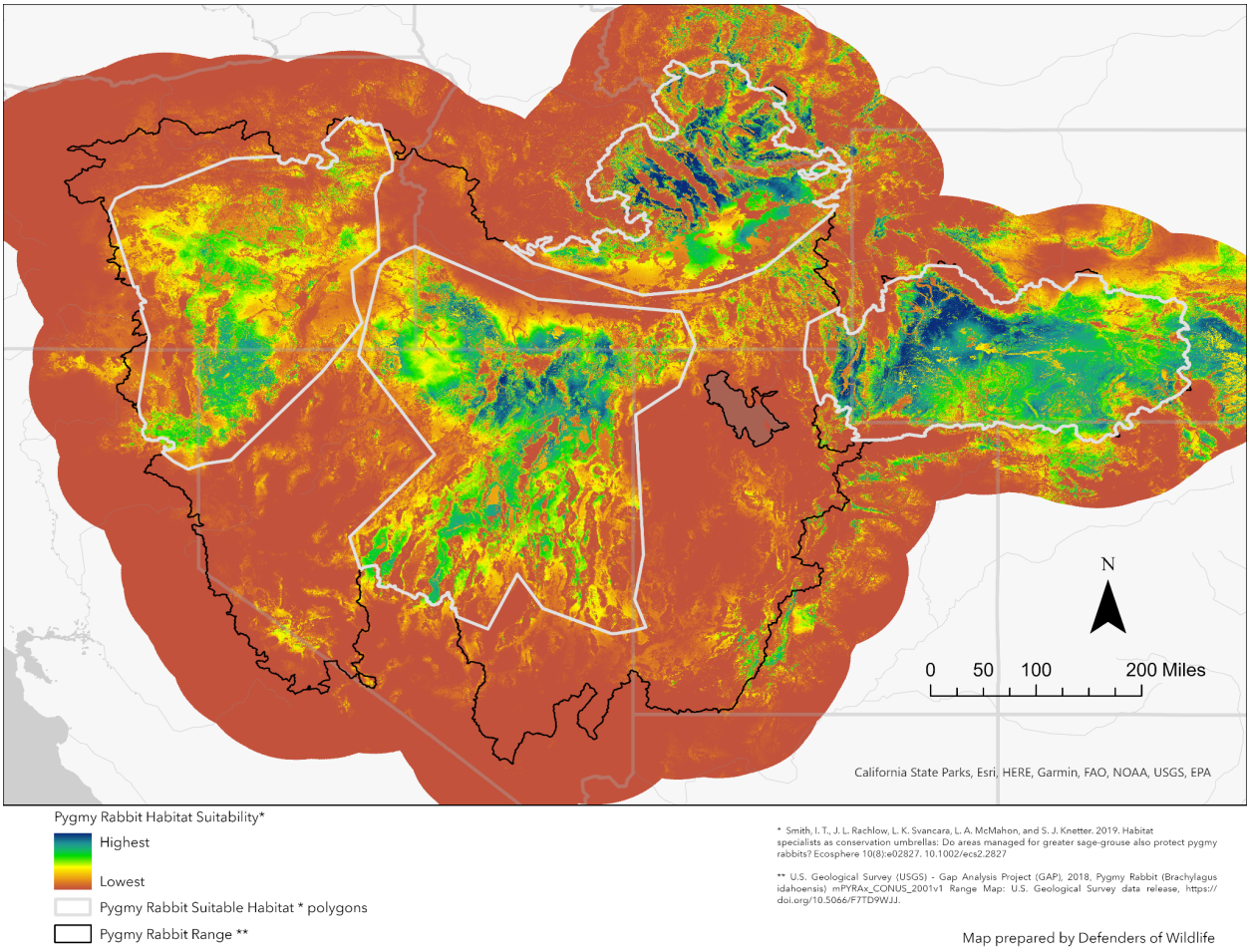

Figure 2. Based on Smith et al 's (2019)[10] modeled, highest ranking pygmy rabbit habitat, we delineated the four primary pygmy rabbit "strongholds" referred to in this petition.

A. Wyoming

The Wyoming Natural Heritage Program (Wyoming Natural Diversity Database) has assigned the State's pygmy rabbit population with a Status of S2, or "Imperiled."

The State of Wyoming's annual Nongame Species Completion reports (WGFD 2013, 2019, 2020) state that pygmy rabbits are especially susceptible to habitat loss. Because the Department had been lacking basic data on population distribution and trends, the WGFD in 2013 initiated ongoing, periodic state-wide survey efforts to document pygmy rabbit distribution through the species' known range in the state (principally southwestern Wyoming), evaluate the impact of a number of variables on occupancy of pygmy rabbits, and develop a baseline occupancy estimate in order to monitor trends going forward.

In the 2013 occupancy surveys WGFD detected pygmy rabbits on 21 of 50 grids throughout the predicted distribution in southwestern Wyoming, a 42% occupancy rate. With detection probability very high (≥0.97), surveyors were confident that occupied sites were not missed in the 2012-2013 surveys. Occupancy was negatively associated with the presence of predators and habitat disturbance but positively associated with the presence of cottontails (*Sylvilagus* spp.). However, the power to detect a decrease in the occupancy of pygmy rabbits compared to previous years was low, potentially suggesting the need for increased survey effort in subsequent years (WGFD 2013).

Regular surveys were to begin in 2013, but WGFD did not conduct pygmy rabbit surveys again in the state until 2018, and then were only done at the Chain Lakes Wildlife Management Area, in the Great Divide Basin (WGFD 2019). WGFD randomly selected and surveyed 10 grids in pygmy rabbit wintering habitat in April, and detected evidence of pygmy rabbits at four of the 10 grids. When adjusted for the probability of detecting pygmy rabbit scat or individuals (p = 0.86, SE = 0.14), WGFD assessed a 0.41 probability of occupancy throughout the available habitat in the Great Divide Basin (SE = 0.16) (WGFD 2019).

The more comprehensive surveys (throughout the range of pygmy rabbit in southwestern Wyoming) were conducted again in 2019 (WGFD 2020). WGFD sampled 74 grids within predicted pygmy rabbit habitat in southwestern Wyoming, but only detected presence of pygmy rabbits on 11 of them, a 15% occupancy rate throughout the predicted distribution of the species in Wyoming. This reflects a 69% lower occupancy rate than in the 2013 surveys (which was a 42% occupancy rate). There was no variation in detection between observers in 2019. There was more snow on the ground, after a heavier winter in 2019 compared to 2013, which potentially limited the amount of observable sign of pygmy rabbits above ground. WGFD recommended that subsequent surveys be conducted with repeated visits staggered through the season (WGFD 2020).

Despite the concerning results of the 2019 survey (a decline of 28 percent) with the potentially confounding factor of heavy snow, WGFD has not as of this petition repeated the rangewide occupancy survey in southwestern Wyoming. In 2021, surveys were limited in extent due to COVID-19 and concerns about disturbing Wyoming rabbit populations who might be suffering from rabbit hemorrhagic disease virus serotype 2 (RHDV2) in 2021 and 2022 (personal communication, Zach Walker, Wyoming Game and Fish Department, July 13, 2022).

However, in late 2021 WGFD conducted limited pygmy rabbit surveys in areas mechanically treated to improve sagebrush habitat, near the Wyoming Range between Pinedale and La Barge. WGFD conducted the occupancy surveys between October and December 2021, at 10 sites. Each site consisted of eight 400m x 50m transects observed for signs of pygmy rabbits (burrows, pellets, tracks, etc.). Five of the sites had been treated by mechanically removing sagebrush and the other five were control plots. Average occupancy across the 10 sites was approximately 50%, but occupancy at the untreated sites was significantly greater than at the treated sites (personal communication, Katie Sauer, Wyoming Game and Fish Department,

September 08 2022), indicating that managers need to be very careful with mechanical sagebrush removal in occupied pygmy rabbit rabbits, even if the goal of such treatments is to ultimately "improve" the habitat for pygmy rabbit.

Pygmy rabbit populations in the Pinedale Anticline in Sublette County have had some monitoring in order to track their response to oil and gas development there. Wyoming established requirements for annual monitoring of pygmy rabbit populations in the 2008 Record of Decision for the Supplemental Environmental Impact Statement for the Pinedale Anticline Oil and Gas Exploration and Development Project in Sublette County (BLM 2008). In 2015 WGFD contracted with an independent scientist (Hayden-Wing Associates, LLC) to compare occupancy dynamics during 2011-2016 in the Pinedale Anticline in order to assess the need for mitigation. Among sites visited during 2011-2016, occupancy was estimated at 48% in the Pinedale Anticline Project Area (PAPA) and 61% in the reference area. Detection probability during 2011-2016 during survey 1 was estimated at 87% in the PAPA and 92% in the reference area. Detection probability during 2011-2016 during survey 2 was estimated at 89% in the PAPA and 91% in the reference area (Hayden-Wing Associates, LLC. 2016). Thus, the PAPA sites were consistently lower than the reference areas.

Between 2011 and 2012, the researchers found an approximate 14% higher rate of local extinction and a 2% lower rate of colonization in the PAPA compared to the reference area. Between 2012 and 2013, they found an approximate 8% higher rate of local extinction in the PAPA compared to the reference area. Between 2013 and 2014, they found an approximately 11% higher rate of local extinction in the PAPA compared to the reference area but a similar rate of colonization between the PAPA and reference area. Between 2014 and 2015, they found an approximate 7% higher rate of local extinction in the PAPA compared to the reference area and a 2% increase in the rate of colonization between the PAPA and reference area. Between 2015 and 2016, extinction rates increased in the reference area. They found an approximate 4% higher rate of local extinction in the reference area compared to the PAPA and a 1% increase in the rate of colonization between the PAPA and reference area (Hayden-Wing Associates, LLC. 2016).

Hayden-Wing Associates, LLC continued to monitor the PAPA population from 2016 through 2020, and in their 2020 report found that among sites visited during 2011-2020, occupancy was estimated at 48% in the PAPA and 61% in the reference area, indicating that after ten years, pygmy rabbit occupancy was lower in the disturbed oil field (Hayden-Wing Associates, LLC. 2020).

Similar to the long-term pygmy rabbit population monitoring in the Pinedale Anticline, the Wyoming Bureau of Land Management ("BLM") has been tracking pygmy rabbit populations in the Jonah natural gas field in the Green River Basin in Sublette County, Wyoming. The Bureau contracted with Aster Canyon Consulting, Inc. to conduct the monitoring in compliance with criteria set forth by the Bureau and the Jonah Interagency Mitigation and Reclamation Office (JIO), as described in the Wildlife Monitoring Plan for the Jonah Infill Drilling Project Area (WMP; JIO 2013). During 2013 monitoring, 83 plots within the Jonah field were surveyed - a few

which were known to have prior pygmy rabbit presence, and the majority of plots were predicted to be suitable habitat due to sagebrush cover (Aster Canyon Consulting, Inc. 2013). The 2013 monitoring found positive, active signs of pygmy rabbits in eight of the 83 plots, with a calculated 9.6% occupancy rate (Aster Canyon Consulting, Inc. 2013).

Beginning in 2016, the originally-identified 83 monitoring plots were divided among three subsets, to be monitored one at a time in subsequent years. In 2016, the first set of plots had positive, active sign of pygmy rabbits in five of the 29 plots, a 17.2% occupancy rate (Aster Canyon Consulting, Inc. 2016). In 2017, the second set of plots showed positive, active sign of pygmy rabbits in three of the 27 plots, a 11.1% occupancy rate (Aster Canyon Consulting, Inc. 2017). The third set of plots surveyed in 2018 found positive, active sign of pygmy rabbits in nine of the 30 plots, a 30% occupancy rate (Aster Canyon Consulting, Inc. 2018). However, in 2017, it was noted that pygmy rabbit presence was detected along the northern and eastern boundaries of the Jonah Field where the sagebrush cover tends to be greater and there is less development (this finding was also noted in the 2018 and 2020 reports, Aster Canyon Consulting, Inc. 2018, 2020).

Triannual monitoring restarted in 2019. The first set of plots found positive, active sign of pygmy rabbits in four of the 29 plots, with a calculated 13.3% occupancy rate (Aster Canyon Consulting, Inc. 2019), down from 17.2 percent in 2016. In 2020, positive, active sign of pygmy rabbits was documented in two of the 28 plots, with a calculated 7.2% occupancy rate (Aster Canyon Consulting, Inc. 2020), a decrease from 11.1 percent occupancy in 2017. The 2018 set of 25 plots surveyed again in 2021 found positive, active sign of pygmy rabbits in eight of the 25 plots, with a calculated 32% occupancy rate (Aster Canyon Consulting, Inc. 2021), a slight increase over the three years. Over the ~decade of repeated pygmy rabbit surveys conducted in the Jonah Gas field, only two years of surveys found occupancy rates greater than 18% (Aster Canyon, 2021), underscoring the generally low occupancy rates in the Jonah Gas Field.

Another study in Wyoming compared genetic connectivity and diversity of pygmy rabbits to that of sympatric cottontail rabbits in southwestern Wyoming (Thimmayya and Buskirk 2012). The authors found that genetic connectivity of pygmy rabbits and cottontails was similar, but pygmy rabbits showed a stronger isolation-by-distance effect than cottontails. Pygmy rabbits in Wyoming were less genetically diverse than populations in other parts of their range, but overall, the results suggest that gene flow is occurring among the populations in the state. The separation of two populations by a major highway caused slight genetic differentiation. Thimmayya and Buskirk (2012) stated that the observed genetic connectivity of pygmy rabbit populations in Wyoming could be the result of historic habitat connectivity and does not necessarily mean gene flow is still occurring. The authors suggest that there is some evidence that pygmy rabbits in Wyoming have become isolated from populations outside of the state, and that managers should ensure pygmy rabbit habitat remains connected (Thimmayya and Buskirk 2012).

B. **Utah**

Despite gains in Utah's knowledge about its pygmy rabbit populations pursuant to the 2010 determination, the distribution of and population trends of Utah pygmy rabbits were still relatively unknown (Hersey 2011). In 2011, the Utah Division of Wildlife Resources ("UDWR") developed a monitoring protocol and implemented a pilot statewide inventory. The UDWR visited suitable habitat both within and outside of the previously known range of pygmy rabbits using a Maxent-generated model they developed based on known pygmy rabbit locations. .

Five areas in Utah had previously documented occurrences of pygmy rabbits: sagebrush habitat in Rich County, Box Elder County, Parker Mountain/Wasatch Plateau, Deep Creek Mountains/Southern Great Basin, and the Ibapah region of Utah's West desert (personal communication, Kim Hersey, Utah Division of Wildlife Resources, July 14 2022). In 2011, pygmy rabbits or recent sign of pygmy rabbits were found at 25 of 64 plots situated within 25 km of known populations within the previous 20 years, which equates to a 39% occupancy rate (Hersey 2011) Occupancy was much higher in the northern region of the state: 93% of the 2011 occurrences were within UDWR's northern region, compared to only a collective 7% of sites in the other four historic pygmy rabbit population areas (Hersey 2011). No pygmy rabbits were found outside of the historically known distribution in 2011 (Hersey 2011). In the 2011 surveys, threats to the habitat included fire (87% of sites surveyed), grazing (74% of sites), agricultural conversion (13% of sites), and development (4% of sites) (Hersey 2011).

Occupancy surveys were performed again in Utah in 2014. In Utah's Central Region, of 17 sites in the central-eastern Great Basin, none were found to have definitive signs of pygmy rabbits (Brewerton 2014). While "active" burrows were found at 11 of the 17 sites, none had definitive signs and no pygmy rabbits were photographed. This area has been impacted by fire, OHV use and improper grazing, and these factors have contributed to degradation of sagebrush and expansion of cheatgrass in the region. In the Ibapah Valley, open burrows and pellets were found at one site (Lower Cemetery Road), confirming continued occupancy, but no sign was detected at the Greasewood Springs site which was impacted by fire in 2012. Additionally, abundant pygmy rabbit sign was found at a new site, Secret Spring (Brewerton 2014).

Utah's Southern Region surveys in 2014 documented populations in Great Basin habitats that were "scattered and small" (Brewerton 2014). The 2014 Survey Team did not survey the best southern Utah habitats where pygmy rabbits had been consistently observed, but a total of 98 surveys covering 429 km were completed in the Southern Region, most in areas of historic sightings or where pygmy rabbit surveys had not been conducted in over 5 years (Brewerton 2014). Of 137 pygmy rabbit waypoints, no sign of pygmy rabbits was found at 114, and positive sign of pygmy rabbits were logged at 9 waypoints; probable pygmy rabbit sign was recorded at 10 waypoints; and 4 waypoints were listed as "uncertain status." Combined, positive and probable occupancy in the 2014 Southern Region surveys would be just 13%.

Finally, in the Northern Region - in Rich and Box Elder Counties - though surveys were also conducted at historic and known sites, these surveys deviated from the standard protocol due to differing objectives. Within the rest of the range in the state, the objective was occupancy, whereas in these northern populations, occupancy was "known and considered to be stable"

(Brewerton 2014). Thus, the objective in those two counties in 2014 was to more precisely define distribution within Box Elder County and to evaluate genetic health and population size in Rich County (Brewerton 2014). Unfortunately, there were amplification issues with the genetic samples and so very little came of the work (personal communication, Kim Hersey, Utah Division of Wildlife Resources, July 25 2022).

C. Idaho

The Service's 12-month finding on pygmy rabbits indicated that the distribution of the species in Idaho at that time more or less matched the historic distribution; in fact the Finding stated, "Recent survey efforts have expanded the known distribution in this State. Numerous previously unknown locations currently show signs of pygmy rabbit occupancy including locations in previously undocumented counties." 75 Fed. Reg. at 60526 (September 30, 2010).

The 12-month finding reported many results of surveys up to that point simply in terms of total positive, active sign (such as active burrows). Unfortunately, unlike other states, Idaho did not often report positive survey results as a percent of potential sites surveyed (i.e., past sites known to have pygmy rabbits). However, using the survey results that were suitably described in the Service's 12-month finding, we estimated an average of 32.5% occupancy within the seven pygmy rabbits sites that were re-surveyed in Idaho between 2000 and 2010. 75 Fed. Reg. 60525-60527 (September 30, 2010).

The Idaho Department of Fish and Game ("IDFG") manages and reports pygmy rabbit data at the regional level. The historic and current range of pygmy rabbits overlaps five regional offices of the IDFG – the Southwest, Magic Valley (or South-Central Region), Salmon, Southeast, and Upper Snake Regions – but no occupancy surveys have been conducted by IDFG since before the Service's 2010 Not Warranted finding (personal communication, Rex Sallabanks, IDFG State Office, July 28 2022; personal communication, Jamie Utz, IFG Southwest Region, August 01 2022).

However, from 2009 to 2012, IDFG worked with some of its Regional Offices that include pygmy rabbit habitat and a couple of the Bureau field offices to develop a survey technique that allows identification of fecal pellets using molecular analysis (Bosworth 2013). This study involved three separate survey efforts. In the first effort, IDFG biologists conducted surveys in the three of its administrative regions in east Idaho (Salmon Region; Upper Snake Region; and Southeast Region) during November 2009 - February 2010. The second survey effort was concentrated on the Bear Lake Plateau (which is in the IDFG Southeast Region) in Southeast Idaho from 2010 to 2011. The third effort focused in 2011 on portions of the Bureau's Shoshone Field Office in south-central Idaho (which is in the IDFG South-central region). The chief goal of the study was to test a technique to positively identify pygmy rabbits through DNA amplification of pellet samples, but because these sites were historically or previously known to have pygmy rabbits,

rough estimations of occupancy could be made in these survey areas.[12] Surveys conducted in the Shoshone BLM District provided too few detections to estimate occupancy. In this dataset, detection probability was severely affected by high rates of misidentification compounded by an overall high failure rate of the molecular test. In the eastern Idaho survey, pellets confirmed pygmy rabbit occurrence at 19 sites, suggesting a "naïve occupancy rate" of 22% (Bosworth 2013). Detection probability was estimated to be 0.5042 (SE 0.0630; 95% CL = 0.3828 - 0.6250). Accounting for detectability, the proportion of sites estimated to be occupied was estimated to be 0.241, or 24% (SE 0.0481; 95% CL = 0.1593 - 0.3469). In the Bear Lake Plateau surveys, 30 sites were surveyed, and pygmy rabbit was detected at 60% of these. With a calculated detection probability of 0.838 (SE 0.0712; 95% CL = 0.6496 - 0.9358) the proportion of sites estimated to be occupied was estimated to be 0.6160 (SE 0.0930; 95% CL = 0.4261 - 0.7761) (Bosworth 2013) on the Bear Lake Plateau.

More recently, various Idaho Bureau field offices have monitored and surveyed pygmy rabbits in advance of proposed projects such as fuel treatments. For example, in 2018 in the Bruneau Field Office in southeast Idaho, 26 previously known active burrows (from 2014-2016) were resurveyed in advance of a mowing treatment planned for a new pipeline (the Bruneau Fuel Breaks project). Of these 26 burrows known to previously be active, six were found to still be active, which is a 23% occupancy rate (BLM 2018). At another fuelbreak project in the Bruneau Field Office in 2019, biologists found that areas that were once considered suitable for pygmy rabbits and mapped as potential pygmy rabbit habitat were "no longer suitable for pygmy rabbits due to either high amount of medusahead (and lack of native grasses and forbs) or high amount of bitterbrush." (Email from Sylvia Copeland, BLM Boise District Fuels Program, to Steve Jimenez, Bruneau Field Office, August 2021).

