PETITION TO LIST THE
Wyoming Pocket Gopher (*Thomomys clusius*)
UNDER THE U.S. ENDANGERED SPECIES ACT

Wyoming pocket gopher. Photo: Wyoming Natural Diversity Database

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

Petitioner:
WildEarth Guardians
319 South 6th Street
Laramie, Wyoming 82070
307-399-7910
Address correspondence to: Erik Molvar
emolvar@wildearthguardians.org

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A FORCE FOR NATURE

INTRODUCTION

WildEarth Guardians (Guardians) respectfully requests that the Secretary of the Interior, acting through the U.S. Fish and Wildlife Service (Service) list the Wyoming pocket gopher (*Thomomys clusius*) as "endangered" under the U.S. Endangered Species Act (ESA) (16 U.S.C. §§ 1531-1544). WildEarth Guardians also requests that the Service designate critical habitat for this species.

ENDANGERED SPECIES ACT AND IMPLEMENTING REGULATIONS

The ESA, 16 U.S.C. §§ 1531 et seq., was enacted in 1973 "to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved, [and] to provide a program for the conservation of such endangered species and threatened species." 16 U.S.C. § 1531(b). The protections of the ESA only apply to species that have been listed as endangered or threatened according to the provisions of the statute. The ESA delegates authority to determine whether a species should be listed as endangered or threatened to the Secretary of Interior, who has in turn delegated authority to the Director of the U.S. Fish & Wildlife Service. As defined in the ESA, an "endangered" species is one that is "in danger of extinction throughout all or a significant portion of its range." 16 U.S.C. § 1532(6); see also 16 U.S.C. § 533(a)(1). A "threatened species" is one that "is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range." 16 U.S.C. § 1532(20). The Service must evaluate whether a species is threatened or endangered as a result of any of the five listing factors set forth in 16 U.S.C. § 1533(a)(1):

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

A taxon need only meet one of the listing criteria outlined in the ESA to qualify for federal listing. 50 C.F.R. § 424.11.

The Service is required to make these 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). "The obvious purpose of [this requirement] is to ensure that the ESA not be implemented haphazardly, on the basis of speculation or surmise." *Bennett v. Spear*, 117 S.Ct. 1154, 1168 (1997). "Reliance upon the best available scientific data, as opposed to requiring absolute scientific certainty, 'is in keeping with congressional intent' that an agency 'take preventive measures' *before* a

species is 'conclusively' headed for extinction." *Ctr. for Biological Diversity v. Lohn*, 296 F.Supp.2d 1223, 1236 (W.D.Wash.2003) (emphasis in original).

In making a listing determination, the Secretary must give consideration to species which have been "identified as in danger of extinction, or likely to become so within the foreseeable future, by any State agency or by any agency of a foreign nation that is responsible for the conservation of fish or wildlife or plants." 16 U.S.C. § 1533(b)(1)(B)(ii). *See also* 50 C.F.R. § 424.11(e) (stating that the fact that a species has been identified by any State agency as being in danger of extinction may constitute evidence that the species is endangered or threatened). Listing may be done at the initiative of the Secretary or in response to a petition. 16 U.S.C. § 1533(b)(3)(A).

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 "that amount of information that would lead a reasonable person to believe that the measure proposed in the petition may be warranted." 50 C.F.R. § 424.14(b)(1).

The regulations further specify four factors to guide the Service's consideration on whether a particular listing petition provides "substantial" information:

i. Clearly indicates the administrative measure recommended and gives the scientific and any common name of the species involved;
ii. Contains detailed narrative justification for the recommended measure; describing, based on available information, past and present numbers and distribution of the species involved and any threats faced by the species;
iii. Provides information regarding the status of the species over all or significant portion of its range; and
iv. Is accompanied by appropriate supporting documentation in the form of bibliographic references, reprints of pertinent publications, copies of reports or letters from authorities, and maps. 50 C.F.R. § 424.14(b)(2)(i)-(iv).

Both the language of the regulation itself (by setting the "reasonable person" standard for substantial information) and the relevant case law underscore the point that the ESA does not require "conclusive evidence of a high probability of species extinction" in order to support a positive 90-day finding. *Ctr. for Biological Diversity v. Morgenweck*, 351 F.Supp.2d 1137, 1140. See also *Moden. U.S. Fish & Wildlife Serv.*, 281 F.Supp.2d 1193, 1203 (D.Or. 2003) (holding that the substantial information standard is defined in "non-stringent terms"). Rather, the courts have held that the ESA contemplates a "lesser standard by which a petitioner must simply show that the substantial information in the Petition demonstrates that listing of the species may be warranted" (emphasis added).

Morgenweck, 351 F.Supp.2d at 1141 (quoting 16 U.S.C. § 1533(b)(3)(A)). See also *Ctr. for Biological Diversity v. Kempthorne*, No. C 06-04186 WHA, 2007 WL 163244, at *3 (holding that in issuing negative 90-day findings for two species of salamander, the Service "once again" erroneously applied "a more stringent standard" than that of the reasonable person).

CLASSIFICATION AND NOMENCLATURE

Common Name. *Thomomys clusius* is commonly known as the Wyoming pocket gopher.

Taxonomy. The petitioned species is *Thomomys clusius* (Table 1). The first Wyoming pocket gopher was collected in 1857 by Dr. W.A. Hammond at Bridger Pass south of present-day Rawlins, Wyoming; in 1875 Coues described this specimen and gave it the name *Thomomys clusius* (Thaeler and Hinesley 1979). Bailey (1915) subsequently reclassified this animal as the Coues pocket gopher, a subspecies of *Thomomys talpoides* (the northern pocket gopher), and attributed to this subspecies (*T. t. clusius*) a much expanded range from its presently understood habitat, stretching northward to the Montana border and southward into eastern Colorado.

Table 1. Taxonomy of *Thomomys clusius*

Kingdom	*Animalia*—animals
Phylum	*Craniata*—chordates
Subphylum	*Vertebrata*—vertebrates
Class	*Mammalia*—mammals
Order	*Rodentia*—rodents
Family	*Geomyidae*—pocket gophers
Genus	*Thomomys* (Clark, 1805)—smooth-toothed pocket gophers
Species	*Thomomys clusius* (Coues, 1875)—Wyoming pocket gopher

Thaeler and Hinesley (1979) determined that *T. clusius* was indeed a separate and distinct species with a chromosome count (2n=46) definitively different from the various subspecies of *T. talpoides* (chromosome counts of 2n= 48 for most subspecies of *T. talpoides* and 2n=56 for *T. talpoides ocius*). Unlike other species of pocket gophers (e.g., *T. talpoides*) that have a range of chromosome numbers (Thaeler 1985), *T. clusius* uniformly has a diploid number of 46 (Thaeler 1980). Pritchett (1977) documented pocket gophers in the Saratoga, Wyoming area (east of Bridger Pass) with 2n=47, and hypothesized this to be the result of interbreeding between then-subspecies *Thomomys talpoides clusius* to the west and *T. t. rostralis* farther east along the Medicine Bow Mountains. According to Keinath and Griscom (2008: 2),

> Preliminary genetic analysis suggests that *T. clusius* is a distinct taxon that is clearly differentiated from sympatric *T. talpoides* at the species level. According to Dr. Dave McDonald (personal communication), specimens identified as *T. clusius* had distinctive chromosome counts (2N = 46) and

represented a monophyletic clade based on genetic analysis (i.e., Amplified Fragment Polymorphism, or AFLP analysis).

McDonald and Parchman (2010) performed a genetic analysis on the Wyoming pocket gopher and other pocket gopher species, and found not only that the Wyoming pocket gopher was a genetically distinct species, but that it was also more closely related to the Idaho pocket gopher (*Thomomys idahoensis*), which lives farther west and is not sympatric with the Wyoming pocket gopher, than it is to the northern pocket gopher (*T. talpoides*). The interpretation of *T. clusius* as a distinct species by Thaeler and Hinesley (1979) is confirmed based on literature reviews by subsequent researchers, notably Patton (2005) and Cudworth and Grenier (2015). Pleistocene evolution of the *Thomomys* genus is discussed by Russell (1968), who also discusses fossil evidence of this genus but does not directly address *T. clusius*.

SPECIES DESCRIPTION

Physical appearance. Keinath and Beauvais (2006: 3) characterized pocket gophers as follows: "They are powerfully built mammals that are strongly adapted to fossorial living, with small ears, small eyes, fur-lined cheek pouches used to carry food, and very strong front limbs with long nails used for digging." Skin growing behind the incisors keeps soil out of the mouth during burrowing and allows the animals to use their teeth while the mouth is closed (Baker et al. 2003). The Wyoming pocket gopher reaches a total body length of 161 to 184 mm, tail length of 50 to 70 mm, hind foot length of 20 to 22 mm, ear length ranging from 5 to 6 mm, and a weight of 44 to 72 grams (Keinath and Beauvais 2006). Cudworth and Grenier (2015) have authored a Mammalian Species Account for the Wyoming pocket gopher, providing a summary of current scientific knowledge.

Field identification. The Wyoming pocket gopher is slightly smaller than the northern pocket gopher, although there is some overlap in body length (Keinath et al. 2014). It has paler pelage, with a yellowish cast, when compared with the northern pocket gopher (Beauvais and Dark-Smiley 2005). The Wyoming pocket gopher is distinguished from *T. talpoides* by a yellowish pelage, lack of periauricular patches, and whitish hair along the margins of the ears (Thaeler and Hinesley 1979). The periauricular patches are darker in *T. talpoides* (see photos in Keinath and Beauvais 2006). According to Keinath and Beauvais (2006), the Wyoming pocket gopher is somewhat similar to the sympatric northern pocket gopher in pelage, morphology, and overall appearance, and "reliable identification of this species involves chromosomal analysis (i.e., karyotyping to count chromosome number)." Keinath et al. (2008: 5) went further, stating "they can be very difficult, if not impossible, to distinguish from one another" based on physical characteristics.

More recent research determined that field identification of the Wyoming pocket gopher was possible on the basis of physical characteristics alone, in the absence of genetic testing (Keinath et al. 2014: 808):

> *T. clusius* is best distinguished from *T. idahoensis* and *T. talpoides* by a complete absence of dark hair on or around the ears, which are uniformly buff colored and have a fringe of hair that is lighter or matches the color of the dorsum (Fig. 2). In contrast, *T. talpoides* has an obvious dark auricular patch that often encircles the ear. The size of the dark auricular patch and dorsal pelage color vary greatly across individuals of *T. talpoides*, but the ear fringe is always darker than the dorsum, whereas the ear fringe of *T. clusius* is never darker than the dorsum. Even when gophers lack pelage on the ears, the color of the skin of the pinnae seems to serve as a reliable substitute. It seems that *T. idahoensis* also has a dark auricular patch, but that it does not extend dorsally, and that it has an ear fringe that is usually lighter than the auricular patch and matches the color of the dorsum.

HABITAT REQUIREMENTS

Initially, researchers believed that the Wyoming pocket gopher occupied dry and gravelly ridges (Beauvais and Dark-Smiley 2005, Keinath and Beauvais 2006). Based on early observations, Thaeler and Hinesley (1979: 486) defined the typical habitat as "well-drained soils frequently containing some gravel-sized elements" occurring "either along the crests of ridges or near the edges of stream-cut washes." Later, this understanding of habitat preference changed to encompass predominantly gentle slopes where Gardner's saltbush and winterfat are prevalent and sagebrush is absent or subdominant (Griscom et al. 2010). Habitat analysis by Keinath et al (2014) determined that Wyoming pocket gophers used flatter slopes with soils with more clay, less sand, and finer particle sizes than habitats used by northern pocket gophers.

The most recent habitat analysis indicates that *T. clusius* is a habitat specialist (Keinath et al. 2014), Compared to northern pocket gophers, Wyoming pocket gophers used flatter slopes with soils with more clay, less sand, and finer particle sizes; greater cover of Gardner's saltbush and winterfat and more bare ground; less cover of big sagebrush, rabbitbrush, leaf litter, and fewer surface rocks (*Ibid.*). The habitat model that best discriminated between Wyoming pocket gopher and northern pocket gopher habitats (with an 84% success rate) included percent cover of Gardner's saltbush (the dominant factor), sagebrush, rabbitbrush, and leaf litter (*Id.*). Keinath and Griscom (2009) characterized Wyoming pocket gopher habitat as follows:

> Despite historic habitat descriptions, ridge-top topography does not seem to uniquely characterize suitable habitat for Wyoming pocket gophers, although most sites seem to be at least moderately sloped. They can be found in many different soil types, although rarely in soils with greater than 60% clay. It appears that vegetation composition may be more important, with *T. clusius* occurring primarily in small 'islands' of low vegetation within a sagebrush matrix…. Wyoming big sagebrush is often a minor component of the vegetation where *T. clusius* are found, with cushion plants, grass, rabbit brush, and other low shrubs and forbs dominating the immediate vicinity…. Wyoming pocket gophers have

> NOT been found in flats dominated by greasewood, valley bottoms, sand dunes or areas where medium to high Wyoming big sagebrush dominates the vegetation community.

Griscom and Keinath (2010: 8) provided a more refined characterization:

> Generally speaking, *T. clusius* sites were characterized by salty, clay soils with abundant bare ground and little rock, litter, and grass cover. In many cases, Gardner's saltbush was the dominant or co-dominant shrub species and big sagebrush, if present, was subdominant.

Competitive exclusion may determine the boundaries between habitats used by various species of pocket gophers, with larger species excluding smaller species from favored habitats, and thereby relegating smaller species to more marginal habitats (Miller 1964). Because the Wyoming pocket gopher is slightly smaller than the sympatric northern pocket gopher (Keinath et al. 2014), competitive exclusion by *T. talpoides* may be driving the Wyoming pocket gopher's seeming limitation to less productive habitat types on more saline soils. According to Miller (1964: 264), "Particular species [of pocket gopher] may be limited… by unfavorable soils relative to their ranges of soil tolerance, by climactic or other factors associated with altitude or latitude, or by interspecies competition." Verts and Carraway (1999) reported that the northern pocket gopher has a broader ecological niche than other pocket gophers, and may exclude other species of pocket gophers through interference competition.

Home ranges are very small for the northern pocket gopher, on the order of 0.015 hectares (Banfield 1974); as noted above, home ranges for the Wyoming pocket gopher are slightly smaller (Keinath et al. 2014). Tunnel systems of Wyoming pocket gophers are smaller in diameter (median = 5 cm) than tunnel systems used by the slightly larger northern pocket gopher (median = 7 cm)(Keinath et al. 2014). Burrow systems consist of a network of feeding tunnels and deeper chambers used for nesting and food storage (Miller 1964). The burrow systems of pocket gophers are used as a habitat component by 40 species of mammals (Verts and Carraway 1999). This elevates the ecological significance of pocket gophers as keystone species in subterranean communities. In addition, pocket gopher burrowing activity can have strong effects on soil fertility, increasing the abundance and growth rates of plants as well as causing shifts in plant species composition (Huntly and Inouye 1988, Martinsen et al. 1990). Reichmann and Seabloom (2002: 44) characterized pocket gophers as "ecosystem engineers" and state that "the extensive excavations [of pocket gophers] and their associated impacts generate a dynamic mosaic of nutrients and soil conditions that promotes diversity and maintains disturbance-dependent components of plant communities." Davidson et al. (2008) likewise found that burrowing rodents create important lizard habitats.

GEOGRAPHIC DISTRIBUTION

Bailey (1915) described the range of the (since reclassified) subspecies, *Thomomys talpoides clusius*, as extending from Sheridan County in northern Wyoming to Colorado

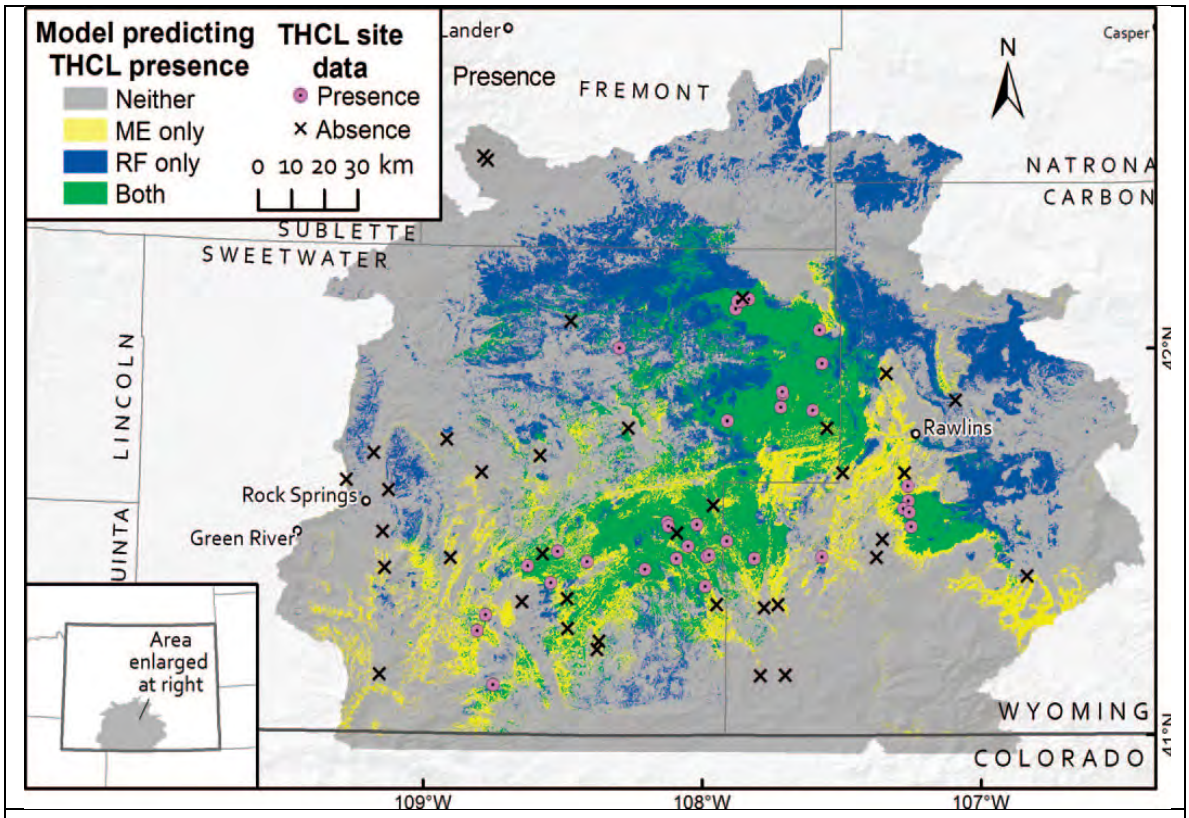

Figure 1. Overlay of distribution models developed for the Wyoming pocket gopher (abbreviated here as THCL) by Keinath et al. (2014), showing confirmed locations of trapped pocket gophers and also localities where Wyoming pocket gopher trapping was attempted but was unsuccessful.

Springs in central Colorado. The most recent information indicates that the Wyoming pocket gopher is limited in distribution to eastern Sweetwater County and western Carbon County, Wyoming (Keinath et al. 2014). Beauvais and Dark-Smiley (2005) speculated that this range may extend slightly into northern Colorado. The Green River appears to be a geographic and ecological dividing line between *T. clusius* and *T. idahoensis*, the Idaho pocket gopher (Keinath et al. 2014). Efforts to trap this species in the Pinedale Field Office of the Bureau of Land Management (BLM), farther west, produced no Wyoming pocket gophers (McGee et al. 2002). The known range of the Wyoming pocket gopher falls almost entirely within the geographic bounds of the Red Desert (*see* Keinath et al. 2014), a high desert dominated by sagebrush and greasewood encompassing two structural basins (Molvar 2010): the Great Divide Basin to the north, which is surrounded by the Continental Divide and has no outlet to the sea, and the Washakie Basin to the south, part of the Colorado River watershed.