The Bureau's Shoshone Field Office in central/south-central Idaho revisited all 196 known mima mounds in the field office. Out of the 196 mounds visited, 19 had fresh pygmy rabbit pellets, and so were considered active, or occupied sites, a 9.7% occupancy rate. The Shoshone Field Office again conducted surveys in 2017, to help inform Idaho's State Wildlife Action Plan in which pygmy rabbits are one of the Species of Greatest Conservation Need. In these 2017 surveys, the Bureau used Rachlow and Svancara's (2006) pygmy rabbit habitat model to select sites of highest likelihood of pygmy rabbit occupancy, and 49 sites were subsequently surveyed. Of these, 10 had fresh lagomorph pellets which were sent to a lab for DNA identification, but only one was positively identified as a pygmy rabbit. Six of the ten samples had DNA amplification problems, which means that in the worst-case scenario, the occupancy rate would be 2%. In the best-case scenario, if all six pellet groups that could not be properly amplified were pygmy rabbit pellets (resulting in seven positive samples total), this would still only equate to a 14.3% occupancy rate of the 49 sites in the Shoshone field office in 2017.

[12] We note that when calculating occupancy, Bosworth (2013) elected to treat quadrants where DNA samples failed to amplify as "no detection". The team could have treated these sites as missed surveys, but they considered treatment as "no detection" to represent a more conservative approach.

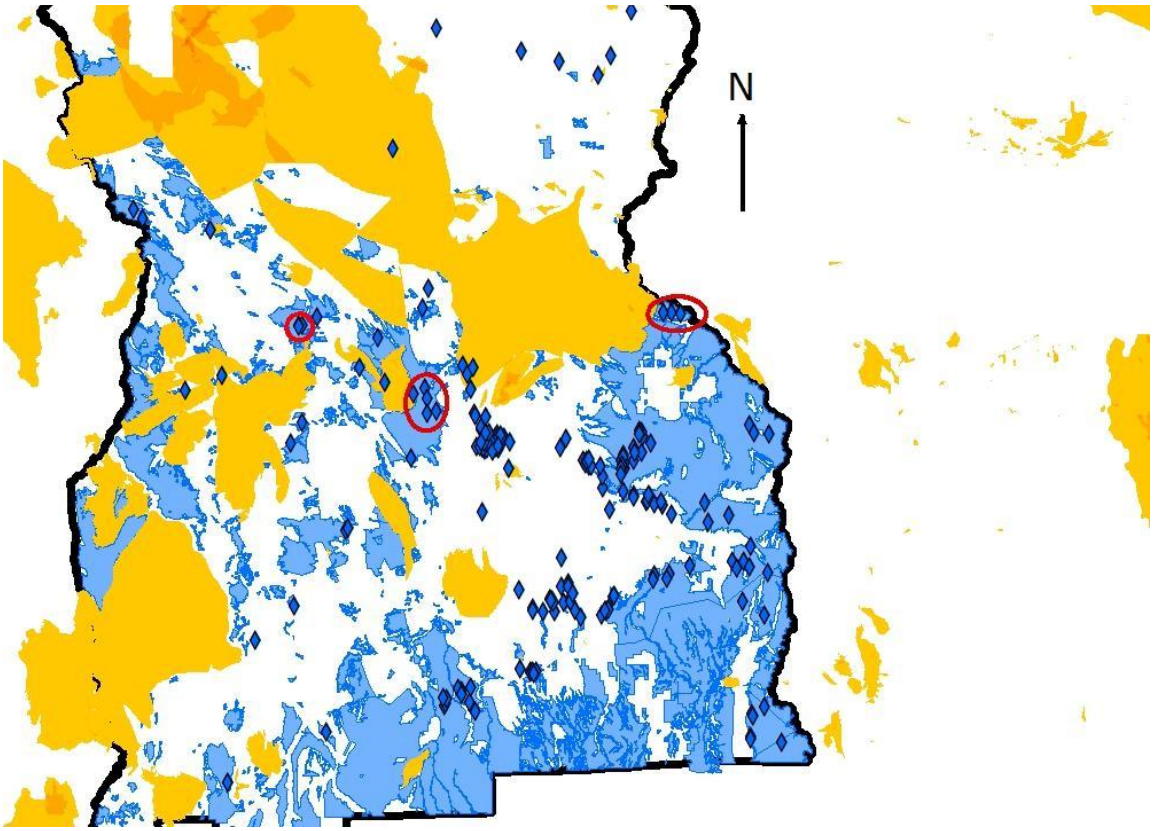

Figure 3. Yellow and orange polygons depict fire perimeters (as of 2021) for the last 10 years, within the Idaho BLM Jarbridge Field Office. Blue diamonds are known pygmy rabbit locations, and blue diamonds enclosed in red ovals are areas where pygmy rabbits are no longer found based on the most recent surveys (map provided by Jim Klott, Idaho BLM Jarbridge F.O).

Pygmy rabbit habitat in Idaho has been hit hard by wildfire since the Service's 2010 determination. Over 6,967,500 acres of pygmy rabbit habitat in Idaho has burned in the last 40 years. This loss represents about 4.1% of all presumably occupied pygmy rabbit range in North America. Figure 3 depicts the effects of wildfire on pygmy rabbits In the Jarbridge Bureau F.O., with a clear toll on the population of pygmy rabbits in this Field Office (personal communication, Jim Klott, Jarbridge BLM Field Office, August 04 2022). This includes a recent 700,000-acre fire in occupied pygmy rabbit habitat. The Jarbridge field office's results of repeat surveys in areas that have recently burned are dire; "The bottom line is no pygmy rabbits were seen and no active burrows or pellet mats were found after the site burned the first time" (personal communication, Jim Klott, Jarbridge BLM Field Office, August 04 2022). Figure 3 below, provided by the Bureau, shows that pygmy rabbit populations adjacent to the fire perimeters from the last 10 years are apparently "blinking out" as of 2021.

D. Nevada

The Service's 2010 assessment of Nevada's pygmy rabbit population stated,

> "Most of the historical records (1999 and earlier) for Nevada document occurrences in the following counties: Elko, Eureka, Lander, White Pine, and Nye Counties…There are fewer records from Washoe, Humboldt, Pershing, and Churchill Counties…Current information (2000 and later) indicates all of these counties, with the exception of Pershing County, continue to support pygmy rabbit activity, and across a broader area within those counties than historically noted.... The recent survey efforts have located populations over a greater area within the State and the expansion of the known range has occurred most notably in Washoe, Lincoln, and Nye Counties."

75 Fed. Reg. at 60529 (September 30, 2010). Across all sites surveyed and reported in the 2010 determination and included in the Service's Nevada database, the occupancy averaged equates to a 31.8% occupancy rate for all 2000-2010 surveys.

Nevada did many surveys for pygmy rabbit in the early 2000's, but since the Service's 12-Month Finding in 2010 the agency has since largely diverted scarce funds from monitoring non-game sensitive species (e.g., pygmy rabbits) to more 'needy' species (personal communication, Shawn Espinosa, Nevada Department of Wildlife, "NDOW", July 21 2022). The agency has continued to perform "general lagomorph surveys" in many of its regions since 2010, where simple presence/absence of pygmy rabbits are conducted along with cottontails and jackrabbits (personal communication, Shawn Espinosa, NDOW, July 21 2022). This practice simply confirms that pygmy rabbits are still present in the counties where they were present in 2010 and does not help establish trends; occupancy surveys and monitoring are generally needed for this.

Fortunately, for the past 6- or 7-years NDOW and USFWS have jointly funded a fairly rigorous pygmy rabbit monitoring and research program at the University of Nevada Reno ("UNR"). From 2016-2019 UNR graduate student Miranda Crowell, advised by Dr. Marjorie Matocq and Dr. Kevin Shoemaker, conducted surveys near the Toquima and Monitor Ranges between the towns of Austin and Elko in central Nevada. During those years the team conducted 78 surveys in areas of known or previously known pygmy rabbit habitat, and determined occupancy at 21 locations (a 26.9 % occupancy rate). The team also utilized a new pygmy rabbit predictive habitat model for the Great Basin (Dilts et al. *in review*) to randomly generate an additional 111 sites in this region of the Humboldt/Toiyabe. Across the four years, an additional 128 surveys were conducted at sites predicted to have pygmy rabbits, and found 22 were found to be occupied (a 17% occupancy rate).

The team also conducted pygmy rabbit surveys from 2016-2019 at the Hart-Sheldon National Wildlife Refuge on both sides of the Oregon-Nevada border. On the Nevada side of the Refuge, the team determined 17 of 32 sites in areas of known or previously known pygmy rabbit habitat were occupied, a 53% occupancy rate. This is the highest occupancy rate of any surveys reviewed in this petition, and it seems noteworthy that the refuge has not been grazed by livestock in over 30 years, unlike most pygmy rabbit habitat in the West.

The Bureau's Applegate Field Office contracted with Eveline Laruccea to resurvey known and historic pygmy rabbit sites in Washoe County, in northeastern Nevada, and to generate predictive habitat models and survey new sites that should harbor pygmy rabbits in the county. The 2021 surveys focused on 45 formerly-occupied pygmy rabbit sites. Twelve of those sites (26.7% occupancy rate) were found active. An additional 172 new sites, identified through satellite imagery plus ground truthing, were surveyed for pygmy rabbit activity, and 29 sites, or 16 percent, were determined to be active activity (Larrucea, unpubl. data, 2022). In her unpublished, December 2022 survey report to the Bureau, Dr Larrucea reported that pygmy rabbits were still active in the eastern portion of the Applegate Field Office, but that there is a potential retraction in distribution which future surveys will try to address. She reported that many of the formerly known lower elevation pygmy rabbit sites in Long Valley no longer showed evidence of activity. It is unclear why pygmy rabbits are no longer active at these sites, because the habitat still appeared suitable (Larrucea, unpubl. data, 2022). In 2024-2025, Dr. Laruccea will revisit all the sites that were active in 2021-22 in order to begin assessing changes in pygmy rabbit occupation across the landscape in this part of its range.

Additionally, Crowell et al. (*in prep*), will soon be publishing estimates of spatiotemporal variation in pygmy rabbit population density using Spatial Capture-Recapture (SCR) models (*see* Crowell et al. 2020 for trapping methods) and extensive burrow surveys. Crowell and others focused the study on two populations entirely within Nevada (sites outside of Elko and Austin) and one site with populations that were contiguous with Oregon populations (Hart-Sheldon National Antelope Refuges in NV and OR), as well as the California population (Mono Basin). Crowell's work demonstrated that with appropriate effort, pygmy rabbit densities can be calculated, and she detected alarming decreases in population density at all sites between 2016 and 2019. During this time, the most dramatic decrease in estimated rabbit density was 14 rabbits/Ha. Only one site showed an increase in estimated rabbit density, and only once between 2016 to 2017, before density at the site decreased in 2018 and again in 2019 (Crowell et al. in prep).

Fire has severely impacted Nevada's sagebrush communities. In the last 20 years, Nevada has lost fully 25% of its Greater sage-grouse habitat to fire (personal communication, Shawn Espinosa, Nevada Department of WIldlife, July 21 2022). Over 9,292,750 acres of pygmy rabbit habitat in Nevada has burned in the last 40 years. (Figure 6) This loss alone represents nearly 5.5% of all presumably occupied pygmy rabbit range in North America.

Nevada was the last state that allowed pygmy rabbits to be hunted, but in 2021, Nevada terminated its hunting season, due to concerns for the viability of the species in the state (personal communication, Shawn Espinosa, Nevada Department of Wildlife, July 21 2022).

In addition, the first confirmed detection of Rabbit Hemorrhagic Disease Virus Serotype 2 in pygmy rabbits in North America was documented in winter of 2022 in Elko County, Nevada (Crowell et al. *in press*). While not indicative of a broader trend, it is worth noting that immediately preceding detection of RHDV2, researchers have 4 percent trap success during 46 trap nights, but immediately after the detection, a total of 150 trap nights resulted in 0 percent

success (Crowell et al. *in press*). Ongoing research is needed to determine if Elko's pygmy rabbits experienced rabbit decline as the result of RHDV2 and whether Nevada's pygmy rabbits are affected by RHDV2 more broadly.

E. Oregon

In Oregon, the Services's 12-month determination on the pygmy rabbit listing petition was based on the database of state records that the Service assembled, which concluded, "In general, pygmy rabbit activity continues to occur in southeastern Oregon in a similar distributional pattern as compared with historical information." 75 Fed. Reg. 60524 (September 30, 2010). The 12-month finding also described the presence/absence and/or occupancy surveys that had occurred between 2000 and 2010. An average of the results reported in the 2010 finding equates to a 27% occupancy rate for all 2000-2010 surveys included in the USFWS database for Oregon. The 12-month finding reported extremely limited occupancy data (or anything that could be used to derive it) prior to 2000 in Oregon; most information reported in the 12-month finding regarding distribution of the species in Oregon prior to 2000 was based on anecdotal records and museum specimens, making long term trends difficult to ascertain.

While the Oregon Department of Fish and Wildlife (ODFW) did perform occupancy surveys of Oregon's pygmy rabbit population areas in the early 2000's and the Bureau attempted to map known burrows on Bureau land during the same period, very little in the way of systematic surveys of Oregon's pygmy rabbit population occurred between that period and when the latest round of surveys began in 2020 (personal communication, Kaylista Adkins, Oregon Department of Fish and Wildlife, July 21 2022). ODFW's pygmy rabbit surveys in 2021 occurred primarily in Harney County, along with a few surveys taking place just along the border of Harney County in Lake and Deschutes Counties (McLean and Adkins 2021). In these surveys, ODFW biologists surveyed 79 sites with historic/previously confirmed the presence of pygmy rabbits. Potential pygmy rabbit burrow complexes were recorded at 18 of these sites, an occupancy rate of 22.8%. However, only 10 of the 18 potential pygmy rabbit burrow complexes were confirmed by trail cameras, which translates to a 12.6% occupancy rate if only data certain of positive identification of pygmy rabbit is used. In addition, the 2021 surveys found that of the 79 surveyed sites where pygmy rabbits were found previously, in 2021, 32 (or over 40%) of the sites were now deemed as unsuitable habitat due to fire, grazing and/or juniper encroachment (McLean and Adkins 2021).

All pygmy rabbit surveys conducted by ODFW in the winter and spring of 2022 occurred outside of Harney County and Lake County in areas that were not surveyed in 2021 (Rose and Adkins 2022). In these studies, ODFW biologists surveyed 61 sites that had historic/previously confirmed presence of pygmy rabbits. They located pygmy rabbits at 28 of these sites, an occupancy rate of 45%.

These few surveys are the entire set of occupancy surveys performed by ODFW since 2010, underscoring how much the state agency does not know about the current status of its pygmy rabbit population. However, in 2016, the Oregon Natural Heritage Program (now known as the

Oregon Biodiversity Information Center, OBIC) re-assessed the status of the State's pygmy rabbit population and assigned it to an S2 Status, or "Imperiled," describing it as: "Small populations with low dispersal ability; subject to local extirpations. Threats include habitat loss/alteration, non-native invasive vegetation [and] wildfire."[6] In terms of the "Viability Rating," OBIC gives a ranking of "C", meaning "Few (4-12) occurrences with excellent or good viability or ecological integrity."[6] In terms of short term trend, OBIC reported in the 2016 pygmy rabbit update a "Decline of 10 - 50%", though with the caveat that "information on populations [is] lacking".[13] OBIC did not have sufficient data to speak to long-term trends of Oregon's pygmy rabbit population at the time of the 2016 assessment, but recognized that the species was likely at risk. As of this writing, the Oregon NHP has not yet updated the 2016 ranking of pygmy rabbits in light of the limited occupancy monitoring Oregon Department of Fish and Wildlife conducted in Lake and Harney counties from 2020-2022.

Pygmy rabbit surveys were conducted from 2016-2019 at the Hart-Sheldon wildlife refuge, on both sides of the Oregon and Nevada borders. On the Oregon side of the Refuge, the team conducted 53 surveys in areas of known or previously known pygmy rabbit habitat, and determined occupancy at 17 locations, which equates to a 32 % occupancy rate, lower than the Nevada side's rate.

Pygmy rabbit habitat in Oregon has also been affected by wildfire in recent decades. As Figure 6 below shows, over 5,830,600 acres of pygmy rabbit habitat in Oregon has burned in the last 40 years. This loss represents about 3.4% of all presumably occupied pygmy rabbit range in North America.

F. California

In 2021, the Service found,

> "There are only a few historical (1999 and earlier) records for California which included Modoc, Lassen, and Mono Counties. Current information (2000 and later) indicates that while pygmy rabbit activity continues to occur in Mono County, pygmy rabbits may have been extirpated from both Modoc and Lassen Counties in northeastern California…Due to limited survey efforts in northern California overall, uncertainty remains whether this contraction has actually occurred."

75 Fed. Reg. at 60528 (September 30, 2010).

Additionally, the Service found "the Mono County populations may be isolated from other known populations because they appear to be separated by a distance of approximately 100 mi (162 km) from the nearest known populations in Nevada (citing Larrucea and Brussard 2008a).

[13] https://inr.oregonstate.edu/orbic

These pygmy rabbit populations may have become isolated from more eastern populations at the end of the Pleistocene." *Id*. (citing Grayson 2006).

The Service's 12-month determination reported on surveys conducted on Bureau land in 2004 in both Modoc County and Lassen County, but in which no rabbits were found. Neither county has conducted additional surveys since that time (personal communication, Richard Shinn, California Department of Fish and Wildlife, Northern Regional Office, July 28 2022; personal communication, Matt Meshrly, California Department of Fish and Wildlife, Northern Regional Office, August 08 2022). Thus, it is now widely believed that the Mono Basin contains the only population of pygmy rabbits remaining in California (Larrucea et al. 2018).

In 2017 a team from University of Nevada Reno led by graduate student Miranda Crowell and Dr. Marjorie Matocq surveyed 23 sites in the Basin, which were a combination of sites previously known to have pygmy rabbits, sites generated randomly from a pygmy rabbit habitat suitability model, and "opportunistic sites" also near Mono Lake. The team found occupancy at 12 sites, which equates to a 52% occupancy rate.

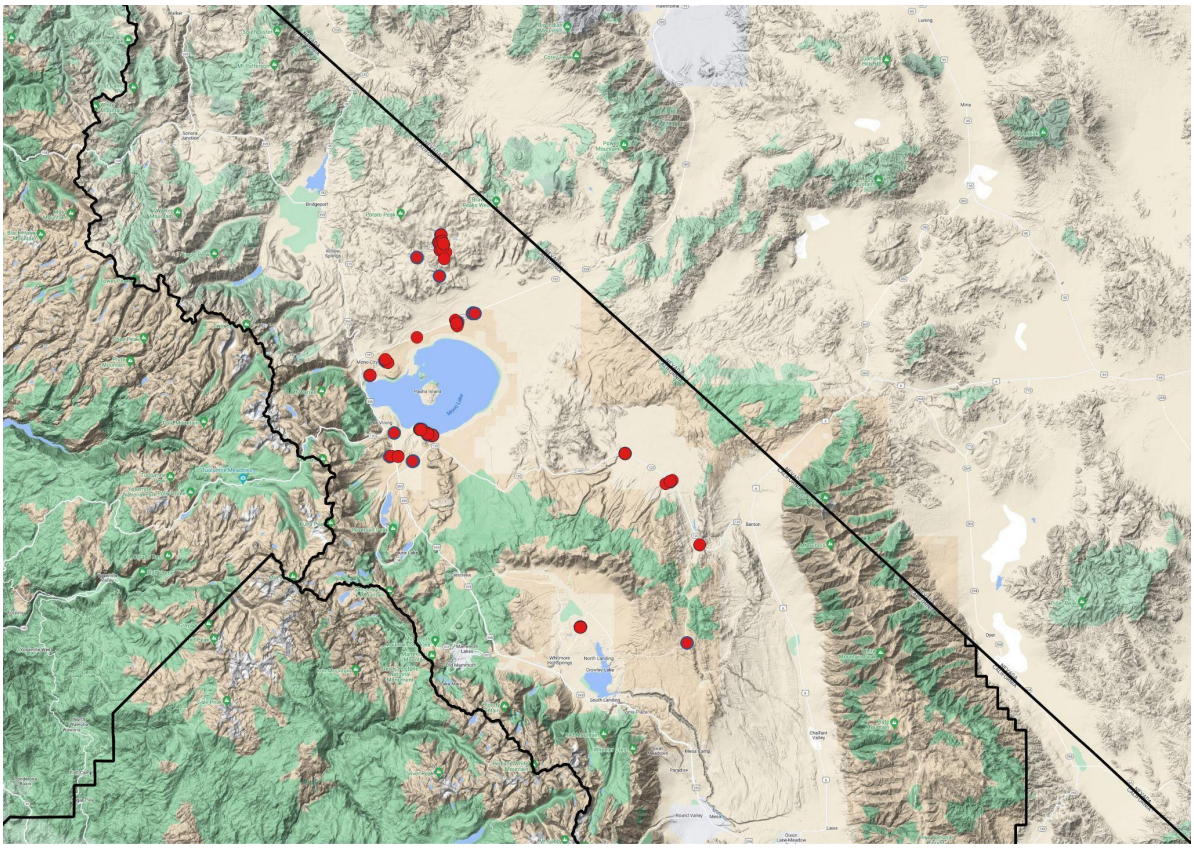

Figure 4. Known areas of pygmy rabbit activity in the Mono Basin, CA area, from 2006-2007 surveys. Only seven of these sites were active in 2020-2021. Map provided by Eveline Larrucea, August 2022.

In addition, Eveline Larrucea, who had performed the previous surveys in the Mono Basin in 2006-2007, independently returned to resurvey the same sites in 2021 and 2022. She resurveyed 20 known pygmy rabbit sites, 7 of which (35%) were still active at that time (2020-

2021) (Eveline Laruccea, unpubl. data 2022). Based on this survey work, Dr. Laruccea provided a map of where the known areas of current pygmy rabbit activity are in the Mono Basin area (Figure 4). In comparison, Dr. Larrucea found a 35% occupancy rate in this population in 2021-2022, down from the 52% rate Crowell found in 2017.

Though the Mono Basin population may seem to be in better shape than was found in the 2006-2007 surveys, it is isolated from other populations in Nevada. Recent genetic work on the Mono Basin populations has shown that the California population is adaptively differentiated from other regions in the southern Great Basin (Byer et al 2021a), and maintains lower levels of genetic diversity than the Nevada Great Basin populations as measured by both heterozygosity and numbers of alleles (Larrucea et al. 2018).

Given their geographic isolation from other known populations and their genetic distinction, these remnant, peripheral populations in Mono County warrant special attention to ensure maintenance of genetic variation and continued viability (Larrucea et al. 2018). For example, if a large fire alters a substantial area of occupied habitat in the Mono Basin, the Mono Basin population would need to "rescue itself" from attrition. This population is disconnected from and could not be recolonized from subpopulations in Nevada. Indeed, a recent follow up study (Byer et al. 2021b) found that relatively few dispersal pathways connect the Mono Basin and Nevada, which indicates that greater attention should be paid to maintaining and restoring sagebrush cover along the border between California and Nevada.

G. Montana

The Service's 2010 finding on pygmy rabbit in Montana stated that "Most of the historical and recent records for Montana occur in the following two counties: Beaverhead and Madison…Current information (2000 and later) indicates these two counties, as well as Deer Lodge County, continue to support pygmy rabbit activity…There is a notable increase in the current distribution of the pygmy rabbit to the northeast in Madison County." 75 Fed. Reg. at 60527 (September 30, 2010). Unfortunately, as with Wyoming and Utah, the limited data included in the 12-month finding makes it difficult to calculate an average occupancy rate for Montana's pygmy rabbits for the 2000-2010 period preceding the Service's 12-month finding, and so we're unable to analyze it in comparison to anything more recent.

Montana has not performed regular or rigorous occupancy surveys, or any deliberate surveys or monitoring, for pygmy rabbits since the Service's 2010 Status review and pygmy rabbit determination (personal communication, Dan Bachen Montana Natural Heritage Program, August 02, 2022). Instead, most records of pygmy rabbits since 2010 have been either incidental while Montana Fish Wildlife and Parks biologists are out doing other fieldwork (personal communication, Claire Gower, Montana Fish Wildlife and Parks, August 01, 2022), or they have been part of the Bureau's watershed assessments, or project clearance monitoring on the National Forests or Bureau land. These records are provided to the Montana Natural Heritage Program (NHP) database, but do not provide consistent data for determining population trends.

Examination of the Montana Natural Heritage Program database revealed 179 pygmy rabbit records (of individual "element occurrences", or indications of "presence") were added to the database since 2010. The majority of new pygmy rabbit records (143) added to the database since 2010 occurred on Bureau land, in the Dillon Field Office in southwestern Montana, as a part of watershed assessments routinely conducted by the Bureau. Presence/absence surveys in suitable pygmy rabbit habitat is part of this assessment process (person communication, Katie Benzel and Kelly Brockting, Montana BLM Dillon F.O, August 25, 2022). The 143 records added to the NHP database from the Dillon field office were part of the following watershed assessments: The Big Sheep Creek, Grasshopper, Medicine Lodge, Sage Creek, and Upper Horse prairie watershed assessments.

The reports for these five watershed assessments that comprise the majority of Monta's pygmy rabbit surveys since 2010 generally indicate that pygmy rabbit populations in these five watersheds currently seem to match the historic occurrence, range, and distribution for pygmy rabbit in southwestern Montana. For example, the Big Sheep Creek Watershed Environmental Assessment reports, "The Big Sheep Creek Watershed provides year-round pygmy rabbit habitat…Pygmy rabbits are found throughout the Big Sheep Creek Watershed in suitable sagebrush habitat…While individuals or habitat may be impacted, none of the alternatives [in the EA] are anticipated to contribute to a trend towards federal listing or cause a loss of viability to the population or species." (BLM 2016a). The Grasshopper Watershed Assessment Report states that "the habitat in the Grasshopper Watershed is known as a stronghold for the pygmy rabbit population in the Dillon Field Office and southwest Montana." (BLM 2022). The Medicine Lodge Watershed Assessment reports that, "pygmy rabbits are found in several areas throughout the watershed." (BLM 2021). The Sage Creek Watershed Environmental Assessment reports that, "the Sage Creek Watershed provides year-round pygmy rabbit habitat...Pygmy rabbits are found throughout the SCW in suitable sagebrush habitat…. While individuals or habitat may be impacted, none of the alternatives [in the EA] are anticipated to contribute to a trend towards federal listing or cause a loss of viability to the population or species." (BLM 2016b). However, it should be stressed that all of these statements were based on simple occurrence (presence/absence) data and not occupancy surveys. Occupancy surveys are preferable to attempting to ascertain numbers of pygmy rabbits through things like active burrow counts, and are certainly preferable to incidental occurrence or simple presence/absence at a site. Simple occurrence data contributes nothing to knowledge of relative abundances of pygmy rabbit, or trends over time, like occupancy surveys can. 68 Fed. Reg. at 43 (November 30, 2001).

The other 36 pygmy rabbit presence/occurrence records added to the Montana NHP database since 2010 included incidental sightings of pygmy rabbits by MFW&P biologists, clearance surveys on Bureau land apart from watershed assessments, a few observations on state and private lands, and apparently very limited project clearance work or incidental observations on the Bitterroot and Beaverhead- Deerlodge National Forests.

Based on the occurrence data in the Montana Natural Heritage Program (NHP) database at the time, in 2018 the NHP re-assessed the conservation status of pygmy rabbit and assigned a state ranking of S3 ("Potentially at risk because of limited and/or declining numbers, range and/or habitat, even though it may be abundant in some areas"), reasoning that "the species occupies a limited distribution within the state and threats to sagebrush habitat including development and conifer encroachment may affect long-term persistence."[14] Thus, even with limited information about status and trends, the NHP expects some degree of threat to the species persistence in the state.

H. Colorado

The pygmy rabbit was not known to occur in Colorado at the time of the Service's 2010 determination. However, in 2010, fecal pellets diagnostic of pygmy rabbits were collected by a team of researchers in the Vermillion Bluffs area of northwestern Colorado (Estes-Zumpf et al. 2014). Presence of pygmy rabbits was confirmed from three locations and pellets represented both adult and juvenile rabbits. Based on the sparseness of burrows in the area, Estes-Zumpf et al. determined that the density of pygmy rabbits in the area was likely low.

Colorado Fish Wildlife and Parks has not revisited the pygmy rabbit population site that was discovered in 2010 for the purposes of doing any sort of formal, or occupancy monitoring of the population (personal communication, Jeremy Siemers, Colorado Natural Heritage Program, September 01, 2022). Since 2014 the Colorado Natural Heritage Program has done periodic camera trapping as well as some pellet sampling in the vicinity of the locations outlined by Estes-Zumpf et al. (2014); but those efforts have not yet detected any pygmy rabbits at those sites (personal communication, Jeremy Siemers, Colorado Natural Heritage Program, September 01, 2022). The pygmy rabbit currently has a Nature Serve status of S1, or Critically Imperiled, in the state of Colorado, but it is unclear whether or not it continues to be present at all.

Summary, Distribution and Population Status

In summary, what we can ascertain about current occupancy rates of pygmy rabbit across its range does not paint a rosy picture. In Wyoming, considered to be one of the strongholds for the species, state-wide occupancy surveys conducted by the Wyoming Game and Fish department have documented a 69% decline in occupancy of pygmy rabbit populations between 2013 and 2019. In Utah in the 2011 state-wide occupancy surveys, only 7% of all occurrences were within the other four historic pygmy rabbit population areas outside of the Northern Region. Repeat occupancy surveys conducted by the Utah Division of Wildlife Resources in 2014 in Utah's Southern Region again confirmed low overall occupancy rates of 13%. In Idaho very little is currently known about pygmy rabbit occupancy rates, as the Idaho Fish and Game has not conducted any of its own occupancy surveys since before 2010. While limited data gleaned from the Bosworth (2013) study in the South-Central and Southeast

[14] https://fieldguide.mt.gov/speciesDetail.aspx?elcode=AMAEB04010

Regions suggest average occupancy rates of about 41% in 2013, occupancy surveys in advance of fuel treatments by the BLM in 2018 in the Southeast Region found occupancy rates of only 23%. In Nevada, University of Reno researchers have found occupancy rates averaging 22% on sites surveyed outside of the ungrazed Hart-Sheldon Wildlife refuge.[15] Since the USFWS 2010 ruling In Oregon, occupancy surveys were not conducted again until 2021-2022, and only in Harney County and small portions of adjacent counties right along the border. Here they found average occupancy rates of only 28.5%.[16] Montana has not conducted any occupancy surveys since before 2010. Presence/absence data included with many Bureau Watershed assessments since 2010 does nothing to help gauge current trends in Montana's pygmy rabbit population, leaving the Montana populations as a large unknown. California, by virtue of a very small geographic range and current research on the genetics of this isolated population, has conducted the most rigorous occupancy surveys of any state. Alarmingly, researchers have reported a 33% decrease in occupancy of the Mono Basin population from 2017-2022. Meanwhile, in Colorado, which likely has the smallest population of pygmy rabbit of any of the 8 states, has no idea if their population (only discovered in 2013) is still extant. Colorado Fish Wildlife and Parks has not revisited the population area for the purposes of occupancy monitoring, and limited Colorado Natural Heritage Program camera trapping and pellet sampling have not yet detected any pygmy rabbits at or near the previously-populated site.

Absence of evidence should not be equated with evidence of absence, and declines of pygmy rabbits where there aren't quantifiable occupancy data can be reasonably presumed by trends within its suitable habitat. *See* Section VI, below.

V. HISTORY OF LEGAL STATUS AND CONSERVATION EFFORTS

In November 2001, the Service issued an emergency rule and proposed rule protecting the pygmy rabbit as an endangered species in the Columbia Basin Distinct Population Segment ("DPS"), located in the Columbia Valley region of Washington. Emergency Rule, 66 Fed. Reg. 59734 (Nov. 30, 2001) and Proposed Rule, 66 Fed. Reg. 59769 (Nov. 30, 2001). In these rules, the Service acknowledged concerns over the declining populations of pygmy rabbits across its historic range, and planned a status review of the pygmy rabbit to determine whether it required range-wide protection under the ESA.

In March, 2003, the Service issued a new, final rule protecting only the Columbia Basin DPS pygmy rabbits as endangered. On April 21, 2003, a coalition of conservation groups submitted a listing petition requesting that the Service list the pygmy rabbit as endangered or threatened in all remaining populations outside of the Columbia Basin DPS. The Service initially failed to respond to the petition within the timelines required under the ESA. The Petitioners accordingly sued the Service on August 31, 2004 to enforce compliance with the ESA (*See Western*

[15] We note that pygmy rabbit occupancy rates found in the Nevada portion of Hart Sheldon (53%) and in the Oregon portion of the Refuge (32%) constitute some of the highest occupancy rates we have encountered in this status review.

Watersheds Project et. al. v. U.S. Fish and Wildlife Service, No. 04-cv-440-BLW, D.Idaho). The parties reached a settlement requiring the Service to submit for publication in the Federal Register a 90-day Finding on Plaintiff's Listing Petition by May 16, 2005, and, if appropriate, a 12-month Finding by February 15, 2006. The Service's 90-day Finding, published on May 20, 2005, concluded that the Petitioners' Listing Petition failed to provide substantial scientific or commercial information to demonstrate that listing the pygmy rabbit under the ESA may be warranted. The Petitioners again sued the Service, seeking judicial review of the Service's Determination (S*ee Western Watersheds Project v. Norton*, No. 06-cv-0127-EJL, 2007 WL 2827375 (D.Idaho Sept. 26, 2007). The Court held that the Service's 90-day Finding improperly imposed a higher standard for scientific and commercial information than that required under the ESA when it denied the plaintiff's listing petition. *W. Watersheds Project v. Norton*, 2007 WL 2827375, at *6. Thus, the Court reversed the Service's 90-day Finding as arbitrary and capricious, and remanded the decision back to the Service to issue a new decision within 90 days. In January 2007, the Service issued a new 90-day Finding concluding that protection of the pygmy rabbit under the ESA may be warranted. 90-day finding, 73 Fed. Reg. at 1312 (Jan. 8, 2007). Rather than issuing a 12-month Finding within one year as required under the ESA, the Service had failed to issue any finding by February of 2010. Western Watersheds Project and its allies again sued the Service for violating the ESA. *See Western Watersheds Project v. U.S. Fish and Wildlife Service*, No. 10-cv-000544-REB (D. Idaho). The parties reached a settlement requiring the Service to issue a 12-month Finding no later than September 24, 2010. On September 30, 2010, the Service published the Not Warranted Finding. 75 Fed. Reg. 60516-561 (Sept. 30, 2010). The Service concluded that listing the pygmy rabbit as an endangered or threatened species under the ESA was not warranted.

The Service 2010 determination essentially concluded that since pygmy rabbit activity continued to occur in Oregon, Idaho, Montana, Wyoming, Nevada, and Utah, in a similar distributional pattern as compared with historical information, additional federal protections were not warranted. Although it found the pygmy rabbit may have suffered range contraction in portions of its historical range in northeastern California, the Service ultimately determined pygmy rabbits continue to occur throughout their historical range, as well as in newly discovered sites. This determination was based on supposition more than science, but subsequent state efforts to track the species were sidelined once the concerns of ESA listing were alleviated by the 2010 finding.

The 2010 12-month finding identified threats to pygmy rabbit, including land management activities such as agricultural conversion, livestock grazing, invasive nonnative plant species, fire, urban and rural development, mining, energy exploration and development, fragmentation of sagebrush habitat, and sagebrush modification for other species. These threats continue – and have accelerated – into the present.

VI. CURRENT AND FUTURE THREATS TO THE SPECIES

In accordance with 16 U.S.C § 1533(a)(1), the Service must consider five factors when considering whether to provide Endangered Species Act protection for a species. These factors are the present or threatened destruction, modification, or curtailment of habitat and range; overutilization for commercial, recreational, scientific, or educational purposes; disease or predation; the adequacy of existing regulatory mechanisms; or other natural or manmade factors affecting its continued existence. The pygmy rabbit, for the reasons described below, merits consideration under these criteria.

A. The Present or Threatened Destruction, Modification, or Curtailment of Habitat and Range

One of the largest concerns for pygmy rabbits is loss of habitat and subsequent habitat fragmentation (Larrucea and Brussard 2008b). In fact, given the dearth of consistent population monitoring data, the habitat losses provide some of the clearest evidence that pygmy rabbits need heightened protection.

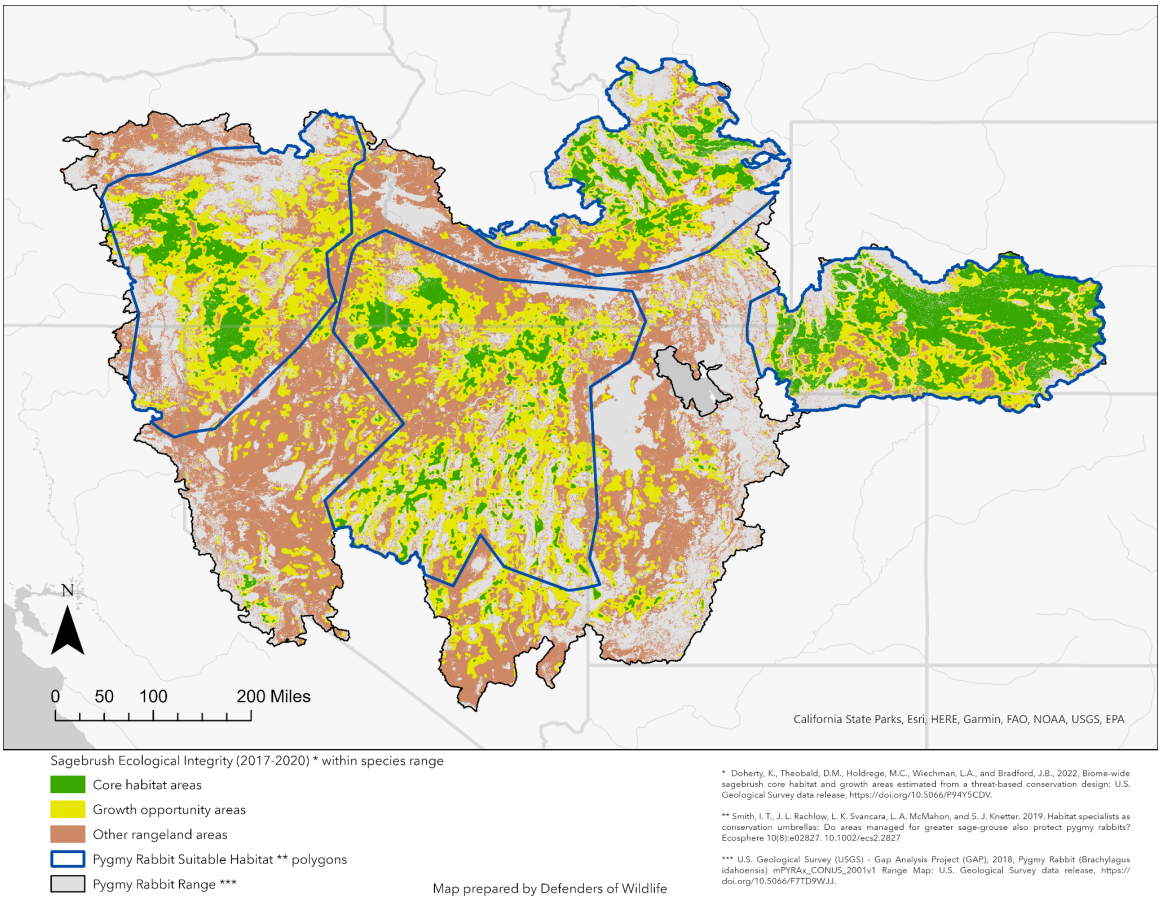

Figure 5. Core Sagebrush Habitat Areas, Growth Opportunity Areas, and Other Rangeland Areas (as defined and modeled by the recent Sagebrush Conservation Design report issued by the U.S Geological Survey, Doherty et al. 2022)[16] within the range of pygmy rabbit. The majority of the core habitat areas also fall within the four pygmy rabbit strongholds we have identified in this petition.

[16] U.S. Geological Survey data release, https://doi.org/10.5066/P94Y5CDV.

There is little doubt that sagebrush habitat is disappearing across the American West. Numerous publications and research efforts have documented the steep decline of intact sagebrush communities. Here, we summarize the most recent results that point to clear degradation of pygmy rabbit habitats.

For example, in 2022, a working group with diverse disciplinary expertise was convened by the U.S Geological Survey to conceptualize a spatially explicit conservation design for the sagebrush biome (Doherty et al. 2022). Specifically, this group was assembled to develop a landscape conservation design that could provide a foundation for a common strategic approach for addressing biome-wide threats to the sagebrush ecosystem. The intent of the effort was to help unify conservation delivery efforts, facilitate and promote discussion among stakeholders to set ecosystem-level objectives, and be a foundation for part of a comprehensive and strategic adaptive management framework. First, the study team developed a spatially explicit model to assess geographic patterns in sagebrush ecological integrity and used this model to identify core sagebrush areas (CSAs), growth opportunity areas (GOAs), and other rangeland areas (ORAs) across the biome. The team determined core sagebrush areas using two steps: first, the team defined patches of high sagebrush ecological integrity (SEI) as being those with abundant sagebrush, native understories, and minimal threats (that is, invasive annual grasses, expanding conifers, and human modification). Second, the team identified the places where these patches converged to create large and intact sagebrush landscapes (Doherty et al. 2022). The team then identified sagebrush areas in the "next tier" below Core Sagebrush Areas as Growth Opportunity Areas, meaning they do not represent the highest value of sagebrush connectivity and function, they are more degraded, and only with human intervention might they eventually be restored into the CSA category.

Figure 5 illustrates the abundance of CSAs and GOAs within the range of the pygmy rabbit. We include this figure here to illustrate how few, and, other than Wyoming and Oregon, how unconnected the best functioning sagebrush CSA patches are within pygmy rabbit range. Only 19,063,513 acres, or 11.2% of the pygmy rabbit range is included within the mostly unconnected CSAs. This underscores the alarming amount of pygmy rabbit habitat that has been lost, degraded and/or fragmented in recent decades.

But even in the remaining stronghold areas, pygmy rabbit habitat is at risk. In 2017, Carr and Melcher developed a general habitat model for pygmy rabbits using the MaxEnt model as part of a Rapid Ecoregional Assessment (REA) in the Wyoming Basin. Key ecological attributes addressed in the model included the distribution of pygmy rabbit habitat, landscape structure (patch size and connectivity), landscape dynamics (fire and sagebrush-juniper ecotone shifts), and anthropogenic change agents (development and climate change). The resulting model predicted that 23,950 km2 (13.4 %) of the Wyoming Basin was potential habitat for the species. Only 20% of potential habitat in the Basin was relatively undeveloped, whereas 35% had high levels of development (Carr and Melcher 2017). Importantly, only 7.8% of undeveloped areas occur in patches greater than 100 km^2 (38.6 mi^2), and there are no relatively undeveloped patches of potential habitat greater than 1,000 km^2 (386.1 mi^2).