The range of the Wyoming pocket gopher overlaps almost completely with the range of the local subspecies of the northern pocket gopher, *T. talpoides ocius*, but the two species may occur on different habitat types, with *T. t. ocius* occurring deeper, sandy soils (Thaeler and Hinesley 1979; "suspected to occupy different habitats," Keinath and

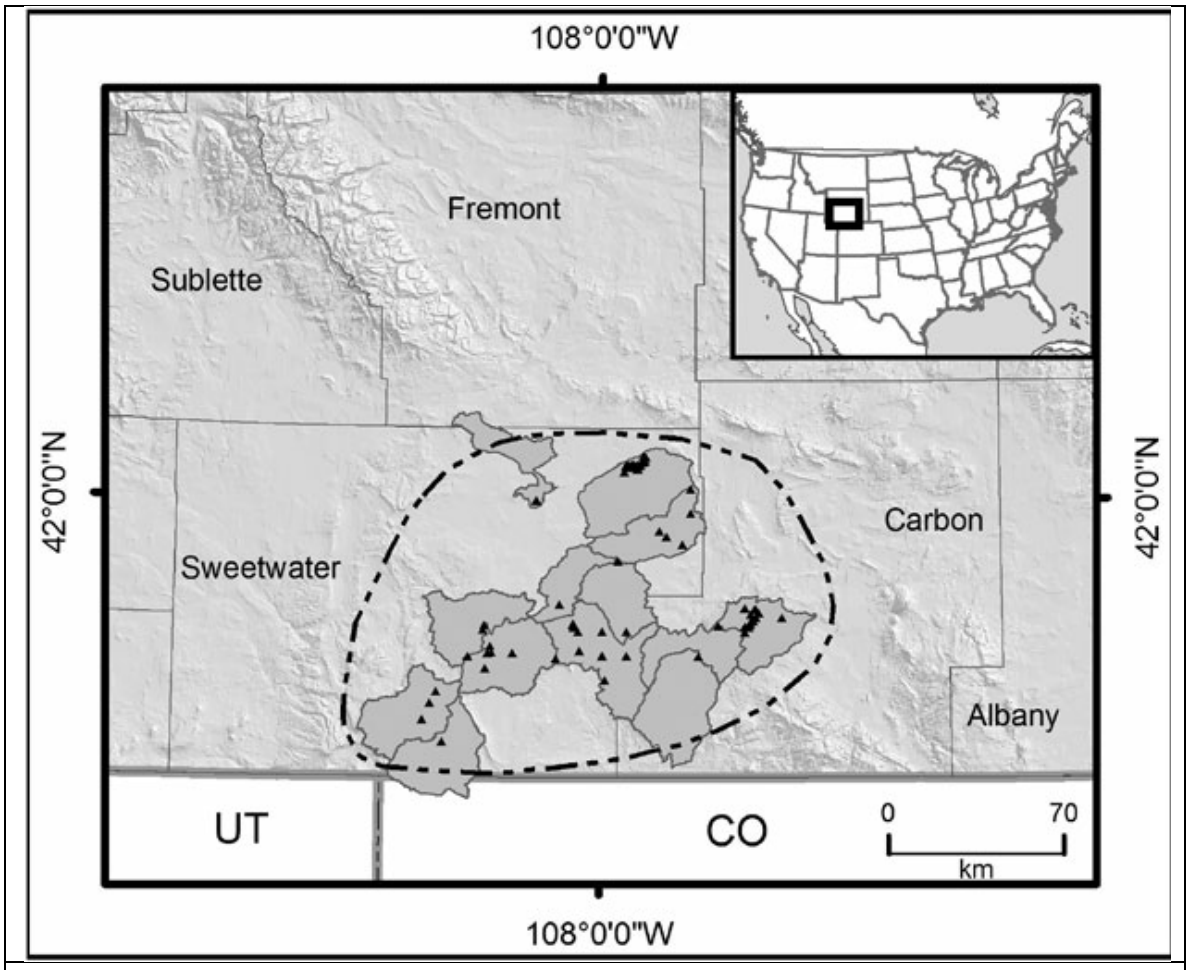

Figure 2. Geographic distribution of *T. clusius*, with known capture locations mapped against hydrologic unit watersheds based on WYNDD data as of February 2015 (reproduced from Cudworth and Grenier 2015).

Beauvais 2006). Keinath et al. (2014) used two models ('Random Forest' or 'RF' and 'Maximum Entropy' or 'ME') to determine the distribution of the Wyoming pocket gopher, and found that the overlap of these two models was a good predictor of occupied and unoccupied locations of Wyoming pocket gophers (*see* Figure 1). In Wyoming, lack of detailed soil maps hinders the ability to model the exact distribution of fossorial mammals such as pocket gophers (Keinath 2015). Cudworth and Grenier (2015) mapped confirmed Wyoming pocket gopher capture sites against distinct sub-watersheds (*see* Figure 2), which reinforces the modeling results by Keinath et al. (2014).

BEHAVIOR

The life history of the Wyoming pocket gopher is assumed to be similar to that of the northern pocket gopher, which is much more thoroughly studied (Clark and Stromberg 1987, Beauvais and Dark-Smiley 2005). All pocket gophers appear to be solitary, apart from brief contact during mating, and the period during which young are dependent on their mothers (Goldman 1939). They disperse aboveground as subadults to establish their

own burrow systems, and mortality is high during this period (Baker et al. 2003). The Wyoming pocket gopher is believed to have an average lifespan of one year (Keinath 2015).

Pocket gophers spend the majority of their lives underground in burrow systems, pushing up mounds of fresh earth, sometimes known as Mima-mounds, at a density of 25 to 50 mounds per hectare (Verts and Carraway 1999). Goldman (1939: 232) observed, "Except in connection with little known breeding activities and migratory movements, they appear only momentarily on the surface to eject earth from the tunnels." For pocket gophers generally, Baker et al. (2003: 276) stated, "Although individuals may move aboveground to disperse to a new area, they generally do not come out of their burrow systems except to push dirt aboveground so the burrow systems can be expanded." Proulx et al. (1995a) found that for northern pocket gophers, time spent aboveground decreased over the course of the summer with decreasing cover from vegetation. In an experimental setting, Proulx et al. (1995b) found that the northern pocket gopher spends an average of 2.7 hours per day foraging aboveground.

Baker et al. (2003) asserted that pocket gophers generally live solitary lives in individual burrow systems. Proulx et al. (1995b) found that northern pocket gophers were active around the clock with periods of activity spaced at random, and spent 53% of their time sleeping, primarily in nest chambers that also serve as food caches. Verts and Carraway (1999) postulated that northern pocket gophers are solitary and highly territorial, defending their burrow systems aggressively from conspecifics. However, generalizing this behavior to the Wyoming pocket gopher may not be accurate: "So few studies have been made of the territorial behavior of pocket gophers that it is difficult to make direct comparisons among species" (Miller 1964: 263).

Efforts to collar Wyoming pocket gophers (Griscom and Keinath 2010) have not succeeded due to mortality of test subjects and/or detachment of tracking devices, which limits the scientific knowledge of behaviors specific to the Wyoming pocket gopher.

Feeding habits. Wyoming pocket gophers are active year-round, feeding primarily on a diet of forbs and grasses (Beauvais and Dark-Smiley 2005). Forbs are apparently the preferred food, while grasses are considered marginal as a dietary staple for pocket gophers generally (Miller 1964, Verts and Carraway 1999). Teitjen et al. (1967) suggested that common grasses are marginally suitable from a dietary perspective, and that succulent grasses or those with corms or rhizomes are required to provide subsistence to northern pocket gophers. In late summer, pocket gophers cache food in underground chambers, to be consumed over the winter months (Beauvais and Dark-Smiley 2005).

According to Beauvais and Dark-Smiley (2005: 14), "The northern pocket gopher forages in underground burrows, but occasionally forages above ground at night or on overcast days." Proulx et al. (1995a) found that northern pocket gophers sometimes foraged aboveground more than 20 cm from their burrow entrances, particularly when high vegetation cover was present to provide cover from predators. According to Proulx et al.

(1995b), forays away from the burrow in an experimental setting lasted about 2 minutes each and occurred in the context of five daily foraging bouts lasting 22 minutes on average. Proulx et al. (1995b) studied northern pocket gopher behavior in a controlled setting, and found that most feeding activity occurs belowground, but consists mostly of plant material gathered at the surface. Dietary studies for northern pocket gopher indicate that while roots and tubers represent a significant part of the diet, the majority of food intake is made up of aboveground plant parts (Verts and Carraway 1999). Gophers plug their burrow entrances with dirt when not actively engaging in aboveground foraging (Proulx et al. 1995b). Due to the absence of species-specific information on the Wyoming pocket gopher in these regards, this behavioral information that applies to pocket gophers more generally should be considered the best available science for the species.

Vleck (1979) found that the energetic cost of burrowing in Botta's pocket gopher (*T. bottae*) required 360-3,400 times the energetic output of traveling aboveground, indicating that low metabolic rates and high rates of food consumption may be necessary to sustain this energy-intensive life history strategy, which is particularly challenging in low-productivity habitats. The Gardner's saltbush habitats preferred by the Wyoming pocket gopher have particularly low vegetation productivity (Keinath et al. 2014).

Breeding. According to BLM (2013: 101), "Wyoming pocket gophers likely do not live more than two breeding seasons, reproduce the calendar year following birth, and have one litter with four to six young per year." The breeding season established for closely-related northern pocket gophers occurs from mid-March to mid-June (Verts and Carraway 1999). The Wyoming pocket gopher is believed to have a litter size of four and an average lifespan of one year (Keinath 2015). This compares to a litter size of 4 to 7 for the northern pocket gopher (Verts and Carraway 1999). Further information specific to Wyoming pocket gophers is lacking, but for closely related pocket gophers (*T. talpoides*, Reid 1973, Andersen 1978; *T. bottae*, Schramm 1961), once copulation occurs, gestation lasts 18 to 19 days. For northern pocket gophers, young are born naked, blind, and toothless (Criddle 1930). Eyes are open by day 26, and by day 39 young can carry food in their pouches (Andersen 1978).

POPULATION STATUS: HISTORIC AND CURRENT

Very little is definitively known definitively about Wyoming pocket gopher population dynamics, beyond the fact that they are very limited in their geographic distribution, and within that distribution they are significantly scarcer than the sympatric northern pocket gopher. Based on their survey results, Keinath et al. (2008: 7) raised concerns about the fragmentation of Wyoming pocket gopher populations:

> A noteworthy aspect of gopher distribution is that [it] appears to be very fragmented. We often found small gopher colonies (an acre or less in size) that were miles from other gophers. Since pocket gophers are wholly fossorial, it is unlikely that they can disperse across such distances, particularly if intervening habitat is sub-optimal. Given this potentially

> extreme isolation, it is probably that gophers would not be able to recolonize a site following local extirpation.

According to Baker et al. (2013: 284), "The nature of pocket gopher population dynamics, however, often results in local extirpation and recolonization." These factors mean that activities that result in direct loss of habitat, habitat fragmentation, and barriers to dispersal are likely to cause extirpations and/or prevent recolonization once local populations die out from natural causes.

Current population estimate. According to Beauvais and Dark-Smiley (2005: 3), "Population status is generally unknown, due to an extreme paucity of data, but the species is assumed to be rare and has a very restricted distribution." Keinath et al. (2014: 809) characterized this species as "uncommon throughout its limited range…. Within this geographic range, *T. clusius* is rare compared to the more common *T. talpoides*, being less than half as prevalent on the landscape." Observed Rowland et al. (2011: 46): "Several vertebrate species of concern in the Wyoming Basins are either rare or imperiled, including black-footed ferret (*Mustela nigripes*) and Wyoming pocket gopher (*Thomomys clusius*)."

Live-trapping studies and prior scientific collection efforts appear to indicate low population densities of Wyoming pocket gophers. Prior to 2007, only 41 Wyoming pocket gophers had been positively identified (NMSU, *no date*). In 2008 and 2009, Hayden-Wing and Associates (HWA, a consulting firm) in collaboration with the Wyoming Natural Diversity Database (WYNDD) and Bureau of Land Management (BLM) captured 20 Wyoming pocket gophers over the course of 901 trap nights within the Continental Divide – Creston Natural Gas Project Area boundary (Keinath et al. 2008, BLM 2012c). Field surveys by HWA (2008) captured roughly twice as many northern pocket gophers as Wyoming pocket gophers, and trapping success rates were substantially lower for Wyoming pocket gophers than for other pocket gopher species. Griscom et al. (2010) captured four Wyoming pocket gophers in a trapping effort northwest of the town of Rawlins, in the area where the Lost Creek uranium mine had been proposed. McDoonald and Parchman (2010) identified 14 Wyoming pocket gophers as part of their study. This yields a total known maximum number of 79 Wyoming pocket gophers ever positively identified. Cudworth and Grenier, citing Keinath (in litt.), concluded that the low rates of trapping success per 100 trap-nights over the course of multiple live-trapping studies results from low population densities in areas where Wyoming pocket gophers occur.

Based on analysis last updated in 2006, NatureServe (2015) stated "[a]dequate information is not available to determine abundance," but estimated the global population at 2,500 to 10,000 individuals.

Population trends. Based on analysis last updated in 2006, NatureServe (2015) noted that population trend is unknown over both the short- and long-term time horizons. However, according to Keinath and Beauvais (2006: 3), "[t]he possibility of decline

appears quite serious given that these pocket gophers are vulnerable to disturbance due to their highly limited distribution, limited dispersal ability, and uncertain ecology."

A 2005 trapping effort by the Wyoming Natural Diversity Database revealed evidence of recent gopher activity in only one of 17 known Wyoming pocket gopher localities trapped, and captured no gophers over the span of 500 trap days (Keinath and Beauvais 2006). This led the authors to hypothesize that a population decline may have been underway during the middle part of the 20th century. Similarly, Keinath et al. (2008) undertook a survey of Wyoming pocket gophers throughout the Continental Divide – Creston natural gas project area, and attempted to relocate the historic colonies described by Thaeler and Hinesley (1979) but found no evidence of gopher activity at any of the historic sites they were able to access. This suggests extirpation in habitats formerly occupied by the species.

Population distribution. Distribution of pocket gophers of both species within the range of the Wyoming pocket gopher is patchy and discontinuous (HWA 2008). According to Miller (1964: 268), "Soil depth and texture and interspecies competition are clearly the most critical factors in both the geographic and habitat distributions of pocket gophers. Specific differences in food requirements are minor and relatively unimportant, and the niche relationships between species depend almost entirely on the 2 variables of soil depth and texture." Keinath et al. (2014: 810) characterized the limited availability of suitable habitat within this range as follows: "Even though habitats characterized by Gardner's saltbush are more common within the range of *T. clusius* than adjacent areas of Wyoming, they still represent a very limited area of potential habitat within a landscape largely dominated by big sagebrush." These researchers concluded that "the general rarity of *T. clusius* on the landscape suggests that much of this area is likely unoccupied."

IDENTIFIED THREATS TO THE PETITIONED SPECIES: CRITERIA FOR LISTING

The Service must evaluate whether a species is "threatened" or "endangered" as a result of any of the five listing factors set forth in 16 U.S.C. § 1533(a)(1):

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

(Factor A) The Present or Threatened Destruction, Modification, or Curtailment of the Species' Habitat or Range

Overall, 13% of the American West is dominated by the human footprint, or lands directly impacted by land conversion (Leu et al. 2008). Within the range of the Wyoming pocket gopher, human footprint level ranges from low to moderate (*see* Figure 3), despite

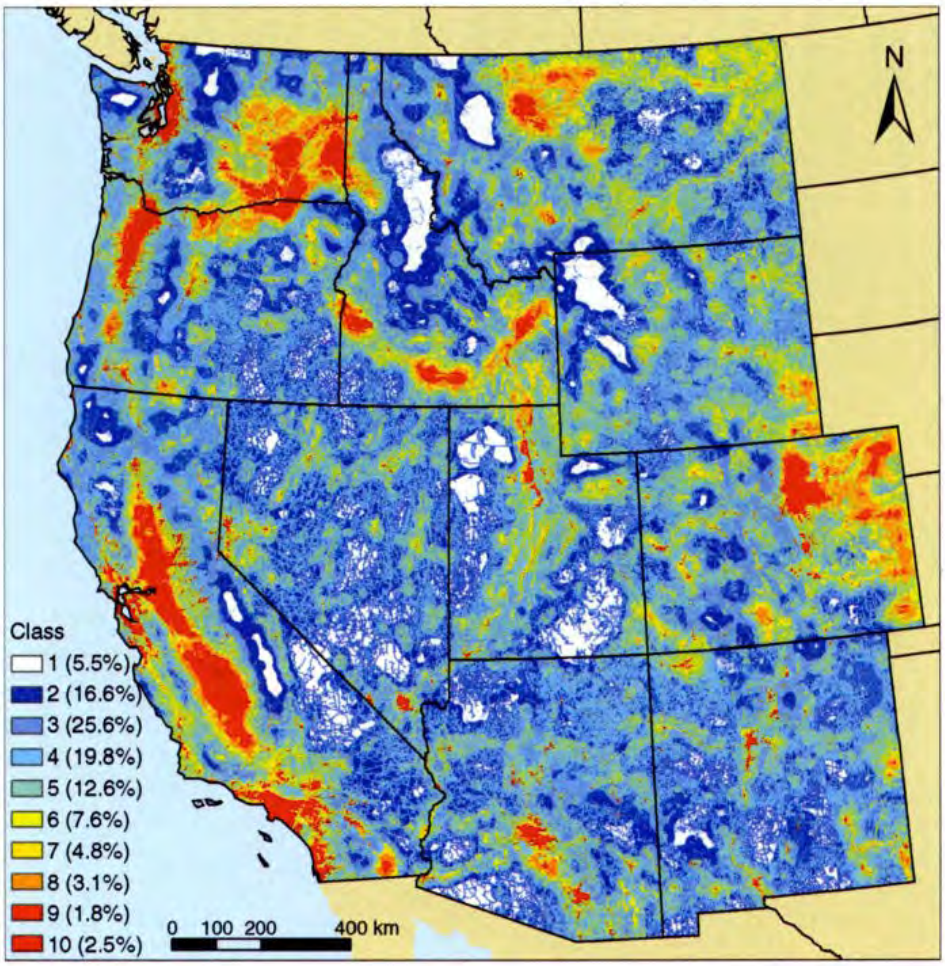

Figure 3. The human footprint in the United States in 2001 (reproduced from Leu et al. 2008). Human footprint intensity ranges from minimal (class 1, white) to high (class 10, red). The percentage of land covered by each human footprint class is provided in parentheses.

the fact that human population density is near zero. Primary contributing factors include energy development and infrastructure such as road and pipeline networks.