The authors found that development has dramatically reduced the structural connectivity of potential habitat at local, landscape, and regional scales. They also suggested that despite interpatch distances being smaller than the maximum reported distances for pygmy rabbit dispersal (6.5 km (4.0 mi) for females and 11.9 km (7.4 mi) for males) that roads may negatively impact dispersal due to avoidance or direct mortality. Therefore, development occurring outside of these patches may still impede pygmy rabbit dispersal (Carr and Melcher 2017), leading to isolation and increased opportunities for stochastic extirpations.

Habitat fragmentation is deleterious for pygmy rabbits. Pierce et al. (2011) looked into the effects of increased edge habitat on pygmy rabbits in Utah, through their efforts to quantify pygmy rabbit activity in edge habitat and non-edge habitat, and to also understand predator and competitor activity within edge and non-edge habitat. Pierce and others observed fewer camera trap images of pygmy rabbits near edge habitat, while images of predators and competitors in edge habitat increased.

Fragmentation necessarily creates more of these edge habitats, increasing the risk of predation and competition for the remaining potentially suitable areas. This is effectively an inverse buffer zone for the species. Indeed, Pierce and others (2011) found that pygmy rabbit fecal pellets decreased near edge habitat, while fecal pellets from cottontails and jackrabbits were more abundant. They concluded that a decrease in abundance of pygmy rabbits near edge habitat may be due to a higher number of predators and competitors in those areas, and they proposed that fragmentation may limit pygmy rabbit population sizes, impede movement between habitat patches, and facilitate the spread of disease (Pierce et al. 2011).

If a population becomes isolated from other populations through habitat fragmentation and human caused barriers to movement and dispersal, genetic repercussions are possible. Small populations stranded in remaining “islands of habitat” within otherwise inhospitable habitat have been shown to suffer deleterious population-level effects resulting from isolation—such as inbreeding, low genetic diversity, genetic drift and even extirpation as small and shrinking populations “blink out” over time (Noss 1983, Wilcove 1987). Small, isolated populations are also more at risk of being wiped out by catastrophic events such as huge fires (Noss 1983, Wilcove 1987) or disease. Pygmy rabbit researchers over time have stressed the importance of preserving connecting sagebrush corridors between isolated patches of sagebrush; for example Rauscher (1997), who stated that without these connecting corridors, isolated populations of pygmy rabbits can become subject to principles of island biogeography and stochastic events.

Pygmy rabbit habitat and range is presently and potentially threatened by factors leading to its destruction and degradation, as explained below.

1. ***Fire and cheatgrass*.**

Wildfire across the sagebrush sea in recent decades has taken a significant toll on existing sagebrush acreage, and within the current range of pygmy rabbit (Figure 6). In the past 40 years

26,105,642 acres within the current range of the species has burned, which comprises over 15% of the range of predicted occupied habitat.

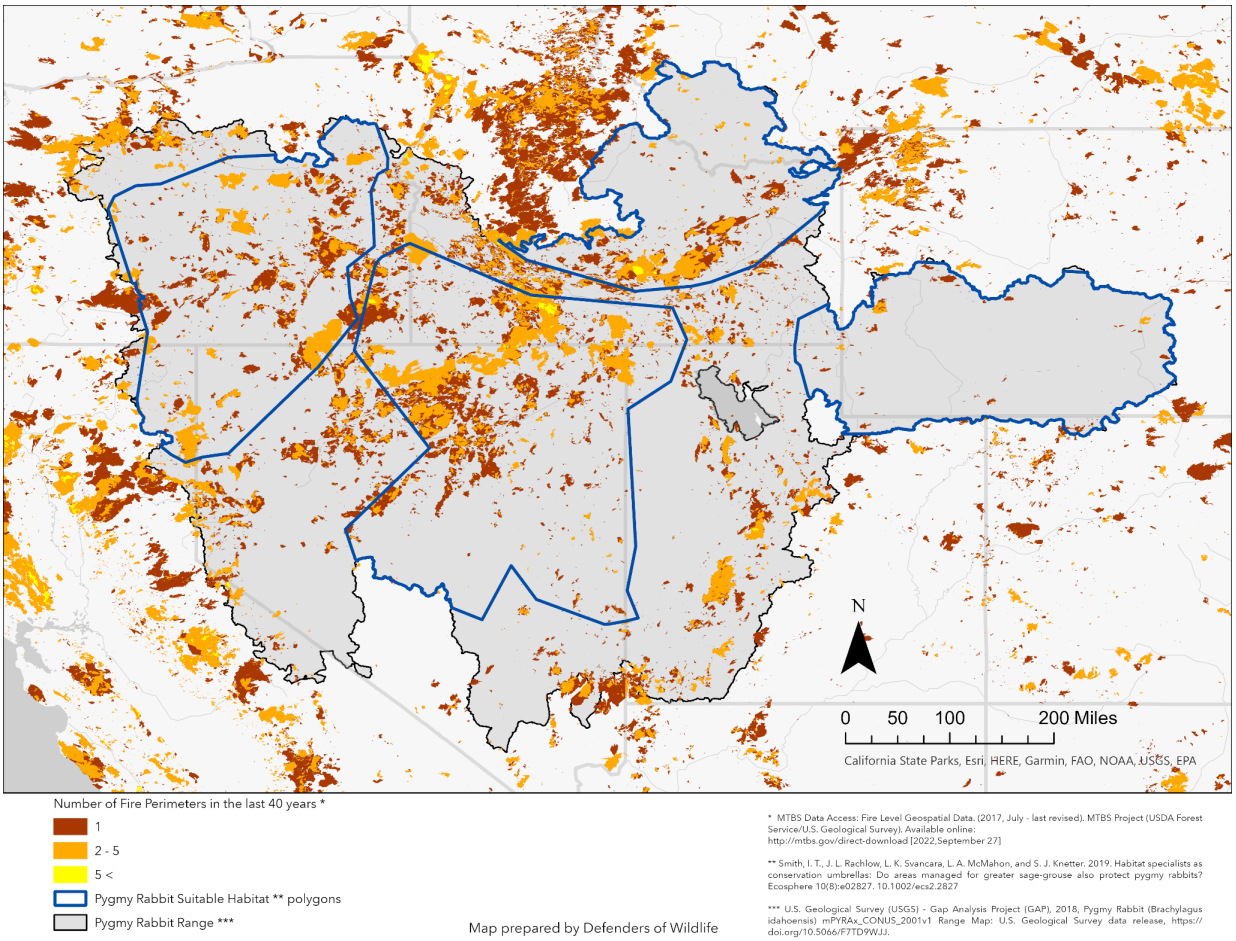

Figure 6. Fires that have occurred in the range of the pygmy rabbit in the past 40 years, and in some places, multiple fires have occurred.[17]

In Idaho, during the past 40 years, 17.3 percent of the pygmy rabbit primary and suitable habitat has buried (1,554,436.5 acres, as defined by Smith et al. 2019). In Oregon, 15 percent of the primary and suitable habitat of the species has burned in the past 40 years (1,537,912.9 acres, as defined by Smith et al. 2019). Nevada's fires have had the greatest spatial impact in pygmy rabbit habitat: 23.8 percent of primary and suitable habitat has burned (4,781,562.3 acres, as defined by Smith et al. 2019). Thus, with just these three examples, it is clear that pygmy rabbits are threatened by fire across a significant portion of their range.

While the current loss of pygmy rabbit habitat due to fire, as shown above in Figure 6, is dramatic and problematic, the trends over the last four decades clearly show that fire is on the increase across the western range of the species, including the strongholds. For example, in

[17] MTBS Data Access: Fire Level Geospatial Data. (2017, July - last revised). MTBS Project (USDA Forest Service/U.S. Geological Survey). Available online: http://mtbs.gov/direct-download [2022,September 27].

Idaho, there were over 2,000 separate "fire perimeter polygons" (included in Figure 6) from 2011 - 2021, more than any other total of fire perimeter polygons in any of the other three previous decades (1981-2011). And in Oregon there were 1,880 fire perimeter polygons from 2011-2021, which is over 50% greater than the average number of fire polygons (between 1,050 and 1,240) that occurred during the three previous decades before. This shows that fire is also an *increasing* threat to the species.

The increased incidence of fire across pygmy rabbit habitat in recent decades is mirrored by the increase in exotic (and highly flammable) annuals, especially cheatgrass (Allred et al. 2021, Remington et al. 2021, and references therein), taking advantage of areas cleared of shrubs and perennial grasses after a fire (Figure 7). In the recent Sagebrush Conservation Design report issued by the U.S Geological Survey (Doherty et al. 2022), the authors found that invasive annual grasses accounted for over 19 million of the 38 million acres identified as Growth Opportunity Areas[18].

Figure 7 layers Doherty et al.'s non-native annual grass coverage layer (from Maestras et al. 2020) within the range of the pygmy rabbit. The map highlights the growing invasive annual grass challenge in the tri-State area of Oregon, Idaho, and Nevada. The areas of the map in Figure 7 from yellow to red represent 43,851,242 acres dominated by annual invasive herbaceous cover (principally cheatgrass). This represents over 25% of the current range of the pygmy rabbit in North America. In the Nevada stronghold in the past few decades 3,776,695.1 acres of primary and suitable habitat (as defined by Smith et al. 2019) has transitioned to non-native annual grass, which equates to 18.8% of all predicted pygmy rabbit in the Nevada stronghold.

[18] Doherty et al (2022) analyzed the level of agreement of SCAs and GOAs with Smith et al.'s (2019) rangewide predictive habitat model for pygmy rabbit, and found that SCAs and GOAs incorporated 78% of known pygmy rabbit population centers that were used to build the Smith et al. model.

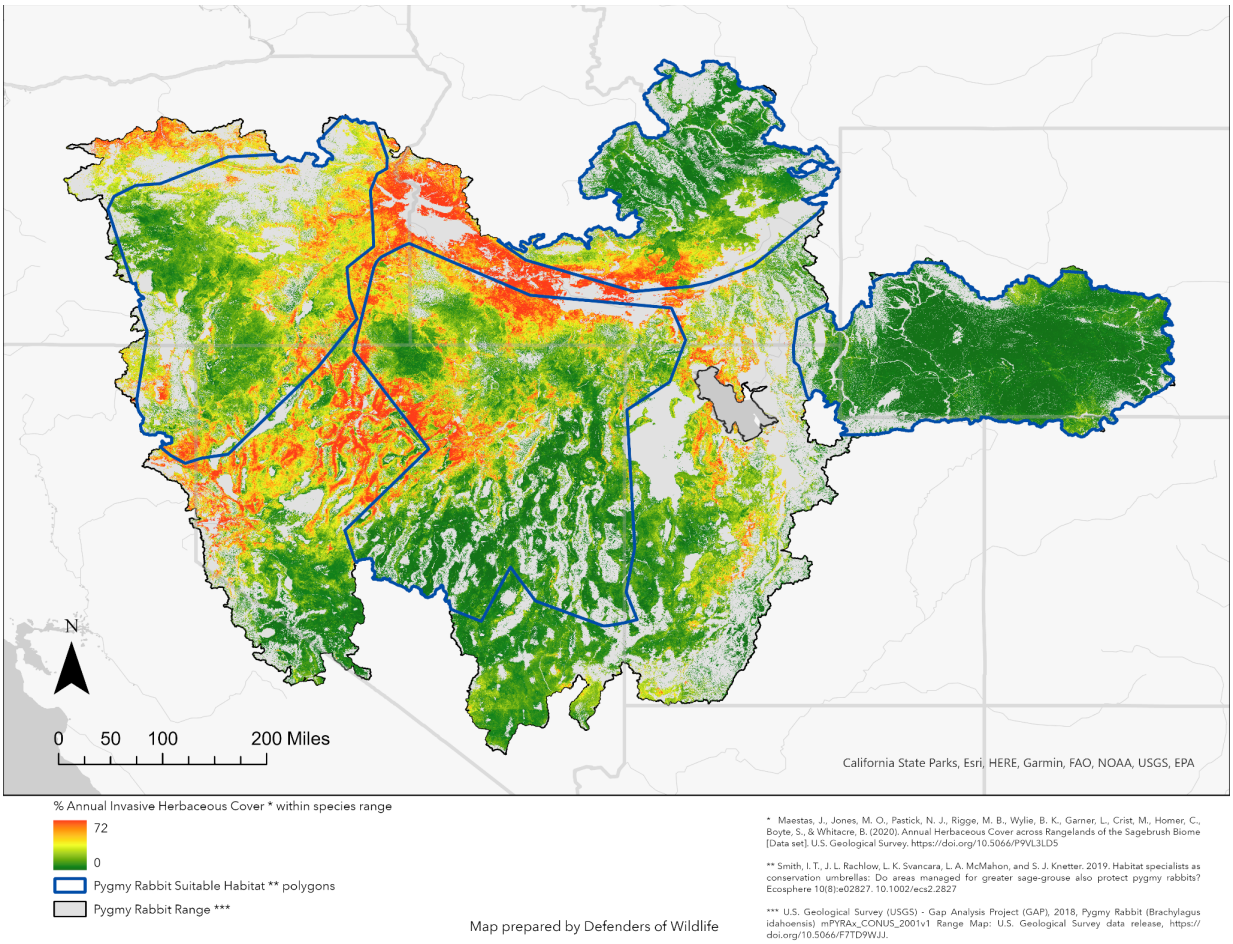

Figure 7. Current annual invasive herbaceous cover within the range of the pygmy rabbit (Maestas et al 2020).[19] The areas of red, orange and yellow represent about 25% of the current range of the species. Maestras et al. (2020) confirm that the majority of this current annual invasive cover consists of cheatgrass.

While the current loss of pygmy rabbit habitat due to nonnative annual grasses such as cheatgrass, as exhibited above, is dramatic and problematic, the trends over the last four decades clearly show that cheatgrass is on the increase across the western range of the species, including the strongholds (Figure 8). Figure 8 illustrates that across the range of the pygmy rabbit, non-native annual grasses have increased from 5,545,983 acres in 1991 to 22,806,586 acres in 2021, which is a troubling 421% increase. Figure 8 shows that much of this increase is occurring in the pygmy rabbit strongholds in Oregon and Nevada.

[19] Maestas, J., M.O Jones, N.J. Pastick, M.B. Rigge, B.K. Wylie, L. Garner, M. Crist, C. Homer, S. Boyte and B. Whitacre. 2020. Annual Herbaceous Cover across Rangelands of the Sagebrush Biome [Data set]. U.S. Geological Survey. https://doi.org/10.5066/P9VL3LD5.

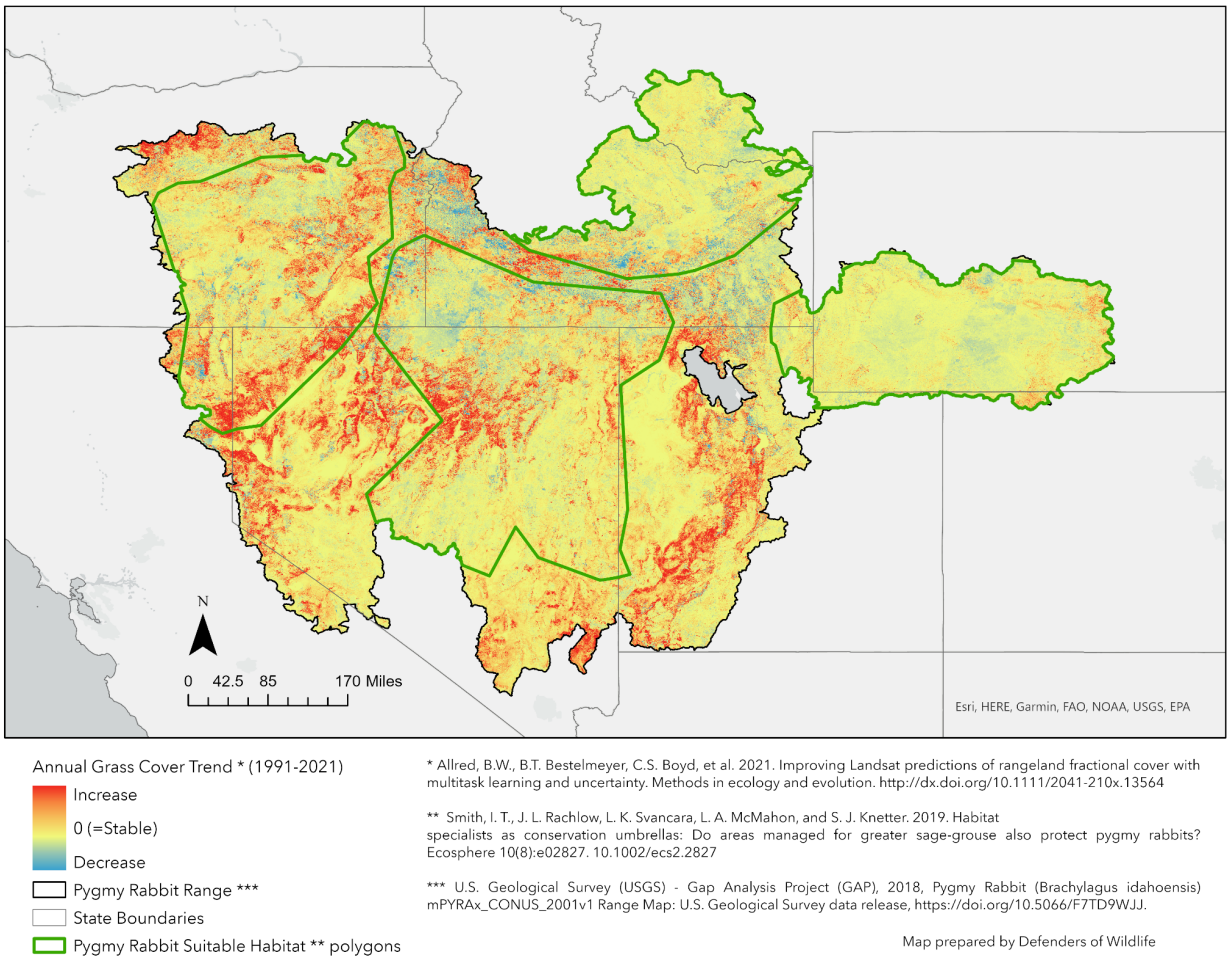

Figure 8. The change in non-native annual grass cover trend across the range of the pygmy rabbit from 1991 - 2021. In terms of acreage of non-native annual grass in 1991 versus 2021, this map conveys a 421% increase of nonnative grasses (principally cheatgrass) during this period. Annual Grass Cover Trend layer provided by Allred et al. 2021.

Unfortunately, as well established by the ecological literature and expanded on below, the phenomena of non-native annual grasses and fire go hand in hand; invasive annual grasses, especially cheatgrass, are known to increase fire frequency (Germino and others, 2016; Davies et al. 2021). Crist et al. (2016) produced a coverage to spatially map the potential of wildfire across the sagebrush biome, in which probability values for wildfires => 300 acres were taken from Short et al. (2016)[20], who in turn generated burn probability and conditional fire intensity level for the conterminous United States using a geospatial Fire Simulation system (FSim).[21] The FSim system includes modules for weather generation, wildfire occurrence, fire growth, and fire suppression. FSim is designed to simulate the occurrence and growth of wildfires under

[20] Short, K.C., M.A. Finney, J.H. Scott, J.W. Gilbertson-Day and I.C. Grenfell. 2016. Spatial dataset of probabilistic wildfire risk components for the conterminous United States. 1st Edition. Fort Collins, CO: Forest Service Research Data Archive. Available at: https://doi.org/10.2737/RDS-2016-0034.

[21] Fire Simulation system developed by the US Forest Service Missoula Fire Sciences Laboratory to estimate probabilistic components of wildfire risk (Finney et al. 2011).

tens of thousands of hypothetical contemporary fire seasons in order to estimate the probability of a given area (i.e., pixel) burning under current landscape conditions and fire management practices. The areas of the map in Figure 9 in red represent 22,482,903 acres most at risk to burn in the near future (Crist et al. 2016) within the range of the pygmy rabbit. This represents over 13% of the current range of the pygmy rabbit in North America. In the Nevada stronghold 5,275,313.1 acres of primary and suitable habitat (as defined by Smith et al. 2019) are in danger of burning soon, which equates to 19.8% of all predicted pygmy rabbit habitat in the Nevada stronghold. Stated another way, nearly one-fifth of the habitat for pygmy rabbits in Nevada is at the highest risk level for fire, a loss that threatens an already declining population and where RHDV2 has recently been detected.