Energy development. Wyoming pocket gophers face threats from approved and pending energy development in the form of oil and gas exploration and development, uranium mining and in situ leaching facilities, and wind power development (*see* Figures 4, 5, and 6). Habitat fragmentation due to road and oil and gas development and stochastic events are considered the greatest threats to the Wyoming pocket gopher on public lands (Keinath and Beauvais 2006, BLM 2010). Regarding the Wyoming pocket gopher, Keinath et al. (2008: 3) pointed out, "Its suspected distribution is restricted to the basins of south-central Wyoming and is largely encompassed by areas expected to experience rapid energy development in the next decade." Regarding their study area encompassing the known range of the Wyoming pocket gopher, Keinath et al. (2014: 804) reported, "Fossil fuel and mineral extraction is the predominant human activity throughout the

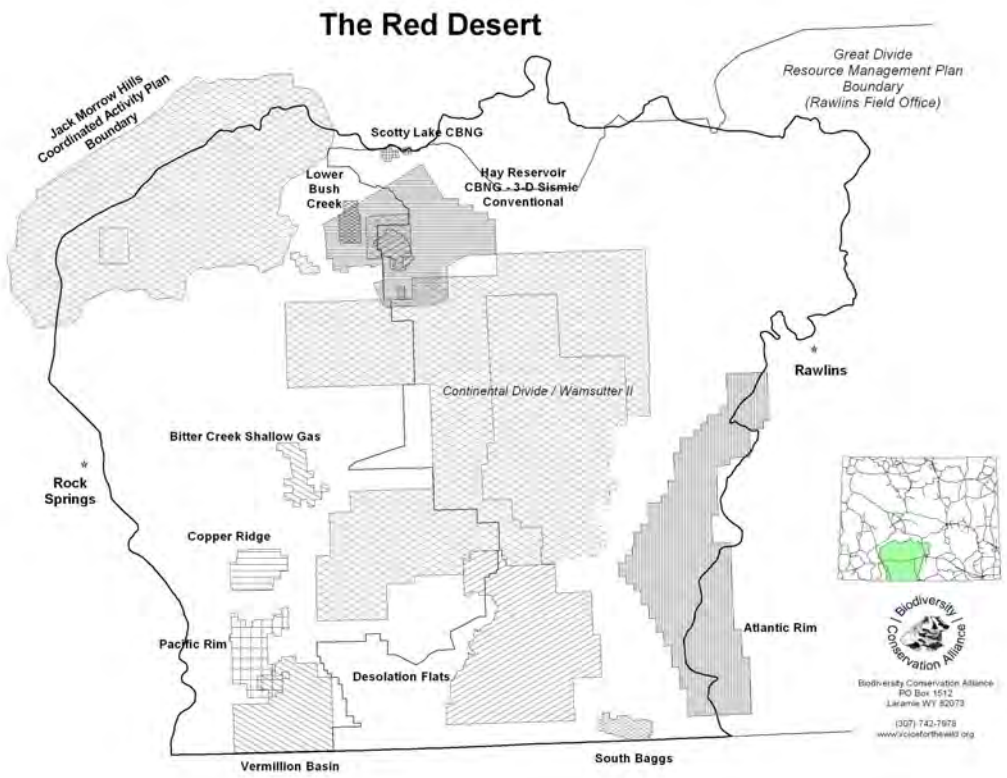

Figure 4. Oil and gas projects approved as of 2008 within the range of the Wyoming pocket gopher as of 2008.

area, with the most intensive and rapid development south of Interstate 80 in the vicinity of Wamsutter." According to Keinath (2015: 44, *internal citations omitted*), "Species with large exposure values [to impacts from energy development] in combination with relatively high confidence in the exposure estimate (e.g., Great Plains toad, pygmy rabbit, Wyoming pocket gopher, greater sage-grouse) fall into the high exposure category and are logical targets of immediate conservation attention and/or intensive research to quantify and mechanistically understand local impacts that could translate into population-level effects."

Keinath (2015) modeled future oil, gas, and wind energy development based on resource potential on a statewide basis; the rapid development of 6,240 new oil and gas wells following development of the initial map allowed this model to be tested and it proved highly predictive for oil and gas (correlation coefficient of 0.99, $p < 0.001$ for oil and gas; 0.89 and $p < 0.001$ for wind).

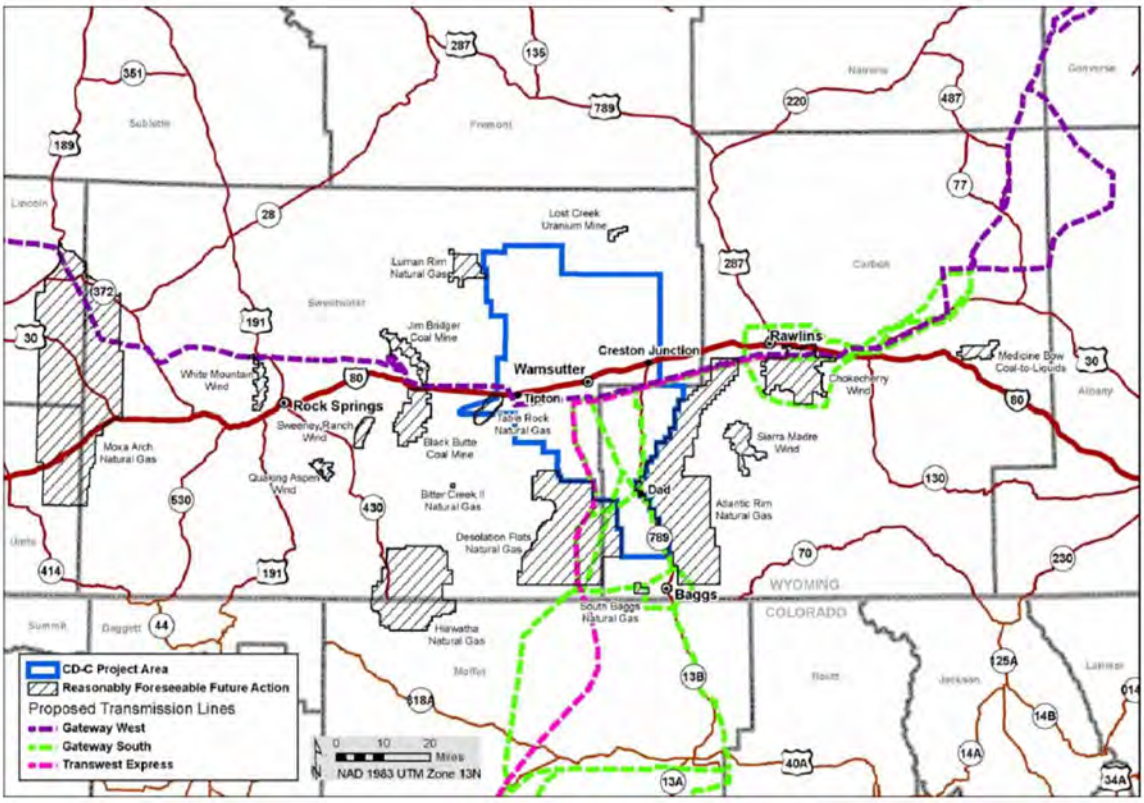

Figure 5. Pending energy development projects in the Wyoming pocket gopher's range (excerpted from BLM 2012c).

Keinath (2015) assessed the relative vulnerability of Wyoming's terrestrial vertebrate Species of Greatest Conservation Need to disturbance and/or ultimate extinction due to energy development activities, and the Exposure Index for the Wyoming pocket gopher was calculated as significantly higher than the greater sage-grouse (*Centrocercus urophasianus*, see Figure 7), which was determined to be 'warranted, but precluded' for protection under the Endangered Species Act in 2010 with energy development as a major contributing threat. 75 Fed. Reg. 13910. Of 156 Species of Greatest Conservation Need designated by the Wyoming Game and Fish Department in Wyoming, the Wyoming pocket gopher was ranked as having the fifth-highest level of exposure to energy development (Keinath 2015). The Wyoming pocket gopher was one of the species predicted to experience accelerated exposure to energy development in the future, a predicted 75% increase over current (and already elevated) levels (Keinath 2015, and see Figure 8. This species exhibited a high exposure rating at both the 200m and 5 km effect distances for energy development (Keinath 2015).

Pocewicz et al. (2011) determined that oil and gas development, followed by wind energy development, were the greatest sources of potential impacts to arid shrublands like those inhabited by the Wyoming pocket gopher. According to Keinath (2015: 34), "The number of petroleum wells and wind turbines in Wyoming has increased drastically in recent years and continued increases of at least 130% and 615%, respectively, are