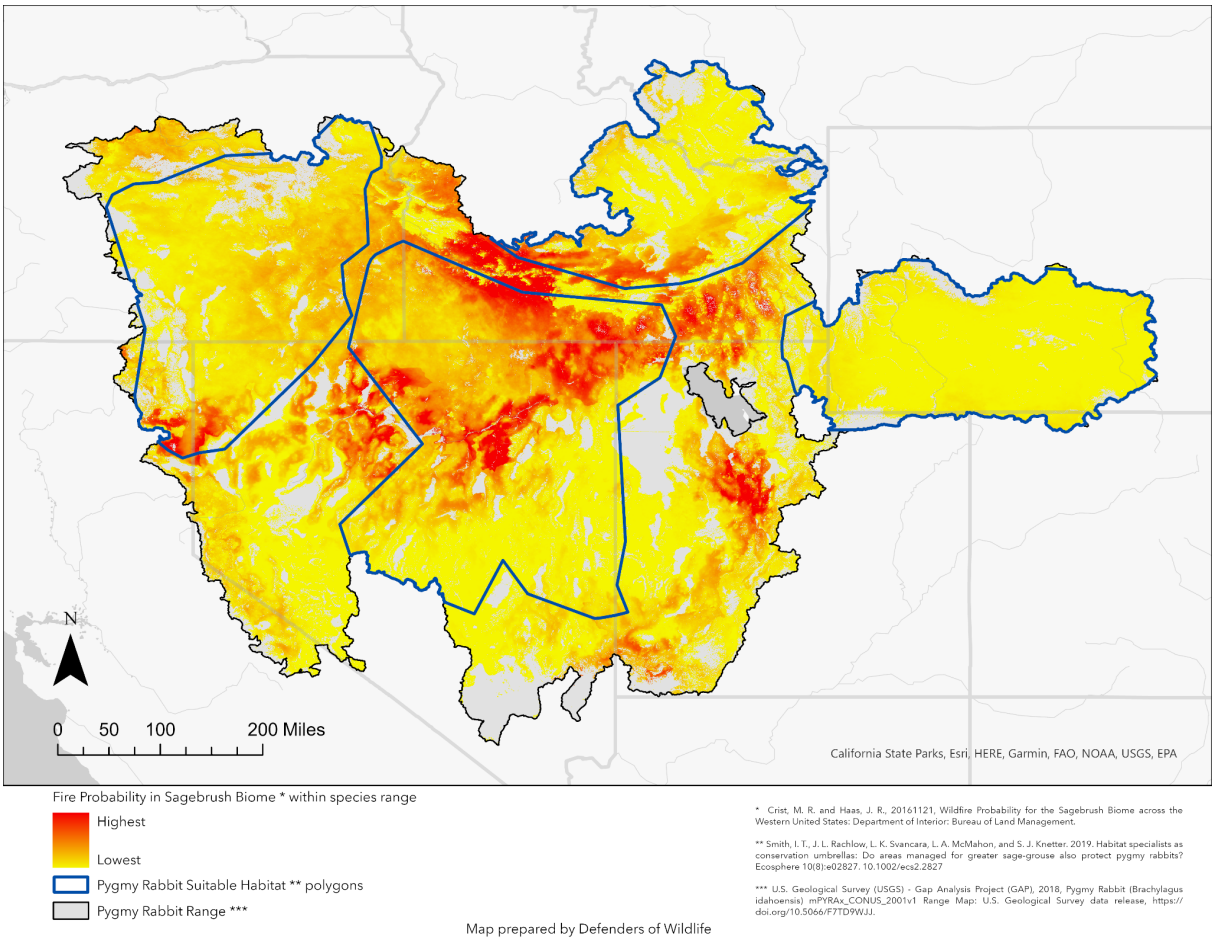

Figure 9. Fire probability within the range of the pygmy rabbit, as defined by Crist et al. 2016[22]

Comprehensive literature reviews by Welch and Criddle (2003) and Jones (2019), indicate that the historic fire return interval in sagebrush-grass communities and big sagebrush communities was likely between 50 to 125 years. In Wyoming big sagebrush, fire cycles historically were of longer duration with average fire rotation likely ranging from 100 to over 300 years, depending

[22] https://www.sciencebase.gov/catalog/item/58516a0be4b0f99207c4f096

on climate, topography, plant composition, and ecological site characteristics (Jones 2019 and references therein).

However, in recent decades a combination of fire and the spread of highly flammable nonnative plants has drastically altered the natural fire regime throughout much of the sagebrush steppe (Jones 2019) especially in the western part of the sagebrush sea. Wildfires now burn larger, hotter, and more frequently in affected lower elevation (i.e., Wyoming big sagebrush) habitats. Sagebrush may return to pre-burn occurrence within 15 to 20 years after fire if conditions are favorable (e.g., proximate seed sources, quick seedling establishment, conducive weather, etc.). If not, various sagebrush varieties may require between 30 to 50 years to re-occupy a burned site (Baker 2006; Knick et al. 2005). Burned areas are often vulnerable to reinvasion by cheatgrass, as cheatgrass fills in the interspaces between native grasses and sagebrush creating a highly flammable matt of fine fuels that facilitates the spread of fire in areas where it would not otherwise occur (Haak 2021), thus setting up a "vicious cycle" of fires followed by even more cheatgrass which will inevitably burn again. Cheatgrass reseeds readily following a fire while the sagebrush may not recover since it is not highly adapted to fire (see Jones 2019 and references therein) thus creating ideal conditions for more fires in the future, resulting in cheatgrass completely occupying a burned site (Brooks et al. 2004, Chambers et al. 2017, Haak 2021). Thus, once pygmy rabbit habitat is lost to fire, it could take decades, if ever, for the sagebrush cover to return in quantities and quality sufficient to support pygmy rabbit colonies.

Rottler et al. (2015) summarized how the conversion of sagebrush steppe to non-native annual or seeded (i.e. Crested wheatgrass, *Agropyron cristatum*) grassland has the potential to directly and indirectly affect many wildlife species. The loss of shrub species may translate to losing a food source or structure for concealment from predators or adverse weather, with clear implications here for the life histories of pygmy rabbit.

As a proxy measure for pygmy rabbit habitat changes, we also point to the Bureau's analysis of the increase of exotic annuals in Greater sage. grouse habitat in its recent 5-year Greater sage-grouse rangewide monitoring report. Invasive plants have increased from being present on a little over 50% of Bureau Greater sage-grouse habitat in 2013, to nearly 70% of habitat in 2018. The percentage of Bureau Greater sage-grouse habitat where invasive plants are abundant (>25% of vegetative cover) has also increased, from about 10% in 2013 to nearly 30% in 2018 (Herren et al. 2021). While imprecise with regard to pygmy rabbits, it is an alarming indicator that all is not well in the sagebrush steppe.

A few studies have directly evaluated the effects of increased cheatgrass and fire on pygmy rabbits. Weiss and Verts (1984) found that only 2 of 51 occupied pygmy rabbit sites in Oregon had cheatgrass in the understory. Annual grasses may restrict movements or visibility by pygmy rabbits and be avoided to increase chances of escaping from predation (Weiss and Verts 1984). The likelihood of pygmy rabbit presence decreases with increased occurrence of cheatgrass (Larrucea and Brussard 2008a). Cheatgrass is only palatable early in the spring when it is still green, so it does not offer a long-term food source and the roots can form dense mats that may

make burrowing difficult for pygmy rabbits (Larrucea and Brussard 2008a). Furthermore, as cheatgrass-dominated areas increase (e.g., post-fire monocultures), a potential barrier to dispersal is created as the physical structure providing protection from predation is lost (Larrucea and Brussard 2008b). Figure 3 above illustrating the large fires in the Jarbridge BLM Field Office in Idaho demonstrates that some populations of pygmy rabbits appear to be disappearing due to these fires.

2. ***Grazing.***

Livestock grazing was identified as a significant threat in the original pygmy rabbit petition, and it remains a threat to pygmy rabbits today. Livestock grazing, which occurs near-universally in lands inhabited by the pygmy rabbit, diminishes grass understories needed for food, lowers nutritional value of grasses, exacerbates exotic species invasions, collapses burrows, and alters and diminishes shrub structural diversity and cover needed by pygmy rabbits for shelter and cover from predators. *See*, generally, 75 Fed. Reg. 60537 (September 30, 2010). Ultimately, the 2010 finding determined, "Our review of the best available scientific data indicates that measurable population decreases attributed to habitat modifications from livestock grazing are not occurring across the range. Therefore, we conclude that livestock grazing is not a significant threat to the pygmy rabbit now or in the foreseeable future." (75 Fed. Reg. 60538)

Since 2010, new studies have demonstrated the specific impacts of livestock grazing on pygmy rabbits. For example, Camp et al. (2014), found that cattle grazing during spring or summer reduced the biomass of perennial grasses available to pygmy rabbits, and spring cattle grazing also reduced the biomass of key forbs.

In 2021 the Oregon Department of Fish and Wildlife surveyed the pygmy rabbit population in Harney County, Oregon, and they report that "[d]isturbance from not only human activity but cattle may also be a big factor in sustained pygmy rabbit presence in Oregon. This has been reported previously, and our observations during this pilot study saw that many big sagebrush plants were crushed and killed in areas open to grazing. They seem to destroy more sagebrush close to a water source, and the traffic back and forth is increased on mounds, which…[include] mounds of friable soil that may have been used by pygmy rabbits in the past. Restrictions or at least reductions of grazing pressure on areas supporting or near pygmy rabbit populations could help to sustain their presence and ability to disperse further into a metapopulation system in Harney County, Oregon." (McLean and Adkins 2021).

We also reiterate the findings, reported above, of the most recent pygmy rabbit occupancy surveys in the Hart - Sheldon Wildlife refuge, which found that in the Nevada portion of the refuge occupancy rates were 53% and in the Oregon portion of the Refuge occupancy rates were 32%. These occupancy rates are some of the highest we have encountered in this status review, and underscore that occupancy rates are higher in ungrazed areas (the Refuge has not been grazed by livestock for over 30 years), compared to other occupied pygmy rabbit sites (which are almost universally grazed). As virtually no studies have been conducted specifically

targeting the question of grazing impacts on pygmy rabbits, this observation bears considerable weight in terms of the impacts cattle grazing are likely to have on the species.

A study conducted by Thines et al. (2004) in Washington's Columbia Basin found that areas ungrazed by livestock had a higher density of burrows than grazed plots, and that late summer through winter grazing reduced the nutritional quality of grass for pygmy rabbits and reduced herbaceous cover by 50%. The authors suggested that the reduction of grasses and forbs may be detrimental to the summer diet of pygmy rabbits in grazed areas and that pygmy rabbits appeared to prefer areas ungrazed by cattle (Thines et al. 2004). Thines et al. concluded that removing cattle from areas important to pygmy rabbit conservation may be beneficial.

Livestock grazing is the most ubiquitous human-caused disturbance across the range of the pygmy rabbit, and thus it is one of the chief factors in contributing to or exacerbating certain cumulative effects on the species' habitat. This is most concerning in light of the interaction of grazing with ongoing climate change and drought, and the synergistic effects this has with the current, problematic cycle with cheatgrass and fire throughout the Great Basin (see above). Livestock grazing significantly exacerbates the spread of cheatgrass (e.g., Reisner et al 2013, 2015; Williamson 2019), which in turn further drives uncharacteristic wildfire.

Mechanical and chemical treatments to reduce sagebrush and other woody species to try to improve cattle forage can result in considerable increases in non-native grasses and forbs, usually drastically reducing habitat for sagebrush-obligate species (Beck et al. 2012, Rottler et al. 2015, and summarized by Jones 2019). Indeed, studies have shown the deleterious effects mechanical sagebrush treatments have had on pygmy rabbits, including home range movements farther from treatments than expected, and observed reluctance of rabbits to enter treated patches (e.g., Wilson 2010, Wilson et al. 2011). Going forward, much more attention needs to be paid to the effects of the near ubiquitous practice of livestock grazing in pygmy rabbit habitat, and how this interacts with and is compounded with climate change and vegetation treatments, even when the aim of such treatments is habitat restoration. Additionally, construction of new livestock infrastructure (primarily water sources) continues to extend livestock use into remnants of less-grazed sagebrush habitats (Catlin et al. 2011, and references therein).

Whereas the Service found in 2010 that there were several examples where pygmy rabbits have been documented to continue to occupy areas grazed by livestock, it stated that this overlap, "may indicate an apparent compatibility between livestock grazing and area use by pygmy rabbits under certain grazing conditions." However, as shown above, there isn't much documentation of pygmy rabbit persistence at all in 2023, with only sporadic monitoring occurring at the state level, and there is even less understanding of the grazing conditions at which compatibility of livestock with pygmy rabbits may occur.

As we expand on in the *Inadequacy of Existing Regulatory Mechanisms* section below, currently one of the more significant problems related to grazing effects on pygmy rabbit habitat is the lack of rigorous monitoring to assess grazing conditions on Bureau lands. However even with

the lack of rigorous standards, the Bureau is required to periodically evaluate whether allotments are meeting the current federal Rangeland Health (RLH) Standards. A recent analysis by Public Employees for Environmental Responsibility (PEER) shows that almost 77,354,000 acres, or 29% of the current range of the pygmy rabbit, are within Bureau allotments identified by the agency as failing Rangeland Health Standards. Of these failing allotments, almost 35,672,500 acres, or over 46%, are failing RLH standards due to livestock grazing. Thus, to the extent that grazing and pygmy rabbits may be compatible, it is a reasonable conclusion that at least 35 million acres are not, based on their failure to meet land health standards. See Figure 10.

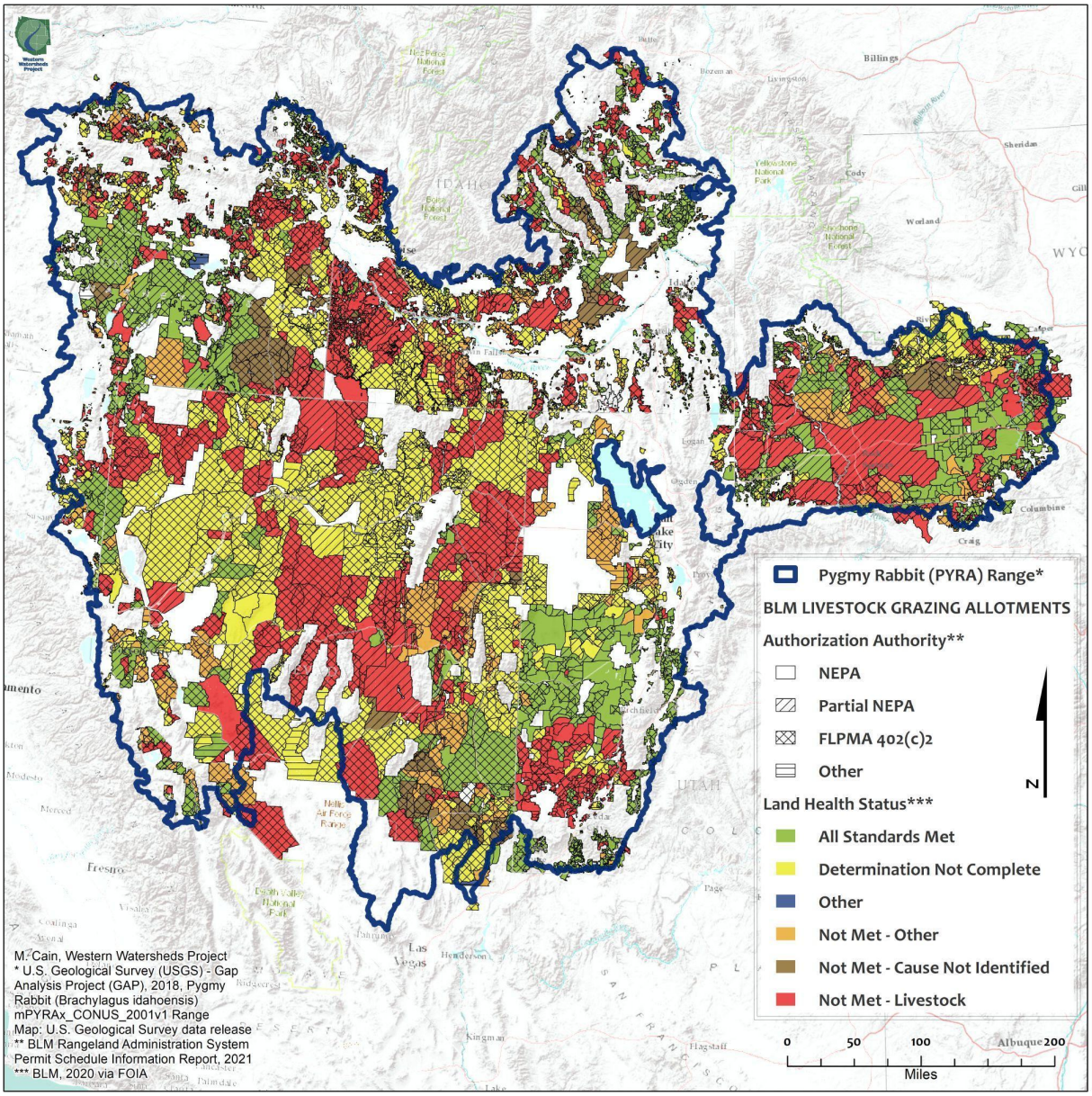

Figure 10. Areas (representing BLM grazing allotments or portions of allotments) within the range of the pygmy rabbit that are currently meeting the federal Rangeland Health Standards, are not currently meeting Standards or have yet to be assessed for Rangeland Health.[23]

Moreover, almost 31 million acres within the range of the pygmy rabbit are within BLM allotments that have *not yet been assessed* for their conformance with Rangeland Health Standards. (Figure 10). Whereas the 2010 Not Warranted determinations concluded that grazing may be compatible with pygmy rabbit habitat, it would be an unwise assumption to assume that grazing operations are even compatible with the Bureau's own land health criteria (which include wildlife habitat). In other words, we simply do not know the condition of many of the public lands that include pygmy rabbit habitat, but we do know that a significant portion are in very poor condition. This is clear evidence that there is present degradation of the habitat that may be threatening pygmy rabbit survival.

3. ***Oil and gas development***.

Existing and future oil and gas development poses a considerable threat to pygmy rabbit populations, especially in Wyoming, which represents a significant portion of the species range.

There are 11,341 active oil and gas wells (represented by black dots), in addition to oil and gas leases both offered and sold since 2015, within the range of the pygmy rabbit in Wyoming (Figure 11). While the well data used for this map is "point data," using a standard ½ mile buffer radius (a prominent figure from the oil and gas wildlife impact literature) around each well results in a cumulative acreage impact of about 5,697,700 acres potentially affected by these active wells, or about 42% of the habitat within the current range of pygmy rabbit in Wyoming.

The additional combined drilling lease offerings and sold leases (blue and orange in Figure 11) include nearly 2,768,440 acres of habitat within the current range of pygmy rabbit in the state, or almost an additional 21% of the range of pygmy rabbit in Wyoming. In total, current and future oil and gas development affects nearly two-thirds of the species' range in the state.

Also noteworthy is that the spatial extent covered by these oil and gas parcels is not concentrated in just one corner of the range, leaving the rest free of leases. Rather these threats are scattered all across the species' range, which could have large impacts on isolation and fragmentation of populations and habitat. Put another way, nearly 90% of both leases offered, and leases sold, in Wyoming occur within suitable pygmy rabbit habitat within the range of the species. The threat of increased oil and gas development within the pygmy rabbit's range in Wyoming, combined with the currently low occupancy rates reported in Wyoming, and the ever-present threats of the interaction of fire, cheatgrass, livestock grazing and climate

[23] Data sources: BLM Rangeland Health Status (2020) - The Significance of Livestock Grazing on Public Lands
BLM's allotment Land Health Standards (LHS) assessment records (1997 - 2019)
BLM LAND HEALTH STATUS (2020) (https://mangomap.com/peer/data/blm_natl_grazing_allot_lhs2020.shp)

change, points to the need to protect pygmy rabbits because of the degradation of a significant portion of the range of the species.

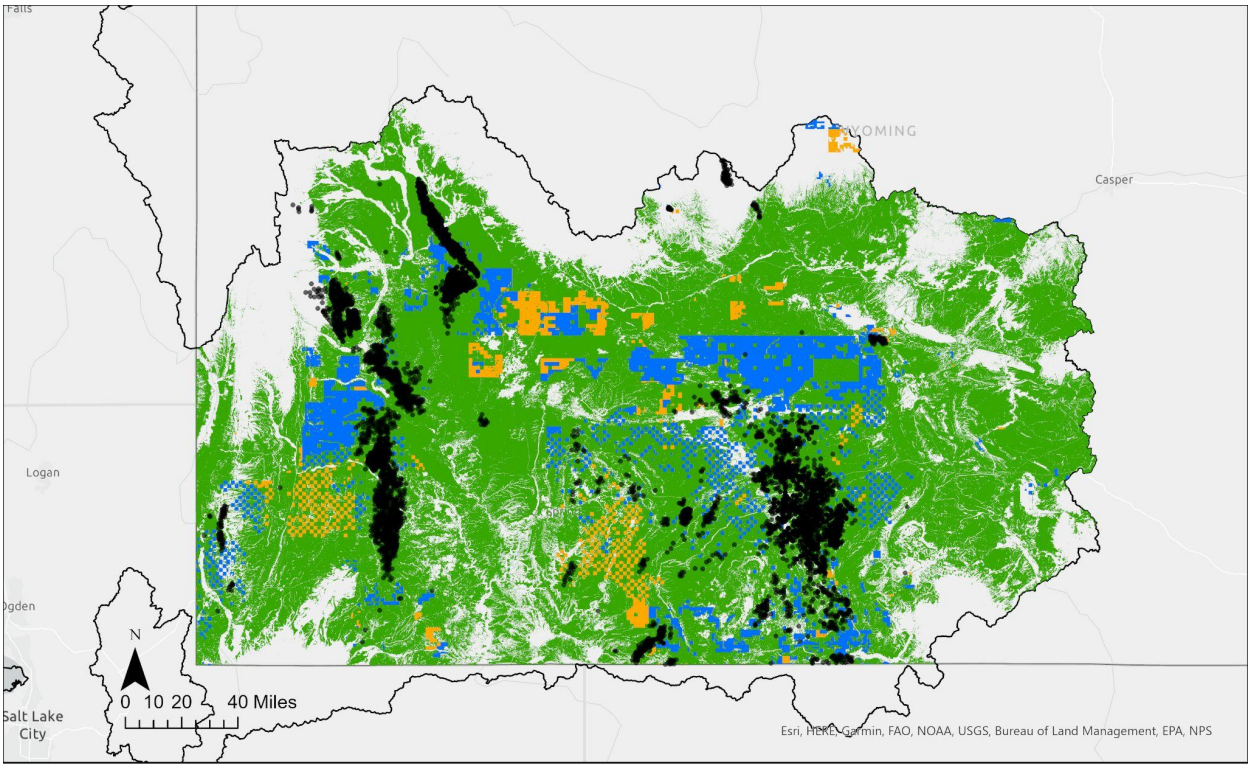

Figure 11. Active oil and gas wells, in addition to oil and gas leases both offered and sold from 2015 - 2020 within the range of the pygmy rabbit in Wyoming.[24]

Recently published literature underscores the impacts that oil and gas development has on pygmy rabbits. For example, in a set of associated studies in southwestern Wyoming oil and gas fields, Germaine et al. (2017, 2020) demonstrated the detrimental consequences of current levels of oil and gas production in Wyoming's sagebrush country. In the first study, Germaine et al. (2017) surveyed 120 plots across four gas fields, with plots distributed across the density gradient of gas well pads on each field. In a 1 km radius around the center of each plot, they measured the area covered by each of 10 gas field infrastructure elements and by shrub cover. Germaine et al. then modeled the relationship between gas field elements, pygmy rabbit presence, and two indices of pygmy rabbit abundance. Gas field infrastructure elements — specifically buried utility corridors and a complex of gas well pads, adjacent disturbed areas, and well pad access roads — were negatively correlated with pygmy rabbit presence and

[24] Center for Biological Diversity compiled quarterly lease sales statistics offered based on E-planning for the years 2015-2020 and converted to GIS.

abundance indices, with sharp declines apparent after approximately 2% of the area consisted of gas field infrastructure. The authors concluded that pygmy rabbits in southwestern Wyoming may be sensitive to gas field development at levels similar to those observed for Greater sage-grouse, and may suffer local population declines at lower levels of development than are allowed in existing plans and policies designed to conserve Greater sage-grouse by limiting the surface footprint of energy development (Germaine et al. 2017).

In the second study, Germaine et al. (2020) used empirical data from southwestern Wyoming to evaluate how the spatial arrangement of gas field features converged with pygmy rabbits and their habitat. They found evidence that gas well pads converged on modeled pygmy rabbit habitat: gas well pads occurred more frequently in suitable pygmy rabbit habitat and less frequently in poor pygmy rabbit habitat than random points did on one gas field, and average pygmy rabbit habitat suitability values were higher at well pads than at random points on three of the four gas fields studied. Also, the influence of gas field infrastructure on pygmy rabbits extended far beyond the physical disturbance footprint. Pygmy rabbit presence and abundance were lower as far as 2 km from the nearest gas well pad, road, or utility corridor. Germaine and others were unable to identify a single type of gas field infrastructure which had the greatest distance effects on pygmy rabbits, and concluded that roads, well pad complexes, and buried utility corridors were all highly influential, with distance effects extending the greatest distances from well pad complexes and buried utilities (Germaine et al. 2020).

Also in Wyoming, and as summarized above in the population status section for Wyoming, in 2015 the Wyoming Game and Fish Department contracted with an independent scientist (Hayden-Wing Associates, LLC) to compare occupancy dynamics across 2011-2016 in the Pinedale Anticline in order to assess the need for mitigation. Among sites visited during 2011-2016, occupancy was estimated at 48% in the Pinedale Anticline Project Area (PAPA). Between 2011 and 2012, the researchers found an approximate 14% higher rate of local extinction and a 2% lower rate of colonization in the PAPA compared to the reference area. Between 2012 and 2013, they found an approximate 8% higher rate of local extinction in the PAPA compared to the reference area. Between 2013 and 2014, they found an approximately 11% higher rate of local extinction in the PAPA compared to the reference area but a similar rate of colonization between the PAPA and reference area. Between 2014 and 2015, they found an approximate 7% higher rate of local extinction in the PAPA compared to the reference area and a 2% increase in the rate of colonization between the PAPA and reference area. Between 2015 and 2016, extinction rates increased in the reference area. They found an approximate 4% higher rate of local extinction in the reference area compared to the PAPA and a 1% increase in the rate of colonization between the PAPA and reference area (Hayden-Wing Associates, LLC. 2016). The relatively consistent results showing higher extinction rates in the oil and gas development zones compared to the undisturbed reference areas demonstrate that fossil fuel development is deleterious to viable pygmy rabbit populations.

A concomitant impact of fossil fuel development within the range of the pygmy rabbit is construction of new pipelines. Edgel et al. (2018) quantified space use, movements, and survival of pygmy rabbits before and after the construction of an oil pipeline right-of-way in

Utah over 18 months. They captured and radio-marked 108 pygmy rabbits at a control site and the pipeline and documented their locations multiple times a day for a month before and after pipeline construction. Location data was then recorded three to four times a week in the summer and biweekly from September to April. The authors then estimated each rabbit's home range and core areas and modeled space use and movements. Pygmy rabbit home ranges and core areas were three times larger before construction of the pipeline and core areas shifted away from the pipeline and remained smaller post-construction (Edgel et al. 2018). The authors suggest that energy development results in habitat loss and decreases space use by pygmy rabbits, therefore reducing both the presence and abundance of the species. Furthermore, the authors suggest that avoidance behavior of edge habitats likely explains the observed decrease in home ranges and core areas, which may increase competition and reduce gene flow (Edgel et al. 2018), in addition to the potential for increased predation discussed above.

In sum, grazing, fire, invasive species, and oil and gas development trends are significantly contributing to the present and threatened destruction, modification and curtailment of pygmy rabbit habitat and ranges, especially within the best remaining "stronghold" habitats. The reluctance of the pygmy rabbit to cross open space is well known (i.e., Green and Flinders 1980, Weiss and Verts 1984, Katzner 1994, Katzner and Parker 1997, Heady et. al. 2001). Unfortunately, the lack of protection specifically given to this species has resulted in these necessary connecting habitats generally not being conserved as aggressively as they need to be, which curtails the functional range of the species as well.

B. <u>Disease or Predation</u>

As discussed above, predation risk for the species increases with the "edge effects," so it can be reasonably surmised that predation threatens the species in proportion to the habitat fragmentation that is occurring through pygmy rabbit range. But pygmy rabbits are also at risk from a newly emerging threat of rabbit hemorrhagic disease virus serotype 2 (RHDV2), first detected in the species in winter of 2022.

In February 2020, RHDV2 was detected in a domestic rabbit in New York City. The virus was quickly identified, isolated and eradicated. But RHDV2 is highly contagious and, unlike other rabbit hemorrhagic disease viruses, it affects both domestic and wild rabbits (USDA-APHIS 2020). There does not appear to be an epidemiological link, but the disease was soon afterward confirmed in black-tailed jackrabbits and desert cottontails in New Mexico in March 2020 – the first confirmed detections in wild lagomorphs in the United States (Crowell et al. *in press*). Since then, RHDV2 has spread throughout the western United States, affecting wild populations of hares (*Lepus* spp.) and cottontails (*Sylvilagus* spp.) in New Mexico, Arizona, Texas, Colorado, Nevada, California, Utah, Wyoming, Oregon, Montana, and Idaho.[25]

As summarized by Crowell et al. (*in press*), RHDV2 is highly contagious, with an incubation period of 23 – 48 hours (Hall et al. 2021) and infects rabbits as young as 15 – 20 days old, which

[25] https://www.aphis.usda.gov/aphis/maps/animal-health/rhd

is younger than previously-detected RHDV strains (6 – 8 weeks old; OIE 2018). This virus can also withstand harsh environmental conditions and will persist in the environment, especially in organic materials, for long periods of time. This disease is primarily spread through direct contact between lagomorphs but may also be spread through contact with carcasses, persistence in the environment (e.g., contaminated food, water, feces, soil), insect or predator feces or spread by humans (e.g., via tools, boots, vehicles, etc.; Taggart et al. 2021; USDA 2020).

Infected individuals may exhibit weight loss, lethargy, increasing body temperature, pulmonary hemorrhage, and seizures. Many times, the only signs of the disease are sudden death and blood-stained noses caused by internal bleeding. Infected rabbits may also develop a fever, be hesitant to eat, or show respiratory or nervous signs (USDA-APHIS 2020). Survival time after the onset of symptoms averages 2 days (30 – 70 hours; Hall et al. 2021). Mortality rates among European rabbit and hare species and domestic rabbits can reach 80% (Capucci et al. 2017), however, the mortality rate among native North American lagomorphs is unknown (Crowell et al. *in press*).

In the winter of 2022, Crowell et al. documented the first known detection of RHDV2 in pygmy rabbits, in Elko County Nevada (Crowell et al. *in press*). Crowell et al. were able to retrieve the carcass because the individual was GPS-collared, and in February of 2022 the California Animal Health and Food Safety Laboratory System (CAHFS) at the University of California, Davis confirmed the rabbit was positive for RHDV2. This was confirmed again by RT-PCR on March 16, 2022 by the National Veterinary Services Laboratories – Foreign Animal Disease and Diagnostic Laboratory (Crowell et al. *in press*). A subsequent lack of trap success post-RHDV2 detection at the Elko site led Crowell, et al.m to suspect the disease may have caused the rapid decline of this population.

Crowell et al. (*in press*) cautioned that If RHDV2 is associated with high mortality rates in pygmy rabbits, the presence of this virus creates heightened risk of rapid extirpation of individuals; and thus, pygmy rabbit populations should be closely monitored across their range to assess how they respond after exposure to this highly contagious and deadly disease. Crowell et al. also cautioned that RHDV2 could spread more quickly through pygmy rabbit populations than perhaps other lagomorphs, since pygmy rabbit are non-territorial and often share burrow systems, putting them in close contact with one another (Crowell et al. *in press*, citing Sanchez 2007).

Crowell et al. pointed out that pygmy rabbits are already also subject to high rates of mortality primarily due to predation (~88% documented predation rates in some studies, citing Crawford et al. 2010). Thus, it is likely that the introduction of a major new source of mortality such as RHDV2 could lead to widespread extirpation of pygmy rabbit populations (Crowell et al. *in press*).

It is unknown the extent to which RHDV2 in pygmy rabbits is present in other states, but it is possible in places where pygmy rabbits co-occur with cottontails or jackrabbit populations in which RHDV2 has been detected. It is easier to find carcasses of infected cottontails or

jackrabbits, because when these animals are sick, they are more likely to curl up under a shrub or in a scrape and so the carcass is more readily detectable. On the other hand, when pygmy rabbits feel sick, they are more likely to retreat to a burrow, making carcass detection very difficult (personal communication, Adam Brewerton, Utah Division of Wildlife Resources, July 14 2022). Therefore, if there is a population of cottontails and/or jackrabbits where RHDV2 has been found, and this population co-occurs with pygmy rabbits, it should not be assumed that the pygmy rabbit population is free of the disease simply because no RHDV2 pygmy rabbit carcasses have been found. Thus, the extent of this threat is unknown, but not insignificant, and it can be reasonably presumed to put pygmy rabbits at risk.

Researchers are learning more about metapopulation dynamics in landscapes with extirpated sites being slowly recolonized by dispersers from adjacent habitat (personal communication Miranda Crowell, University Nevada Reno, August 25, 2022; personal communication, Janet Rachlow, University of Idaho Moscow, August 29, 2022; personal communication, Eveline Larrucea, August 31, 2022). But, the concern of some of these researchers is that in light of cumulative effects of fires, RHDV2, human-caused habitat fragmentation, the recolonization rate will be insufficient to offset local extirpations, potentially leading to widespread declines in occupancy rates across the range (personal communication, Eveline Larrucea, August 31, 2022).

C. The Inadequacy of Existing Regulatory Mechanisms

Pygmy rabbits merit consideration for listing under the Endangered Species Act because of the inadequacy of existing regulatory mechanisms. Public lands regulatory measures have not been enough to protect this species from the aforementioned habitat and population declines.

1. Federal Agencies do not adequately protect pygmy rabbit habitat on public lands

There are no specific management plans in place on Bureau or National Forest system lands that adequately protect the pygmy rabbit.

While the Bureau has a policy for management of special status species and their habitats, this classification in reality guarantees unlisted species little protection. Manual 6840 directs that Bureau shall carry out management activities consistent with the principles of multiple-use for the conservation of proposed, candidate, Bureau sensitive, and State species of special concern and their habitat. It also directs that the Bureau shall ensure that any activities authorized, funded or carried out do not contribute to the need to list any species. However, when it comes to declining species across broad ranges, as is the case with the pygmy rabbit, these efforts on Bureau lands often do not add up to effective conservation.

In particular, BLM Land Use Plans (LUPs) that are supposed to serve as a current inventory of lands and provide objectives and guidance for activities like livestock grazing are woefully outdated throughout a significant portion of the lands inhabited by the pygmy rabbit. These LUPs contain few if any ORV or road building prohibitions, have outdated and scientifically indefensible livestock grazing standards, and have set otherwise the management paradigm in which the habitat and population losses enumerated above have occurred in recent decades.

In the same year that pygmy rabbits were determined to be “Not Warranted” for ESA protections, the Greater sage grouse was given a “Warranted” status. This prompted the development of LUP amendments to 98 Forest Service and Bureau plans (first finalized in 2015) that were intended to better protect sage grouse habitat, and, by extension, afford some protection for other sagebrush obligate species. The development of these amendments led to the 2015 determination that Greater sage grouse were “Not Warranted” for ESA protections after all, based on the projected adequacy of the regulatory mechanisms of the plan amendments.

Unfortunately, that projected protection has not manifested and the amendments have not stemmed the decline of sagebrush habitats. In its 5-year rangewide monitoring report on the implementation of the GRSG plans, the Bureau acknowledges that, anthropogenic disturbance increased between 2015 and 2020 in the most important sage grouse habitats, and that some of the “biologically significant units” for sage grouse exceeded 10 percent loss of sagebrush between 2012 and 2018 (Herrent et al. 2021) Invasive plants have increased from being present on a little over 50% of Greater sage-grouse habitat on Bureau lands in 2013, to nearly 70% of habitat in 2018; and the area of the sagebrush sea where invasive plants are abundant (>25% of vegetative cover) has also increased, from about 10% in 2013 to nearly 30% on Bureau lands in 2018 (Herren et al. 2021). And, since 2015, in 16 cases habitat triggers established in the plan amendments were tripped, indicating that habitat losses have exceeded thresholds set in the respective land use plan (Herren et al. 2021).

Part of the problem with the 2015 plans is that they haven’t been implemented effectively. The change in presidential administrations led to general weakening of the plan amendments through Instruction Memoranda and ultimately, in 2018, new plan amendments. The 2018 amendments were enjoined by the courts, but the application of the 2015 amendments has been inconsistent. New revisions have been proposed but have not yet reached draft stage, and in the meantime, sage grouse habitat has been lost and populations continue to plummet, a problematic indicator for the 36 percent of pygmy rabbits that co-occurs with sage grouse priority areas (Doherty et al 2022).

The 2015 amendments were supposed to set new habitat objectives for maintaining suitable sage grouse habitat in uplands and riparian habitat. While the federal Rangeland Health (RLH) Standards are somewhat modified and specialized to each state, they are all supposed to ensure that grazing management on Bureau-managed allotments does not move a special status species closer to ESA listing. 43 CFR 4180. Yet, no state rangeland health standards have specific metrics addressing pygmy rabbit habitat. The Bureau continues to apply upland grazing use standards and monitoring and assessment processes that have been shown to be inadequate in terms of ensuring viability of sagebrush-bunchgrass ecosystem health (Anderson 1991, Catlin et al. 2011). Despite scientific consensus of the harm caused by 50% utilization levels (Holechek et al. 2004), current LUPs and associated Allotment Management Plans

continue to authorize 50% utilization levels, or even higher in many of the Bureau Field Offices throughout the Intermountain West.

Even though it is clear that the current rangeland health standards and methods are not rigorous enough, for now they are "the best we have" for a Bureau-wide assessment of current grazing management on Bureau lands. While above we point out the alarming percentage (29%) of Bureau lands within the range of the pygmy rabbit that are currently not in compliance with the RLH Standards, what is more alarming is the percentage (18%) and acres (31 million) of Bureau allotments within the range of the pygmy rabbit that have not been assessed for Rangeland Health at all. Thus, even if rangeland health standards were a useful measure of pygmy rabbit habitat quality, the "regulatory mechanism" of this metric is not implemented frequently enough to be an adequate for ensuring habitat integrity.

While some Forest Plans for National Forests that overlap the range of pygmy rabbit mention the species, by and large there are not significant management or habitat protections afforded the species on these Forests. Our review of the elevant forest plans rendered these findings:

- *Beaverhead-Deerlodge*: The Forest Plan DEIS states, "it is not reasonable to expect Forest Service management to play a vital role in long-term conservation of this species in southwest Montana. The long-term sustainability of the pygmy rabbit in southwest Montana is directly linked to the maintenance of sagebrush habitat on State, BLM, and private ownerships which encompass the bulk of the known distribution of the species. Where pygmy rabbit habitat does exist on the Forest, little management activity is expected to occur. For those activities that do occur (i.e., grazing) the plan includes provisions that will maintain the quality of existing pygmy rabbit habitat needs; namely dense sagebrush canopy cover." Additionally, in the Forest-wide Direction in the Forest Plan, it contains a section on wildlife habitat Objectives. The subsection on sage grouse mentions pygmy rabbit: "Maintain or improve sagebrush height, and canopy and grass-forb canopy of sagebrush habitat, emphasizing habitat within 18 kilometers of documented active or inactive sage grouse leks and the area mapped as potential pygmy rabbit habitat." However, there is no mention of pygmy rabbit in the Forest Standards section, so the aspirational talk in the wildlife habitat Objectives is largely meaningless.
- *Caribou-Targhee*: Even though the pygmy rabbit is considered to be a Species-At-Risk on this Forest, the FEIS for the Forest Plan states, "It is not feasible to consider all Species-at-Risk in detail in the planning process… Three species-at-risk (the northern leopard frog, pygmy rabbit, and marten) appeared to need more specific analysis based on habitat outcomes from ICB 2000."
- *Ashley*: This Forest is currently revising its Forest Plan. Even though it is vague direction, the DEIS for the new Plan does state, "under all action alternatives, vegetation management activities should…maintain pygmy rabbit habitat (FW-GL-WL 07)."

The following Forest Plans (and their associated EIS's) within the potential range of pygmy rabbit failed to mention pygmy rabbit at all (in terms of management direction or habitat conservation guidance or objectives):

- Salmon-Challis
- Sawtooth
- Boise
- Malheur
- Fremont
- Ochoco
- Deschutes
- Shoshone
- Wasatch-Cache-Uinta
- Humboldt-Toiyabe
- Dixie
- Fishlake

2. *State Agencies Fail to Protect Special Status Species Habitats*

Recent pygmy rabbit declines have not been stemmed by designation as State Sensitive Species or as a "Species of Greatest Conservation Need" (or however they are defined) in the State Wildlife Action Plans. This is largely because these plans typically do not have any regulatory teeth that would override decisions on whether to proceed on, for example, certain developments or projects on Bureau lands. For example, the Nevada Bureau approved the Thacker Pass Lithium Mine Plan of Operations without imposing any protections for pygmy rabbits despite occupied pygmy rabbit habitat with active rabbit sign in the Project area,[26] and despite its status as a "priority species" in the Nevada Wildlife Action Plan. [27]

Similarly, state land designations do not offer the robust regulatory protections pygmy rabbits need. For example, as pointed out in the original 2003 petition, State Endowment Lands in Idaho composed of sagebrush are classified as "rangeland", and are generally used for livestock grazing, and maximization of financial returns to the state endowment fund. There is often little, if any, environmental analysis and no public involvement in the management of the Idaho State Endowment Lands.

In the Status review section above by State, we review the State status of each species, whether a State Conservation Plan exists for each species, and level of monitoring afforded for

[26] Thacker Pass Lithium Mine Project Final Environmental Impact Statement at 4-41 (available at https://eplanning.blm.gov/public_projects/1503166/200352542/20030633/250036832/Thacker%20Pass_FEIS_Chapters1-6_508.pdf)

[27] Wildlife Action Plan Team. 2012. Nevada Wildlife Action Plan. Nevada Department of Wildlife, Reno. Available online: https://www.ndow.org/wp-content/uploads/2021/10/SWAP-2012.pdf

the species since the Service's Not Warranted decision in 2010. As that discussion reveals, some states are not even monitoring the status of pygmy rabbits, let alone undertaking any conservation efforts to protect the species.

D. Other Natural or Manmade Factors Affecting its Continued Existence

Climate change imperils the pygmy rabbit because it will limit the extent of the species' sagebrush habitat. Climate change is a currently recognized threat to the sagebrush sea (Schlaepfer et al. 2012, Remington et al. 2021) and some of its iconic sagebrush obligate species such as the Greater sage-grouse (Connelly et al. 2011, Blomberg et al. 2012). Nevada Department of Wildlife recognized that pygmy rabbit may be more vulnerable to climate change because of its dependence on a specific habitat type (i.e., sagebrush). (NDOW 2012, see footnote 27)

Climate change is already impacting pygmy rabbit habitats. For example, by 2015, temperatures in the Wyoming Basin Ecoregion, a significant portion of the range of the species, had warmed by almost 1.1 ºCelsius (2ºFahrenheit) over the previous 30 years, which is statistically significant (Carr and Melcher 2017). Based on the climate models evaluated for the Wyoming Basins Rapid Ecological Assessment, as of 2015 the Wyoming Basin is projected to warm by about 1.4 ºC (2.5 ºF), with a modeled range of 0.8−1.9 ºC (1.5−3.5 ºF) by 2030. The projected increase in temperature was higher for the period ending in 2060, with an average increase of about 2.7 ºC (4.9 ºF) and a range from 1.5−2.7 ºC (2.7−4.9 ºF) (Carr and Melcher 2017).