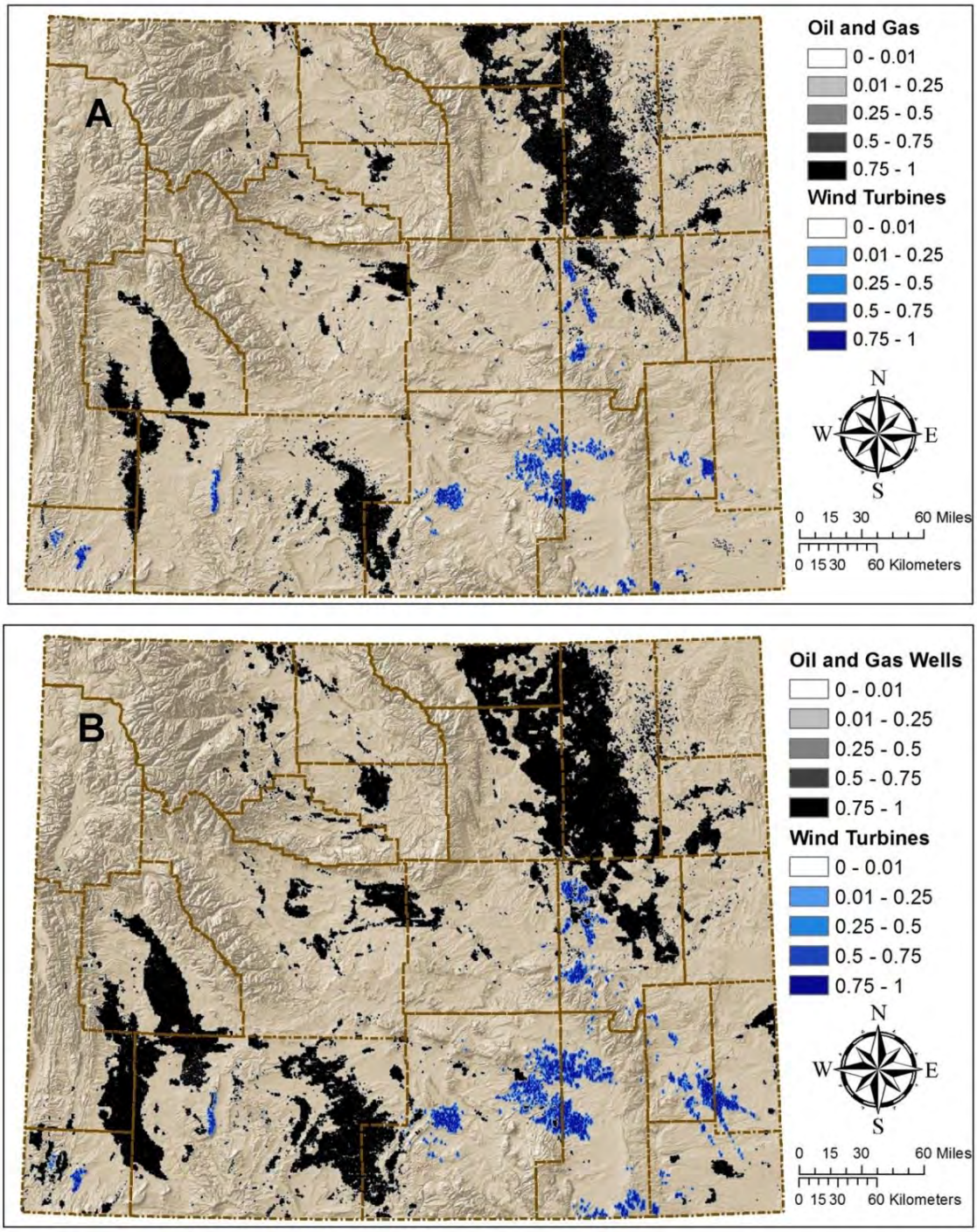

Figure 6. Energy footprint maps of Wyoming showing the 2030 predicted exposure surface for oil and gas wells and wind-power turbines under anticipated (A) and unrestrained (B) scenarios. Data are displayed over a shaded topographic relief map with county boundaries for reference (reproduced from Keinath 2015).

predicted over the next 20 years." The known range of the Wyoming pocket gopher is a

focal point for this expansion in energy development.

Impacts from energy development. Pocewicz et al. (2014) rated the Wyoming pocket gopher as having the fourth-highest ranking of all Wyoming species for exposure to existing oil and gas development and the third-highest ranking for exposure to cumulative oil and gas development. Virtually the entire known range of the Wyoming pocket gopher occurs in areas approved for full-scale energy development (*see* Figure 4). Oil and gas development poses a threat to Wyoming pocket gophers due to a variety of impacts, explicated below.

Physical disturbance of gophers and their habitat, and direct mortality. Geophysical exploration, either using shot-hole or vibroseis methods, could result in tunnel collapse and/or crushing of pocket gophers. Pocket gophers could be crushed in their tunnels by heavy equipment (e.g., front-end loaders, bulldozers, and road graders) used to construct road networks and energy production sites, or crushed by equipment as they venture aboveground. Spills of toxic chemicals such as fracking fluids and liquid nitrogen commonly used during drilling and completion could result in the poisoning or death of individual pocket gophers and/or the long-term degradation of soils that provide habitat for pocket gophers. The act of drilling could crush or dismember individual pocket gophers unfortunate enough to be caught beneath the drilling bit. The use of backhoes, ditch witches, and other heavy equipment to excavate pipeline corridors and emplace pipelines could directly kill or maim pocket gophers, and the denuding of pipeline corridors to a width of a hundred feet or more eliminates plant cover and thereby creates a potential barrier to pocket gopher dispersal. The erection of tall structures and the increase in vehicle traffic is known to increase the concentration of raptor and corvid predation in and around wellfields (Bui et al. 2010), potentially increasing mortality for pocket gophers as they venture aboveground. The creation of networks of roads and wellpads also fragments pocket gopher habitat and potentially isolates remnant pocket gopher populations that survive. Vibrations caused by machinery and/or vehicles could disturb, stress, and/or displace pocket gophers from favored habitats. Finally, the direct conversion of habitat to road or wellpad surface eliminates pocket gopher habitat directly, causing loss of net primary productivity of forage plants, and the dust associated with heavy vehicle traffic in wellfields reduces the productivity of vegetation in surrounding areas. BLM predicted a 15 to 30% loss of vegetation productivity in the Atlantic Rim coalbed methane project area due to dust alone (BLM 2006).

Direct conversion of habitat to roads or wellpads poses an immediate threat to Wyoming pocket gopher populations. A typical wellpad requires 6.3 acres of surface disturbance (BLM 2012c), an area far larger than the one-acre colony size reported for smaller Wyoming pocket gopher colonies by Keinath et al. (2008). Thus, a single wellpad has the potential to permanently destroy an entire metapopulation of Wyoming pocket gophers. Even if oil and gas operators are tasked with identifying and avoiding Wyoming pocket gopher colonies during project-related activities, there is little incentive for operators to notice and/or report Wyoming pocket gopher localities prior to surface-disturbing activities. It is therefore likely that even in cases where pocket gopher presence is noticed

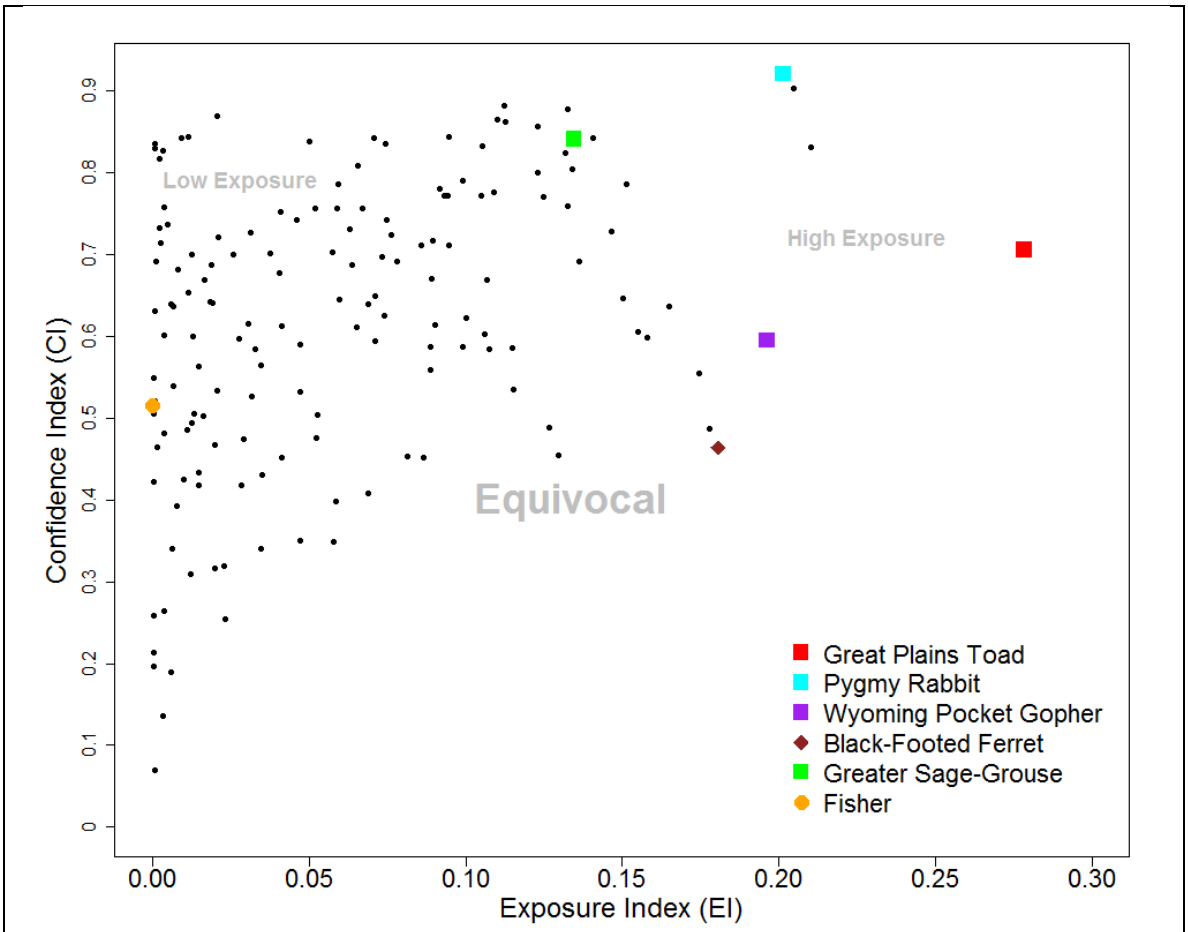

Figure 7. Joint distribution of exposure index (EI) and confidence index (CI) for 156 SGCN in Wyoming. Higher EI values indicate greater exposure to development, while higher CI values indicate more confidence in the exposure estimate. Gray text highlights heuristic zones of concern (reproduced from Keinath 2015).

and correctly attributed to the Wyoming pocket gopher rather than the common northern pocket gopher (itself unlikely because heavy equipment operators are rarely trained in the biological sciences), there is financial incentive for companies to ignore pocket gopher colonies in order to locate industrial facilities in locations most optimal (and profitable) for energy development. There is no scientific evidence that pocket gophers can survive the bulldozing, soil compaction, and conversion of native habitat to an energy production site.

Disruption of communication. Geophysical exploration (including both vibroseis and shot-hole methods) as well as drilling rigs and heavy equipment, cause underground vibrations that may interfere with pocket gopher communication. Because vocalizations cannot be heard over long distances underground, it is likely that pocket gopher communication is primarily through seismic signals such as foot-drumming, which has been documented in pocket gophers (Mason and Narins 2001). Frequent noise and vibrations from energy-related exploration and production activities, as well as road and

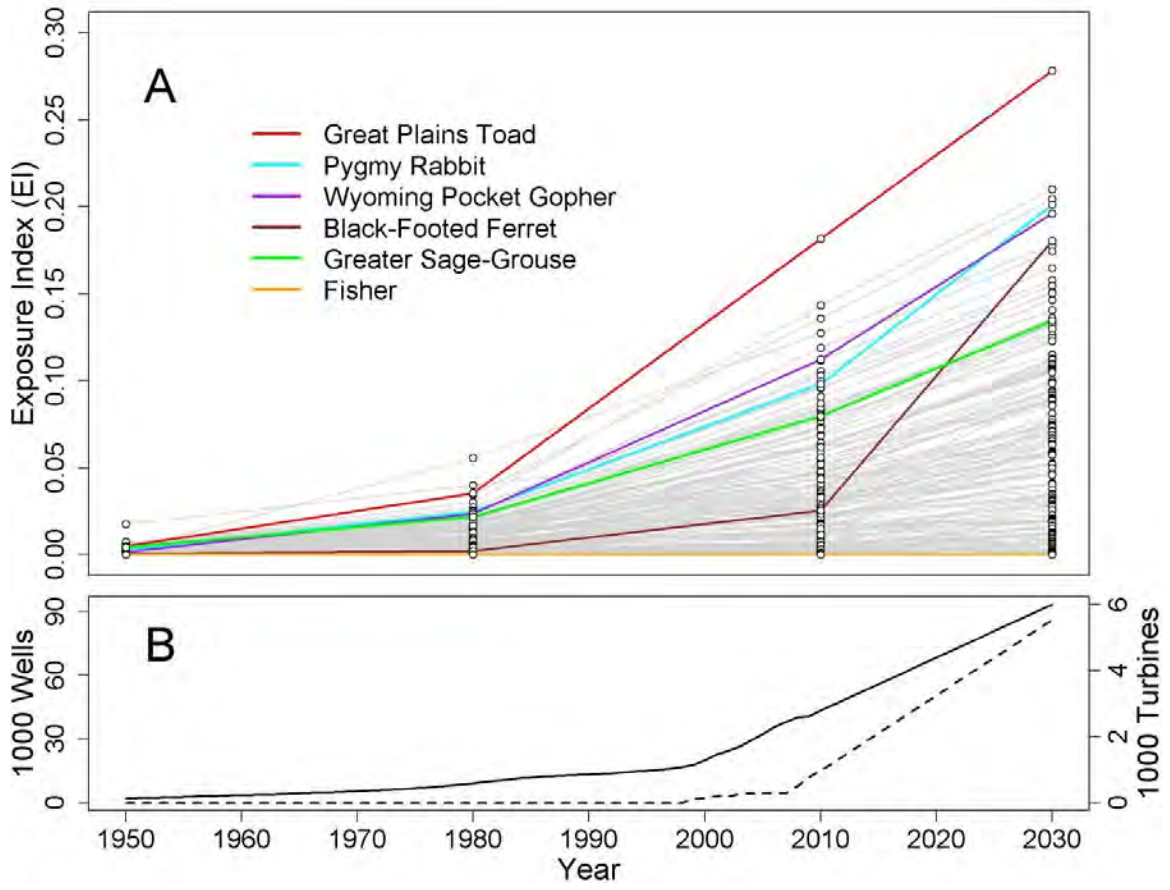

Figure 8. Changes through time in exposure to energy development for 156 Species of Greatest Conservation Need (SGCN) in Wyoming (A) relative to the cumulative number of oil and gas wells (B; solid line) and wind-power turbines (B; dashed line).

pipeline construction, could disrupt communications important for the survival of Wyoming pocket gophers (including signals to avoid predators, attract mates, and/or warn intruders in the burrow system).

Habitat fragmentation. Griscom and Keinath (2010: 3) reported:

> Because pocket gophers are fossorial and defend small territories, the young disperse relatively short distances and it is unknown whether they could disperse across soil-compacting barriers such as roads and well pads. An inter-agency meeting held in Laramie, Wyoming in April 2010 identified roads associated with oil and gas development across *T. clusius'* range as the biggest potential threat to population viability due to potential genetic fragmentation.

These researchers conducted a literature review for related species and found evidence for above-ground dispersal in other pocket gopher species, but little evidence regarding whether or not roads constitute a barrier to such surface dispersal. If, however, the finding that time spent aboveground is dependent on vegetative cover for northern pocket

gophers (Proulx et al. 1995a) also holds for Wyoming pocket gophers, then energy-related roads, typically bare gravel with no vegetative cover whatsoever, could nonetheless represent impassable barriers to pocket gopher dispersal and thereby fragment and isolate Wyoming pocket gopher populations. Despite the reduced concern for the impacts of road construction on blocking dispersal of young pocket gophers, Griscom and Keinath (2010: 6) concluded that "[f]or a species with a limited range, and limited habitat within that range, habitat destruction and degradation from energy development should be of concern."

At a meeting between state and federal biologists and industry representatives on March 3, 2009, the issue of habitat fragmentation was summarized as follows (Beauvais 2009):

> Observations to-date suggest a high degree of population fragmentation. Small colonies of *T. clusius* (some even on the order of 10 m^2) appear to be separated by several kilometers of apparently unoccupied habitat. If this pattern is confirmed, surface disturbances between and distant from known colonies could significantly endanger colony persistence by reducing/ preventing inter-colony dispersal.

All available information confirms the patchy and discontinuous distribution of Wyoming pocket gophers and their obligate Gardner's saltbush habitat on the landscape, and thus habitat fragmentation that results from energy development must be interpreted as a major threat to both colony persistence and recolonization.

Loss of vegetation productivity. Wyoming pocket gophers rely on vegetation for their food. Allred et al. (2015) examined the loss of net primary productivity (NPP), the amount of carbon fixed by plants and accumulated as vegetation biomass, as a result of oil and gas development, and found that loss of NPP due to direct surface disturbance alone could result in a loss of almost four teragrams (four million metric tons) of vegetation (measured in biomass) on North American rangeland. In additios, the resulting increase in fragmentation could sever migratory pathways, altering wildlife behavior and mortality and increasing susceptibility to ecologically disruptive invasive species. According to these researchers (*ibid*.: 401), "[t]he loss of NPP is likely long-lasting and potentially permanent, as recovery or reclamation of previously drilled land has not kept pace with accelerated drilling."

In addition to direct impacts from habitat conversion, dust can have major indirect impacts on vegetation productivity (BLM 2006: 4-53):

> Indirect impacts due to dust from roads is expected to affect vegetation adjacent to roads, resulting in additional impacts across 15 to 30 percent of the ARPA [Atlantic Rim Project Area]. The primary effects expected are reduced photosynthetic capability for plants and reduced palatability of forage.

Based on the research of Miller (1964), Beauvais and Dark-Smiley (2005) concluded that

"[t]he extremely varied diets of various pocket gopher species has led to the conclusion that food is seldom a limiting factor in pocket gopher distributions, although the nature and amount of vegetation may affect local population densities." However, as Vleck (1979) noted, the fossorial life history of pocket gophers entails radically elevated energy expenditures. The reduction of vegetation productivity due to dust, coupled with the already low productivity of the Gardner's saltbush plant communities that this species inhabits, could tip the scales against the survival of Wyoming pocket gophers.

Threats related to hydraulic fracturing. Hydraulic fracturing, or "fracking," is an increasingly prevalent stimulation technique for oil and gas wells undertaken to increase oil and gas production, particularly in tight (<1 millidarcy permeability) sandstone and shale formations. Hydraulic fracturing is employed in the majority of the oil and gas wells in the area inhabited by the Wyoming pocket gopher (*see, e.g.,* BLM 2012c: 2-3).

Spills of toxic chemicals are common in association with oil and gas development, and their occurrence and frequency is coincident with the density of drilling (Vengosh et al. 2014). Well blowouts can occur during hydraulic fracturing operations, releasing tens of thousands of gallons of toxic fluids (Wiseman and Gradijan 2015). Between 2005 and 2009, 750 chemicals and other components were used in fracking operations, including 29 chemicals considered "toxic" that are components in 652 different products used in hydraulic fracturing (House Committee on Energy and Commerce 2011). Spills of these chemicals can be immediately toxic to wildlife, and can have deleterious health and survival effects on wildlife over the long term (Papoulias and Valasco 2013). Spills of chemical toxins have the potential to cause death or long-term health impairment in all forms of wildlife into which they come in contact, including Wyoming pocket gophers.

Wells are commonly fractured with a liquid nitrogen foam with sand proppant (Curtis 2002). This method requires liquid nitrogen to be transported by truck to the site of the frack job (Plummer and Johnson 1976). Wells can also be fracked directly with liquid nitrogen (Maguire 1974). Liquid nitrogen is used to freeze soils in an engineering and construction context; indeed, Hu et al. (2014) used liquid nitrogen in enclosed pipes to freeze soils to a temperature of -45°C (-49°F) during the repair of a collapsed subway tunnel in China. Liquid nitrogen typically has a temperature of approximately -196°C (-320°F), and in soil freezing applications results in freezing of the soil within 4 to 7 days (Linde, no date). Spills of liquid nitrogen in Wyoming pocket gopher habitat could result in direct mortality as well as longer-term habitat changes deleterious to Wyoming pocket gophers.

Both fracking and the underground injection of used fracking fluids can result in earthquakes. Walker (2015) documented approximately 1,000 earthquakes in British Columbia that were either proven to be or possibly caused by fracking or other drilling-related activities, including 6 events of Magnitude 4 or greater. Fracking-related earthquakes could result in tunnel collapse and direct mortality of Wyoming pocket gophers.

Herbicide application. The spraying of herbicides is frequently associated with energy development and subsequent reclamation, and also can be used to address invasive weeds spread by vehicles or excessive livestock grazing. Teitjen et al. (1967) found that spraying application of herbicide 2,4-D resulted in an 80 to 90% decline in northern pocket gophers. Miller (1964) asserted that gopher declines in response to 2,4-D spraying were the result of changes in vegetation (specifically, loss of forbs) rather than direct toxicity of the herbicide. The spraying of herbicides related to weed control associated with interim and final reclamation at energy production sites, or for the control of invasive weeds, could deplete the food supply needed for survival by Wyoming pocket gophers, and also could result in direct mortality through poisoning.

Approved and pending energy development projects. There are a number of energy development projects that have been approved by the BLM, and for which the construction of industrial facilities is partially or entirely completed (*see* Figure 4 and Attachment 1).