These changes will impact the distribution of sagebrush on the landscape, which is driven by soil-water availability as influenced by the timing and amount of precipitation as well as seasonal temperatures which affect evaporation and transpiration processes (Haak 2021). Homer et al. (2015) found a decrease in sagebrush and herbaceous cover and litter and an increase in bare ground associated with decreased precipitation in southwestern Wyoming.

Most climate change simulations predict sagebrush steppe will contract as mean temperatures increase and the frost line shifts northward (Blomberg et al. 2012, Schlaepfer et al. 2012, BLM 2015, Balzotti et al. 2016). In the worst-case scenario, sagebrush species are simulated to contract to just 20 percent of current distribution (Neilson et al. 2005, Wisdom et al. 2005). Once that happens, the largest areas of sagebrush that will remain will be in southern Wyoming and in the gap between the northern and central Rocky Mountains, followed by areas along the northern edge of the Snake River Plateau and small patches in Washington, Oregon and Nevada (Miller et al. 2011). Modeling of the impacts of climate change under different land management scenarios in southeastern Oregon indicates that without active management, native sagebrush shrub-steppe will decline to approximately one-third its initial extent (Creutzburg et al. 2015). None of these predictions bode well for pygmy rabbits, which are obligate species of this ecosystem.

Future climate models also predict that climatic changes in the Northern Great Basin will result in increased cheatgrass cover, particularly in susceptible areas (Boyte et al. 2016). As discussed

above, climate change, especially with increasing temperatures, will only compound the current problem of the out-of-whack cheatgrass and fire cycle problem in the sagebrush sea along with other anthropogenic impacts that stress and alter natural processes (Chambers et al. 2017, Haak 2021), as increasing temperatures and prolonged drought conditions may increase the frequency, intensity and spread of fire regimes (Palmquist et al. 2016).

There are many indications that human-caused climate change could have significant impacts on pygmy rabbit populations. For example, Crowell (*in prep*) posited that, "As the climate warms and weather patterns become more variable over time, the impact of shorter-term weather conditions on [pygmy rabbit] population dynamics may become more dramatic." Milling et al. (2018) sought to quantify the energetic consequences to pygmy rabbits of thermoregulating in a burrow during summer and winter. They found that pygmy rabbits displayed seasonal acclimation to cold temperatures, expending more energy on thermoregulation in the summer than winter. Based on those findings, the authors posited that climate and land-use change may increase thermoregulatory costs associated with burrow use and future research should explore the impacts of these changes (Milling et al. 2018).

As climate change potentially alters perennial shrub cover or soil composition over large scales, this could affect population densities of small mammals. Or, extreme temperatures and decreasing precipitation regimes may cause an increase in energy expenditure of small mammals due to thermal stress on a species, or may decrease availability of water and the availability and abundance of food resources that may ultimately lead to decreases in survival and reproduction and thus, population sizes (Cole 2017).

Similarly, both long-term and seasonal temperatures and precipitation may influence feeding strategies or may impact the palatability and nutritional content of forage for herbivores. For example, in captive feeding trials whitethroat woodrats (*Neotoma albigula*) and desert woodrats (*Neotoma lepida*) voluntarily ate less of a toxic plant when acclimated to greater ambient temperatures (Dearing et al. 2008, Kurnath et al. 2016), likely due to a reduction in their physiological tolerance of the toxins (Kurnath and Dearing 2013). Additionally, toxins in sagebrush vary seasonally (Olsoy et al. 2020), likely due to extreme temperatures that are characteristic of these ecosystems.

Temperature may also have an effect on reproduction, as seen in pocket mice (*Perognathus* spp.) where below average temperatures and precipitation in the spring resulted in total reproductive failure (Kenagy and Bartholomew 1985). As the climate warms and weather patterns become more variable over time, the impact of shorter-term weather conditions on population dynamics of mammals, especially small mammals like leporids, may become more dramatic. All of these findings in regards to the impacts of rising temperatures and changes in precipitation point to potentially dire impacts of climate change to pygmy rabbits and their habitat.

Under all of these criteria for ESA listing, protection for the pygmy rabbit is warranted.

VII. CRITICAL HABITAT DESIGNATION IS NECESSARY TO PROTECT PYGMY RABBITS IN THE INTERMOUNTAIN REGION AND GREAT BASIN REGION

Petitioners request the designation of critical habitat for the pygmy rabbit concurrent with this listing. The habitat of the pygmy rabbit continues to be degraded and fragmented, with further isolation of populations. In addition, the pygmy rabbit continues to be subjected to adverse human impacts and environmental conditions, including an increased incidence of fire in sagebrush habitat especially in the western part of its range, climate change and drought. Landscape-level efforts necessary to protect and restore pygmy rabbit populations and its sagebrush steppe habitat have not materialized.

There will be significant social, ecological and economic benefits to creating critical habitat for pygmy rabbits. For example, hundreds of other sagebrush-obligate species will benefit from protection of sagebrush habitats. Many of these declining species (i.e., Greater sage-grouse, Columbia sharp-tailed grouse, and others) are also species of great and growing concern to biologists and land management agencies. Conservation and restoration actions in areas of important habitat will result in long-term agency management savings and thus economic savings to US taxpayers. In addition, critical habitat designation for pygmy rabbit will also contribute to not only the U.S.'s goal of protecting 30% of wildlife habitat by 2030 (the America the Beautiful Initiative), but also international objectives, as witnessed by the same "30 by 30" goal being adopted recently at the Montreal COP15 biodiversity summit. Moreover, designating connected pygmy rabbit critical habitat across the landscape would be in accordance with the new Bureau policy to ensure that habitats for native fish, wildlife, and plant populations are sufficiently interconnected across the landscape (BLM - IM 2023-005, November 2022).

VIII. CONCLUSION

This petition demonstrates that the pygmy rabbit is currently threatened or endangered in a significant portion of its range. This petition includes evidence of a 69% decline in occupancy of pygmy rabbit populations in Wyoming; alarmingly low occupancy rates (between 7% and 13%) of pygmy rabbits everywhere in Utah outside of the Northern Region; occupancy rates in Idaho and Nevada in the low twenty percents, the latter of which has some of the highest survey rates of any state; very limited survey data in Oregon but what little there is indicating occupancy rates of only 28.5%; basically nothing at all known about Montana occupancy rates; California reporting a recent 33% decrease in its only pygmy rabbit population (which is likely the most closely monitored population outside of Washington State's endangered population); and finally Colorado, which has no idea whether its only population of the rabbit still exists.

In addition, the pygmy rabbit's sagebrush steppe habitats have suffered significant declines, especially in recent decades with only about 14% of the sagebrush biome considered ecologically intact. Stochastic events and continued disturbance will further diminish and fragment the pygmy rabbit's habitat and limit post-disturbance "rescue" from adjacent

populations. Added to this is the recent onset of Rabbit Hemorrhagic Disease Virus Serotype 2 (RHDV2) which appears to further stress, diminish, and isolate pygmy rabbit populations. The pygmy rabbit must be listed under the Endangered Species Act in light of these compounded threats, and we respectfully request prompt consideration of this petition.

REFERENCES

(Digital copies provided on thumb drive with March 6, 2022 hard copy)

Allred, B.W., B.T. Bestelmeyer, C.S. Boyd, C. Brown, K.W. Davies, M.C. Duniway, L.M. Ellsworth, T.A. Erickson, S.D. Fuhlendorf, T.V. Griffiths, V. Jansen, M.O. Jones, J. Karl, A. Knight, J.D. Maestas, J.J. Maynard, S.E. McCord, D.E. Naugle, H.D. Starns, D. Twidwell and D.R. Uden. 2021. Improving Landsat predictions of rangeland fractional cover with multitask learning and uncertainty. Methods in ecology and evolution. http://dx.doi.org/10.1111/2041-210x.13564

Anderson. L. D. 1991. Bluebunch wheatgrass defoliation effects and recovery. USDI. BLM. Technical Bulletin. Salmon, ID.

Anthony, H. E. 1913. Mammals of northern Malheur County, Oregon. Bulletin American Museum of Natural History. 32: 1-27.

Aster Canyon Consulting, Inc. 2013. 2013 Jonah Infill Drilling Project Area Wildlife Monitoring Final Report. Jonah Infill Drilling Project Area, Sublette County, Wyoming, USA.

Aster Canyon Consulting, Inc. 2016. 2016 Jonah Infill Drilling Project Area Wildlife Monitoring Final Report. Jonah Infill Drilling Project Area, Sublette County, Wyoming, USA.

Aster Canyon Consulting, Inc. 2017. 2017 Jonah Infill Drilling Project Area Wildlife Monitoring Final Report. Jonah Infill Drilling Project Area, Sublette County, Wyoming, USA.

Aster Canyon Consulting, Inc. 2018. 2018 Jonah Infill Drilling Project Area Wildlife Monitoring Final Report. Jonah Infill Drilling Project Area, Sublette County, Wyoming, USA.

Aster Canyon Consulting, Inc. 2019. 2019 Jonah Infill Drilling Project Area Wildlife Monitoring Final Report. Jonah Infill Drilling Project Area, Sublette County, Wyoming, USA.

Aster Canyon Consulting, Inc. 2020. 2020 Jonah Infill Drilling Project Area Wildlife Monitoring Final Report. Jonah Infill Drilling Project Area, Sublette County, Wyoming, USA.

Aster Canyon Consulting, Inc. 2021. 2021 Jonah Infill Drilling Project Area Wildlife Monitoring Final Report. Jonah Infill Drilling Project Area, Sublette County, Wyoming, USA.

Bailey, V. 1936. The Mammals and Life Zones of Oregon. North American Fauna. No. 55. 1-416.

Baker, W. L. 2006. Fire and restoration of sagebrush ecosystems. Wildl. Society Bull. 34(1): 177-185.

Balzotti, C.S., S.G. Kitchen and C. McCarthy. 2016. Beyond the single species climate envelope — A multifaceted approach to mapping climate change vulnerability. Ecosphere 7(9): article e01444, p. 23.

Beck, J.L., J.W. Connelly and C.L. Wambolt. 2012. Consequences of Treating Wyoming Big Sagebrush to Enhance Wildlife Habitats. Rangeland Ecology & Management 65:444-455.

Blomberg, E. J., J. S. Sedinger, M. T. Atamian, D. V. Nonne. 2012. Characteristics of climate and landscape disturbance influence the dynamics of greater sage-grouse populations. Ecosphere 3(6): 1-20.

Borell, A. E. and R. Ellis. 1934. Mammals of the Ruby Mountains region of northeastern Nevada. Journal of Mammalogy 15: 12-44.

Bosworth, W. 2013. Pygmy Rabbit DNA Survey Marker: Implementation of surveys using molecular identification of fecal pellets. Idaho Department of Fish and Game Final Report Submitted to Idaho State Office, Bureau of Land Management Contract # L08AC14334, Amendment 1. IDF&G, Boise, ID.

Boyd, C.S., D.D. Johnson, J.D. Kerby, T.J. Svejcar and K.W. Davies. 2014. Of grouse and golden eggs—Can ecosystems be managed within a species-based regulatory framework? Rangeland Ecology and Management 67(4): 358–368. Available at https://doi.org/ 10.2111/ REM- D- 13-00096.1.

Boyte, S. P., B. K. Wylie, D. J. Major. 2016. Cheatgrass percent cover change—Comparing recent estimates to climate change–driven predictions in the northern Great Basin: Rangeland Ecology and Management 69(4): 265–279.

Brewerton, A. 2014. Statewide pygmy rabbit inventory and monitoring. Endangered Species Mitigation Fund Annual Report for 2014. Utah Division of Wildlife Resources. Salt Lake City, UT.

Bureau of Land Management (BLM). 2008. Record of decision, Pinedale Anticline Project Area, supplemental environmental impact statement. Available at: http://www.blm.gov/wy/st/en/info/NEPA/documents/pfo/anticline/seis.html

Bureau of Land Management (BLM). 2016a. Big Sheep Creek Watershed Environmental Assessment. Environmental Assessment MT- DOI-BLM-MT-B050-2016-0009-EA. Dillon, MT.

Bureau of Land Management (BLM). 2016b. Sage Creek Watershed Environmental Assessment. Environmental Assessment DOI-BLM-MT-B050-2016-0008-EA. Dillon, MT.

Bureau of Land Management (BLM). 2021. Medicine Lodge Watershed Assessment Report. BLM Dillon Field Office, Dillon, MT. Report available at: https://eplanning.blm.gov/eplanning-ui/project/2017357/570

Bureau of Land Management (BLM). 2022. Grasshopper Watershed Assessment Report. BLM Dillon Field Office, Dillon, MT. Report available at: https://eplanning.blm.gov/eplanning-ui/project/2017345/570

Byer, N.W., T.E. Dilts . E.S. Larrucea . M.M. Crowell . K.T. Shoemaker . P.J. Weisberg and M.D. Matocq. 2021b. Holocene-era landscape conditions affect genetic connectivity in a sagebrush obligate species, the pygmy rabbit (*Brachylagus idahoensis*). Landscape Ecology: August 2021 (online). Available at: https://doi.org/10.1007/s10980-021-01328-1(0123456789().,-volV)(01234567.

Byer, N.W., M.L. Holding, M.M. Crowell, T.W. Pierson, T.E. Dilts. E.S. Larrucea. K.T. Shoemaker. and M.D. Matocq. 2021a. Adaptive divergence despite low effective population size in a peripherally isolated population of the pygmy rabbit, *Brachylagus idahoensis*. Molecular Ecology 2021:1–16.

Camp, M.J, J.L. Rachlow , L.A. Shipley, T. R. Johnson and K.D. Bockting. 2014. Grazing in sagebrush rangelands in western North America: implications for habitat quality for a sagebrush specialist, the pygmy rabbit. The Rangeland Journal: http://dx.doi.org/10.1071/RJ13065.

Camp, M.J., J.L. Rachlow, B.A. Woods, T.R Johnson and L.A. Shipley. 2012. When to run and when to hide—The influence of concealment, visibility, and proximity to refugia on perceptions of risk: Ethology 118(10): 1010–1017.

Camp, M.J., L.A. Shipley, T.R. Johnson, J.S. Forbey, J.L. Rachlow, and M.M. Crowell. 2015. Modeling trade-offs between plant fiber and toxins: a framework for quantifying risks perceived by foraging herbivores. Ecology 96: 3292-3302.

Cano-Sánchez, E., F. Rodríguez-Gómez and L.A. Ruedas 2022. Using ultraconserved elements to unravel lagomorph phylogenetic relationships. J Mammal Evol 29: 395–411. Available at: https://doi.org/10.1007/s10914-021-09595-0

Capucci, L., P. Cavadini, M. Schiavitto, G. Lombardi and A. Lavazza. 2017. Increased pathogenicity in rabbit haemorrhagic disease virus type 2 (RHDV2). Vet Rec 180:426-426.

Carlisle, J.D., D.A. Keinath, S.E. Albeke and A.D. Chalfoun. 2018. Identifying holes in the greater sage-grouse conservation umbrella. Journal of Wildlife Management 82(5): 948-957.

Carr, N.B. and C.P Melcher, eds. 2017. Wyoming Basin Rapid Ecoregional Assessment: (ver. 1.1, April 2017) U.S. Geological Survey Open-File Report 2015–1155, 896 p.

Catlin, J.C., Carter, J. and A.L. Jones. 2011. Range Management in the Face of Climate Change. In: (Monaco, T.A. et al. eds.) 2011 Proceedings - Threats to shrubland ecosystem integrity: 2010 May 18-20, Logan, Utah. Natural Resources and Environment Issues Volume XVII.

Chambers, J.C., J.D. Maestas, D.A. Pyke, C.S. Boyd, M. Pellant and A. Wuenschel. 2017. Using resilience and resistance concepts to manage persistent threats to sagebrush ecosystems and greater sage-grouse: Rangeland Ecology & Management, v. 70, no. 2, p. 149–164.

Cole, E. 2017. Understanding the complex relationships between climate, vegetation, and foraging behavior of a climate-sensitive alpine mammal in order to explain patterns of persistence. MSc Thesis. University of San Francisco, CA.

Connelly, J. W., S. T. Knick, C. E. Braun, W. L. Baker, E. A. Beever, T. J. Christiansen, K. E. Doherty, E. O. Garton, C. A. Hagen, S. E. Hanser, D. H. Johnson, M. Leu, R. F. Miller, D. E. Naugle, S. J. Oyler-McCance, D. A. Pyke, K. P. Reese, M. A. Schroeder, S. J. Stiver, B. L. Walker, M. J. Wisdom. 2011. Conservation of Greater Sage-grouse: a synthesis of current trends and future management. Pages 549-563 *in* S. T. Knick and J. W. Connelly (eds). GREATER SAGE-GROUSE: ECOLOGY AND CONSERVATION OF A LANDSCAPE SPECIES AND ITS HABITATS. Studies in Avian Biol. Series, vol. 38. Cooper Ornithological Society. Univ. Calif. Press. Berkeley, CA.

Crawford, J.A., R.G. Anthony, J.T. Forbes and G.A. Lorton. 2010. Survival and causes of mortality for pygmy rabbits (*Brachylagus idahoensis*) in Oregon and Nevada. J Mamm 91:838-847.

Crowell, M.M, N. LaHue, E. Heath, K. Shoemaker and M. Matocq. In press. The first confirmed case of RHDV2 in the pygmy rabbit (*Brachylagus idahoensis*). Journal of Wildlife Diseases

Crowell, M.M, M.D. Matocq, and K.T. Shoemaker. In prep. Estimating population densities of a sagebrush and burrowing obligate species across the Great Basin.

Crowell, M.M., L.A. Shipley, M.J. Camp, J.L. Rachlow, J.S. Forbey, and T.R. Johnson. 2016. Selection of food patches by sympatric herbivores in response to concealment and distance from a refuge. Ecology and Evolution 6: 2865-2876.

Crowell, M.M., L.A. Shipley, J.S. Forbey, J.L. Rachlow, and R.G. Kelsey. 2018. Dietary partitioning of toxic leaves and fibrous stems differs between sympatric specialist and generalist mammalian herbivores. Journal of Mammalogy 99: 565-577.

Crowell, M.M., K.T. Shoemaker, and M.D. Matocq. 2020. Ideal conditions for increased trapping success of pygmy rabbits (*Brachylagus idahoensis*) across the Great Basin. Journal of Mammalogy 101: 1736-1749.

Creutzburg, M. K., E. B. Henderson and D. R. Conklin. 2015. Climate change and land management impact rangeland condition and sage-grouse habitat in southeastern Oregon. Environmental Science 2(2): 203–236.

Davies, K.W., C.S. Boyd, J.L. Beck, J.D. Bates, T.J. Svejcar and M.A. Gregg. 2011. Saving the sagebrush sea—An ecosystem conservation plan for big sagebrush plant communities. Biological Conservation 144(11): 2573–2584. Available at https://doi.org/ 10.1016/ j.biocon.2011.07.016.

Davis, W. B. 1939. Recent mammals of Idaho. Caxton Printers. Ltd., Caldwell, ID. 400 pps.

Dearing, M.D., J.S. Forbey, J.D. McLister, and L. Santos. 2008. Ambient temperature influences diet selection and physiology of an herbivorous mammal, *Neotoma albigula.* Physiological and Biochemical Zoology 81: 891-897.

DeMay, S.M., P.A. Becker, L.P. Waits, T.R. Johnson, and J.L. Rachlow. 2016. Consequences for conservation: population density and genetic effects on reproduction of an endangered lagomorph. Ecological Applications 26: 784-795.

Dilts T.E., K.A. Zeller, S.A. Cushman, E.S. Larrucea, M.M. Crowell, N.W. Byer, K.T. Shoemaker and M.D. Matocq. *In review*. Pygmy rabbit habitat network reveals threats and opportunities for management and conservation.

Dobler, F. C., and K. R. Dixon. 1990. The pygmy rabbit Brachylagus idahoensis. Pp. 111-115, in Rabbits, hares and pikas status survey and conservation action plan (J. A. Chapman and J. E. C. Flux, eds.). International Union for the Conservation of Nature, Gland, Switzerland, 168 pp.

Doherty, K., D.M Theobald, J.B. , Bradford, L.A. Wiechman, G. Bedrosian, C.S. Boyd, M. Cahill, P.S. Coates, M.K. Creutzburg, M.R. Crist, S.P Finn, A.V. Kumar, C.E. Littlefield, J.D. Maestas, K.L Prentice, B.G. Prochazka, T.E. Remington, W.D., Sparklin, J.C. Tull, Z. Wurtzebach and K.A. Zeller. 2022. A sagebrush conservation design to proactively restore America's sagebrush biome: U.S. Geological Survey Open-File Report 2022–1081. 38 pp. Available online at: https://doi.org/ 10.3133/ ofr20221081.

Edgel, R. J., R. T. Larsen, J. C. Whiting, and B. R. McMillan. 2018. Space use, movements, and survival of pygmy rabbits in response to construction of a large pipeline. Wildlife Society Bulletin 42:488-497.

Estes-Zumpf, W.A., J.L. Rachlow, L.P. Waits and K.I. Warheit. 2010. Dispersal, gene flow, and population genetic structure in the pygmy rabbit (*Brachylagus idahoensis*). Journal of Mammalogy 91 :208–219. Available at: https://doi.org/10.1644/09-MAMM-A-032R.1

Elias, B.A., L.A. Shipley, R.D. Sayler, and R.S. Lamson. 2006. Mating and parental care in captive pygmy rabbits. Journal of Mammalogy 87: 921-928.

Estes-Zumpf, W.A, S.E. Zumpf, J.L. Rachlow, J.R. Adams and L.P. Waits. 2014. Genetic evidence confirms the presence of pygmy rabbits in Colorado. Journal of Fish and Wildlife Management 5: 118-123.

Falcón, W., C.S. Goldberg, L.P. Waits, W.A. Estes-Zumpf, and J.L. Rachlow. 2011. First record of multiple paternity in the pygmy rabbit (*Brachylagus idahoensis*): evidence from analysis of 16 microsatellite loci. Western North American Naturalist 71: 271-275.

Germaine, S.S., T. Assal, A. Freeman and S.K. Carter. 2020. Distance effects of gas field infrastructure on pygmy rabbits in southwestern Wyoming. Ecosphere 11(8) : https://doi.org/10.1002/ecs2.3230

Germaine, S.S., S.K Carter, D.A Ignizio and Freeman. 2017. Relationship between gas field development and the presence and abundance of pygmy rabbits in southwestern Wyoming: Ecosphere, v. 8, no. 5, article e01817, 19 p.

Germino, M.J.,J.C. Chamber and C.S. Brown, eds. 2016. Exotic brome-grasses in arid and semiarid ecosystems of the Western US—Causes, consequences, and management implications. Springer International Publishing, Switzerland. 475 p. Available at https://doi.org/ 10.1007/ 978- 3- 319- 24930- 8.

Green, A.W., C.L. Aldridge and M.S. O'Donnell. 2017. Investigating impacts of oil and gas development on Greater Sage-grouse. Journal of Wildlife Management 81(1):1-12.

Green, J. S. and J. T. Flinders. 1980. *Brachylagus idahoensis*. *Mammalian species*. 125:1-4.

Green, J. S. and J. T. Flinders. 1981. Alarm call of the pygmy rabbit. Great Basin Naturalist. 41(1): 158-160.

Grinnell, J., J. Dixon and J. M. Linsdale. 1930. Vertebrate history of a section of northern California through the Lassen Peak Region. University of California Publications in Zoology 35: 1-594. https://babel.hathitrust.org/cgi/pt?id=uc1.b3104327&view=1up&seq=7

Haak, A.L. 2021. A Range-wide Assessment of Potential Habitat for Greater Sage-Grouse. Special publication by Conservation Geography, Boise ID.

Hall, E.R. 1951. A synopsis of the North American Lagomorpha. U Kans Publ Mus Nat Hist 5:119–202.

Hall, E.R. 1981. The Mammals of North America. Vol. 1. John Wiley & Sons. New York.

Hall, R.N, T. King T, T. O'Connor, A.J. Read, J. Arrow, K, Trought, J. Duckworth. M. Piper and T. Strive.. 2021. Age and infectious dose significantly affect disease progression after RHDV2 infection in naïve domestic rabbits. Viruses13:1184. https://doi.org/10.3390/v13061184

Hanser, S.E. and L.A. Wiechman, eds. 2020. U.S. Geological Survey sagebrush ecosystem research annual report for 2020: U.S. Geological Survey Circular 1470, 94 p. https://doi.org/10.3133/cir1470.

Hayden-Wing Associates, LLC. 2016. Pygmy Rabbit Monitoring in the Pinedale Anticline Project Area Sublette County, Wyoming. Report Prepared for: Wyoming Game and Fish Department, Pinedale Anticline Project Office, and Bureau of Land Management Pinedale, Wyoming. Lander, WY.

Hayden-Wing Associates, LLC. 2020. Pygmy Rabbit Monitoring and Development Area Analysis in the Pinedale Anticline Project Area, Sublette County, Wyoming. Report Prepared for: Wyoming Game and Fish Department, Pinedale Anticline Project Office, and Bureau of Land Management Pinedale, Wyoming. Lander, WY.

Heady, L. T., K. I. Gabler and J. W. Laundre. 2001. Habitat selection by pygmy rabbits in southeast Idaho. BLM Technical Bulletin. No. 01-7.

Heady, L.T., and J.W. Laundré. 2005. Habitat use patterns within the home range of pygmy rabbits (*Brachylagus idahoensis*) in southeastern Idaho. Western North American Naturalist 65: 490-500.

Herren, V., E. Kachergis, A. Titolo, K. Mayne, S. Glazer, K. Lambert, B. Newman and B. Franey. 2021. Greater sage-grouse plan implementation: Rangewide monitoring report for 2015–2020. U.S. Department of the Interior, Bureau of Land Management, Denver, CO.

Hersey, K.A. 2011. Implementation of a statewide pygmy rabbit inventory and monitoring protocol. Endangered Species Mitigation Fund Annual Report for 2011. Utah Division of Wildlife Resources. Salt Lake City, UT.

Hirawaka, H. 2001. Coprophagy in leporids and other mammalian herbivores. Mammalian Review. 31(1):61-80.

Holechek, J., R. Pieper and C. Herbel. 2004. Range management: Principles and practices. 5th ed. New Jersey, USA: Upper Saddle River.

Holloran, M.J., R.C. Kaiser and W.A. Hubert. 2010. Yearling Greater Sage-grouse response to energy development in Wyoming. The Journal of Wildlife Management. 74(1): 65-72.

Homer, C., J. Dewitz, S. Jin, G. Xian, C. Costello, P. Danielson, L. Gass, M. Funk, J. Wickham, S. Stehman, R. Auch and K. Ritter. 2020. Conterminous United States land cover change patterns: 2001–2016. From the 2016 National Land Cover Database. ISPRS Journal of Photogrammetry and Remote Sensing 162: 184–199. Available at https://doi.org/ 10.1016/ j.i sprsjprs.2 020.02.019.

Jones, A.L (Editor). 2019. Do Mechanical Vegetation Treatments of Pinyon-Juniper and Sagebrush Communities Work? A Review of the Literature. Special Publication # 12, the Wild Utah Project. https://www.researchgate.net/publication/331414368.

Janson, R.G. 1946. A survey of the rabbits of Utah with reference to their classification, distribution, life histories and ecology. MS Thesis. Utah State Agricultural College, Logan, UT.

Janson, R.G. 2002. The pygmy rabbit from Utah to Montana. University of Montana. Cooperative Wildlife Research Unit. Missoula, MT.

Katzner, T.E. 1994. Winter ecology of the pygmy rabbit in Wyoming. MS. University of Wyoming. Laramie, WY. 124 pps.

Katzner, T.E. and K.L. Parker. 1997. Vegetative characteristics and size of home ranges used by pygmy rabbits (*Brachylagus idahoensis*) during winter. Journal of Mammalogy. 78:1063-1072.

Katzner, T.E., K.L. Parker and H.H. Harlow. 1997. Metabolism and thermal response in winter-acclimatized pygmy rabbits (*Brachylagus idahoensis*). Journal of Mammalogy 78(4):1053-1062.

Kenagy, G.J.., and G.A. Bartholomew. 1985. Seasonal reproductive patterns in five coexisting California desert rodent species. Ecological monographs 55: 371-397.

Knick, S.T., D.S. Dobkin, J.T Rotenberry, M.A. Schroeder, W.M. Vander Haegen and C. Van Riper. 2003. Teetering on the edge or too late? Conservation and research issues for avifauna of sagebrush habitats. Condor 2003: 611-634.

Knick, S.T., A.L. Holmes and R.F. Miller. 2005. The role of fire in structuring sagebrush habitats and bird communities. Pages 63-75 in V. A. Saab and H. D. W. Powell (eds.). Fire and Avian Ecology in North America. Studies in Avian Biology, no. 30. Cooper Ornithological Society. Boise, ID.

Kurnath, P., and M.D. Dearing. 2013. Warmer ambient temperatures depress liver function in a mammalian herbivore. Biology Letters 9: 20130562. http://doi.org/10.1098/rsbl.2013.0562

Kurnath, P., N.D. Merz, and M.D. Dearing. 2016. Ambient temperature influences tolerance to plant secondary compounds in a mammalian herbivore. Proceedings of the Royal Society B 283: 20152387. http://dx.doi.org/10.1098/rspb.2015.2387

Larrucea, E.S. and P.F Brussard. 2008a. Habitat selection and current distribution of the pygmy rabbit in Nevada and California, USA. J Mammalogy 89:691-699.

Larrucea, E.S. and P.F Brussard. 2008b. Shift in location of pygmy rabbit (*Brachylagus idahoensis*) habitat in response to changing environments. J Arid Environ 72:1636-1643.

Larrucea, E.S., and P.F. Brussard. 2009. Diel and seasonal activity patterns of pygmy rabbit (*Brachylagus idahoensis*). Journal of Mammalogy 90: 1176-1183.

Larrucea, E.S., M.L. Robinson, J.S. Rippert and M.D. Matocq. 2018. Genetically distinct populations of the pygmy rabbit *(Brachylagus idahoensis*) in the Mono Basin of California. Journal of Mammalogy 99: 408–415. Available at: https://doi.org/10.1093/jmammal/gyx187

Lee, J.E., R.T. Larsen, J.T. Flinders, and D.L. Eggett. 2010. Daily and seasonal patterns of activity at pygmy rabbit burrows in Utah. Western North American Naturalist 70: 189-197.

Leu, M. and S.E. Hanser. 2011. Influences of the human footprint on sagebrush landscape patterns. Pgs 253-271 in S.T. Knick and J.W. Connelly, eds: Greater sage-grouse ecology and conservation of a landscape species and its habitats. Studies in Avian Biology. Volume 38. University of California Press, Berkeley, California, USA.

Marshal, J.P., P.R. Krausman, and V.C. Bleich. 2005. Rainfall, temperature, and forage dynamics affect nutritional quality of desert mule deer forage. Rangeland Ecology and Management 58: 360-365.

McLean, R. and K. Adkins. 2021. Pygmy Rabbit Monitoring in Eastern Oregon 2021. Oregon Department of Fish and Wildlife internal report. Portland, OR.

McMahon, L.A., J.L. Rachlow, L.A. Shipley, J.S. Forbey and T.R. Johnson. 2017. Habitat selection differs across hierarchical behaviors: selection of patches and intensity of patch use. Ecosphere 8: e01993.

Merriam, C. H. 1891. Results of a biological reconnaissance of south-central Idaho. North American Fauna 5: 1-416.

Miller, R. F., S. T. Knick, D. A. Pyke, C. W. Meinke, S. E. Hanser, M. J. Wisdom, A. L. Hild. 2011. Characteristics of sagebrush habitats and limitations to long-term conservation. Pages 145-184 *in* S. T. Knick and J. W. Connelly (eds). GREATER SAGE-GROUSE: ECOLOGY AND CONSERVATION OF A LANDSCAPE SPECIES AND ITS HABITATS. Studies in Avian Biol. Series, vol. 38. Cooper Ornithological Society. Univ. Calif. Press. Berkeley, CA.

Milling, C.R., J.L. Rachlow, M.A. Chappell, M.J. Camp, T.R. Johnson, L.A. Shipley, D.R. Paul and J.S. Forbey. 2018. Seasonal temperature acclimatization in a semi-fossorial mammal and the role of burrows as thermal refuges: PeerJ, article 6:e4511, 22 p.

Milling, C.R., J.L. Rachlow, T.R. Johnson, J.S. Forbey, and L.A. Shipley. 2017. Seasonal variation in behavioral thermoregulation and predator avoidance in a small mammal. Behavioral Ecology 28: 1236-1247.

Montana Natural Heritage Program (MT NHP). 2022. Species Occurrence Data for Animal Species of Concern in Montana. Montana Natural Heritage Program. Helena, MT. Available at: https://mtnhp.org/Animal/pygmyrabbit

National Fish, Wildlife and Plants Climate Adaptation Partnership (NFWPCAP). 2012. National Fish, Wildlife and Plants Climate Adaptation Strategy. Association of Fish and Wildlife Agencies, Council on Environmental Quality, Great Lakes Indian Fish and Wildlife Commission, National Oceanic and Atmospheric Administration, and U.S. Fish and Wildlife Service. Washington, DC.

Neilson, R. P., J. M. Lenihan, D. Bachelet and R.J. Drapek. 2005. Climate change implications for sagebrush ecosystems. Trans. N. Amer. Wildl. & Nat. Res. Conf. 70: 145-159.

Noss, R.F. 1983. A Regional Landscape Approach to Maintain Diversity. Bioscience 33: 700 -703.

Noy-Meir, I. 1974. Desert Ecosystems: higher trophic levels. Annual Review Ecology and Systematics 5:195-214.

Orr, R. T. 1940. The rabbits of California. Occasional Papers of the California Academy of Sciences. 19:1-227.

OIE (Office International des Epizooties). 2018. Rabbit Haemorrhagic Disease. In: *OIE Terrestrial Handbook*. Office International des Epizooties, Paris, France, pp. 1389-1406.

Olsoy, P.J., J.S. Forbey, L.A. Shipley, J.L. Rachlow, B.C. Robb, J.D. Nobler and D.H. Thornton. 2020. Mapping foodscapes and sagebrush morphotypes with unmanned aerial systems for multiple herbivores. Landscape Ecology 35: 921-936.

Palmquist, K.A., D.R. Schlaepfer, J.B. Bradford and W.K. Lauenroth. 2016. Mid-latitude shrub steppe plant communities: climate change consequences for soil water resources. Ecology 97: 2342-2354.

Pierce, J.E., R.T Larsen, J.T. Flinders and J.C. Whiting. 2011. Fragmentation of sagebrush communities—Does an increase in habitat edge impact pygmy rabbits?: Animal Conservation 14 (3): 314–321.

Price, A.J., W. Estes-Zumpf, and J. Rachlow. 2010. Survival of juvenile pygmy rabbits. Journal of Wildlife Management 74: 43-47.

Rachlow, J.L., D.M. Sanchez, and W.A. Estes-Zumpf. 2005. Natal burrows and nests of free-ranging pygmy rabbits (*Brachylagus idahoensis*). Western North American Naturalist 65: 136-139.

Rachlow, J.L. and L.K. Svancara. 2006. Prioritizing habitat for surveys of an uncommon mammal: a modeling approach applied to pygmy rabbits. Journal of Mammalogy 87: 827 – 833.

Rauscher, R. L. 1997. Status and distribution of the pygmy rabbit in Montana. MFWP Report. WDFW. Bozeman, MT. 19 pps.

Reisner, M.D., P.S. Doescher and D.A. Pyke. 2015. Stress-gradient hypothesis explains susceptibility to *Bromus tectorum* invasion and community stability in North America's semi-arid *Artemisia tridentata wyomingensis* ecosystems. Journal of Vegetation Science 26(6): 1212-1224.

Reisner, M.D., J.B. Grace, D.A. Pyke and P.S. Doescher. 2013. Conditions favoring Bromus tectorum dominance of endangered sagebrush steppe ecosystems. Journal of Applied Ecology 50(4): 1039-1049.

Remington, T.E., P.A. Deibert, S.E. Hanser, D.M Davis, L.A. Robb, L.A. and J.L. Welty. 2021. Sagebrush conservation strategy—Challenges to sagebrush conservation: U.S. Geological Survey
Open-File Report 2020–1125, 327 p., https://doi.org/10.3133/ofr20201125.

Rose and K. Adkins. 2022. Pygmy Rabbit Monitoring in Eastern Oregon 2022. Oregon Department of Fish and Wildlife internal report. Portland, OR.

Rottler, C.M, C.E. Noseworthy, B. Fowers and J.L. Beck. 2015. Effects of Conversion from Sagebrush to Non-Native Grasslands on Sagebrush-Associated Species. Rangelands 37(1):1—6.

Sanchez, D.M. 2007. Pieces of the pygmy rabbit puzzle: space use, survival, and survey indicators. Ph.D. Dissertation, Natural Resources, University of Idaho, Moscow, Idaho, USA, 162 pp.

Sanchez, D.M., and J.L. Rachlow. 2008. Spatio-temporal factors shaping diurnal space use by pygmy rabbits. Journal of Wildlife Management 72: 1304-1310.

Schlaepfer, D. R., W. K. Lauenroth and J. B. Bradford. 2012. Effects of ecohydrological variable on current and future ranges, local suitability patterns, and model accuracy in big sagebrush. Ecography 35(4): 374–384.

Schroeder, M.A., C.L. Aldridge, A.D. Apa, J.R. Bohne, C.E. Braun, S.D. Bunnell, J.W. Connelly, P.A. Deibert, S.C. Gardner, M.A. Hilliard, G.D. Kobriger, S.M. McAdam, C.W. McCarthy, C.W., D.L.

Mitchell, E.V. Rickerson and S.J. Stiver. 2004. Distribution of sage-grouse in North America. The Condor 106(2): 363–376. Available at https://doi.org/ 10.1093/ condor/ 106.2.363.

Smith, I.T, J.L Rachlow, L.K. Svancara, L.A.McMahon and S.J. Knetter. 2019. Habitat specialists as conservation umbrellas: Do areas managed for greater sage-grouse also protect pygmy rabbits? Ecosphere 10: 1-23.

Thimmayya, A.C. and S.W. Buskirk. 2012. Genetic connectivity and diversity of pygmy rabbits (Brachylagus idahoensis) in southern Wyoming. Journal of Mammalogy 93: 29–37.

Thines, N.J.S., L.A. Shipley and R.D. Sayler. 2004. Effects of cattle grazing on ecology and habitat of Columbia Basin pygmy rabbits (*Brachylagus idahoensis*). Biological Conservation 119: 525–534.Available at: https://doi.org/10.1016/j.biocon.2004.01.014

Thomas, V. G. 1987. Similar winter energy strategies of grouse, hares and rabbits northern biomes. Oikos. 50: 206-212.

USDA-Animal and Plant Health Inspection Service. APHIS. 2020. Fact Sheet: Rabbit Hemorrhagic Disease. June, 2020. Available online at: https://www.aphis.usda.gov/publications/animal_health/fs-rhdv2.pdf

U.S. Fish and Wildlife Service (USFWS). 2010. Endangered and threatened wildlife and plants; Twelve-month finding on a petition to list the pygmy rabbit as endangered or threatened; Proposed rule. September 30, 2010. 75 FR 60516-60561.

Taggart P.L, R.N. Hall, T.E. Cox, J. Kovaliski, S.R. McLeod and T. Strive. 2021. Changes in virus transmission dynamics following the emergence of RHDV2 shed light on its competitive advantage over previously circulating variants. Transbound Emerg Dis 00:1-13.

Washington Department of Fish and Wildlife (WDFW). 1995. Washington State Recovery Plan for the pygmy rabbit. Wildlife Management Program. Olympia, WA.

Welch, B.L. and C. Criddle. 2003. Countering misinformation concerning big sagebrush (No. RMRS-RP-40). U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Ft. Collins, CO. Available online at: https://doi.org/10.2737/RMRS-RP-40.

Weiss, N. T. and B .J. Verts. 1984. Habitat and distribution of pygmy rabbits in Oregon. Great Basin Naturalist 22: 563-571.

Wilcove, D. 1987. From fragmentation to extinction. Natural Areas Journal. 7(1):23-29.

Wilde, D. B. 1978. A population analysis of the pygmy rabbit (*Sylvilagus idahoensis*) on the INEL site. Ph. D. Dissertation. Idaho State University. Pocatello, ID. 172 pps.

Wilde, D. B. 1981. Pygmy rabbit reproduction: possible modification by drought conditions. Pages 559-571 *In* K. Myers and C.D. MacInnes (eds.) Proceedings of the World Lagomorph Conference held n Guelph, Ontario, August 1979. 983 p.

Williamson, M.A, E. Fleishman, R.C. MacNally, J.C. Chambers, B.A. Bradley, D.S. Dobkin, D.I Board, F.A. Fogarty, N. Horning, M. Leu and M.W. Zilig. 2019. Fire, livestock grazing, topography, and precipitation affect occurrence and prevalence of cheatgrass (*Bromus tectorum*) in the central Great Basin, USA. Biological Invasions (22) 663–680.

Wilson, T.L. A Multi-scale Evaluation of Pygmy Rabbit Space Use in a Managed Landscape. 2010. All Graduate Theses and Dissertations. 706. https://digitalcommons.usu.edu/etd/706.

Wilson, T.L., F.P Howe and T.C. Edwards, Jr. 2011. Effects of sagebrush treatments on multi-scale resource selection by pygmy rabbits: Journal of Wildlife Management 75 (2): 393–398.

Wilson, T.L., A.P. Rayburn, and T.C. Edwards, Jr. 2012. Spatial ecology of refuge selection by an herbivore under risk of predation. Ecosphere 3: 6.

Wisdom, M.J., M.M. Rowland, L.H. Suring, L. Schueck, C.W. Meinke, S. T. Knick, B.C. Wales. 2005. Habitats for groups of species. Chap. 7 in part II: Regional assessment of habitats for species of conservation concern in the Great Basin. Pages 205-231 *in* M. J. Wisdom, M. M. Rowland, L. H. Suring (eds.). HABITAT THREATS IN THE SAGEBRUSH ECOSYSTEM: METHODS OF REGIONAL ASSESSMENT AND APPLICATIONS IN THE GREAT BASIN. Alliance Communications Group. Lawrence, KS.

Woods, B.A., J.L. Rachlow, S.C. Bunting, T.R, Johnson and K. Bocking. 2013. Managing high-elevation sagebrush steppe—Do conifer encroachment and prescribed fire affect habitat for pygmy rabbits?: Rangeland Ecology and Management, 66:462–471.Available at: https://doi.org/10.2111/REM-D-12-00144.1

Wyoming Game & Fish Department (WGFD). 2013. Threatened, Endangered and nongame bird and mammal investigations: Annual Completion Report. WGFD Nongame Program, Biological Services Section, Wildlife Division. Cheyenne, WY.

Wyoming Game & Fish Department (WGFD). 2019. Threatened, Endangered and nongame bird and mammal investigations: Annual Completion Report. WGFD Nongame Program, Biological Services Section, Wildlife Division. Cheyenne, WY.

Wyoming Game & Fish Department (WGFD). 2020. Wyoming Department of Fish and Game Nongame Program: Annual Completion Report. WGFD, Cheyenne, WY.

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