The Creston – Blue Gap Natural Gas Project was approved in 1994, authorizing up to 330 wells on 160-acre well spacing; by 2012 most of the authorized wells had been drilled (BLM 2013). The Continental Divide – Wamsutter II Natural Gas Project was approved in 2000, permitting 3,000 additional wells and associated facilities across a 1.1 million acre project area. Between 2005 and 2013, Applications for Permit to Drill for 1,011 wells in the Continental Divide – Wamsutter Field were approved (BLM 2013). To date, between the Continental Divide – Wamsutter and Creston – Blue Gap fields, over 4,400 natural gas wells have been drilled, and over 500 of these have been plugged and abandoned (BLM 2012c).

The Desolation Flats Natural Gas Project was approved in 2004, with the following projected impacts across the 233,542-acre project area (BLM 2004: 5):

> The activities proposed by the proponents include 385 wells at 361 locations with a forecasted viability success rate of 65 percent. This would result in a total build-out of 250 producing wells. A supporting access and transportation system of up to 450 miles of upgraded and new roads; approximately 361 miles of pipelines; 4 compressor stations, one gas processing plant, 3 water evaporation ponds, 2 disposal wells and 10 water wells would be associated with the target number of well locations. Total short–term surface disturbance is estimated at about 4,900 acres. The proponents proposed 2 to 4 well locations per aliquot section dependent on the geological resources.

Pursuant to this project approval, some 95 Applications for Permit to Drill have been issued between 2005 and 2013 (BLM 2013), resulting in dozens of wells drilled. Due to a downturn in natural gas prices, it appears that the majority of wells approved under this project have not yet been drilled.

The Atlantic Rim Project was approved in 2007, with the following projected impacts across the 270,080-acre project area (BLM 2007: 1): "drilling of approximately 2,000 gas wells within the ARPA to recover energy resources, while limiting total new surface disturbance from the drilling program across the ARPA (federal, state and fee minerals)

to a maximum of 7,600 acres, at any given time, and a 6.5-acre/well site short-term (less than 6 years) disturbance goal." Pursuant to this project approval, 391 Applications for Permit to Drill have been approved from 2007 to 2013 (BLM 2013).

In 2012, BLM published a Draft Environmental Impact Statement for its Continental Divide – Creston Natural Gas Project, entailing 8,950 wells on and estimated 6,126 new pads with densities up to 16 wellpads per square mile, along with associated access roads, pipelines, and overhead and buried electrical lines, a gas processing plant, water disposal facilities, and equipment storage facilities, across a project area spanning 1.1 million acres (BLM 2012c). The project as proposed would add 47,200 acres of new surface disturbance (4.4% of the project area) to the existing 60,176 acres of current surface disturbance (5.6% of the project area)(*id.*). In 2008 and 2009, 20 Wyoming pocket gophers were captured as part of inventory efforts associated with this project (*id.*).

In 2013, BLM approved the Chokecherry and Sierra Madre Wind Farm, approving the siting of 1,000 wind turbines, over 400 miles of new roads, and 7,733 acres of surface disturbance as part of the project (BLM 2012a). Most of this project area is sited within predicted Wyoming pocket gopher habitat (*see* Figure 9, from BLM 2012b). According to analysis for this project, "The potential impacts to Wyoming pocket gopher include: 1) direct loss of habitat; 2) indirect loss of habitat; and 3) increased traffic on roads and human activity resulting in Wyoming pocket gopher fatalities" (BLM 2012b: 4.15-9). Based on habitat modeling by the Wyoming Natural Diversity Database, 103,898 acres of the Chokecherry – Sierra Madre project area as a whole are predicted to be occupied by Wyoming pocket gophers, with several known occurrences within the project boundary, and 25 predicted Wyoming pocket gopher mounds or mound complexes inventoried for this small sub-project of roads, rail facilities, and quarries (BLM 2014, *and see* Figure 10). While sage grouse Core Area designations may have originally prevented the siting of wind farm facilities in Wyoming pocket gopher habitats in this area, subsequent boundary alterations were made to allow wind farm development on lands originally designated as Core Areas to protect sage grouse, and as a result both sage grouse and Wyoming pocket gopher habitats are now slated for industrial development. Other portions of this project, including individual turbine arrays and their access roads, are awaiting further site-specific environmental review.

Uranium mining. The Lost Creek in Situ Uranium Project was approved by BLM on October 5, 2012. BLM's data collection for this project indicates the following with regard to Wyoming pocket gophers (BLM 2012d: 3.8-55):

> Trapping was completed during fall 2010 to determine if Wyoming pocket gophers are present within the Lost Creek Disturbance Area (approximately 345 acres anticipated to be disturbed by the Project). Based on the trapping effort, Wyoming pocket gophers are present throughout the Lost Creek Disturbance Area. Wyoming pocket gophers were captured in nine different locations within the Disturbance Area. Additional active burrow complexes were located throughout the Disturbance Area. Active burrow complexes were located within very

small grassy openings within the sagebrush plant community …. There is a high likelihood that Wyoming pocket gophers are present throughout the Permit Area.

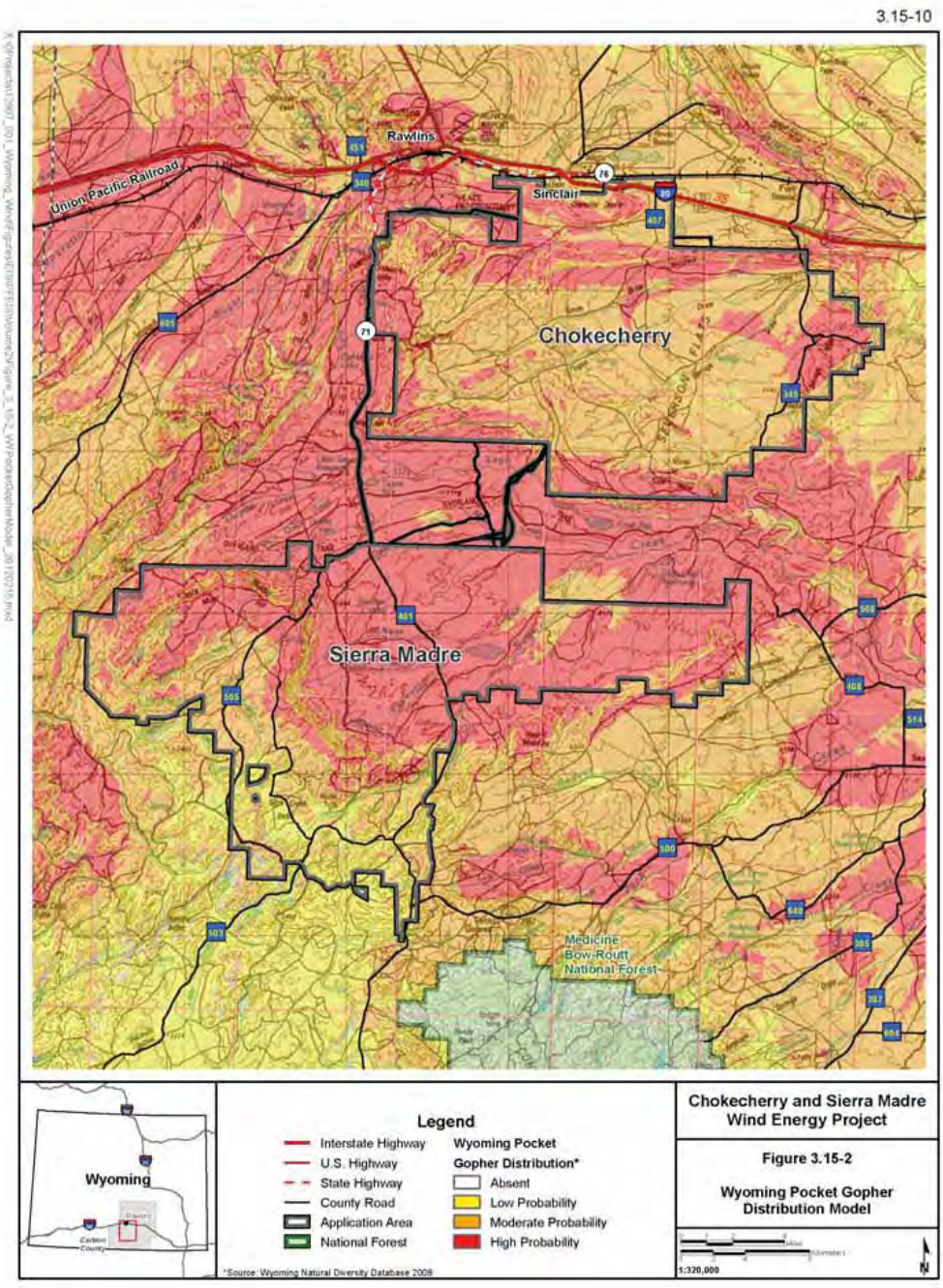

Figure 9. Likely distribution of Wyoming pocket gopher in Chokecherry – Sierra Madre project area.

Regarding the potential impacts of this in situ uranium mine, BLM (2012d: 4.9-38) provided a candid assessment:

> Project Construction would result in long-term direct impacts to the Wyoming pocket gophers within the Permit Area. Wyoming pocket gopher active burrow complexes were located throughout the Permit Area …. Burrow complexes were located within very small open and grassy pockets within the Upland Big Sagebrush Shrubland habitat. Project Construction would result in ground and vegetation disturbances, ground compaction, and fragmentation of sagebrush habitat. At most, eight percent of vegetation within the Permit Area would be disturbed during Construction. Wyoming pocket gopher burrow complexes can be expected to disappear in the disturbed areas for the life of the Project and direct mortalities from construction equipment can also be expected.

In 2015 Ur-Energy, the corporation that owns the Lost Creek uranium facilities, proposed to more than double the spatial extent of mining activity, from the 4,254 acres originally permitted to approximately 10,000 acres, and also expand uranium milling activity. 80 Fed. Reg. 55,149, 55150.

Summary of habitat destruction and degradation. Sensitivity is broadly defined as the degree to which species respond to external stressors, with species that are more sensitive exhibiting larger responses. According to Keinath (2015: 61), "Variation in species sensitivity to disturbance translates directly to their probability of decline, endangerment and ultimately extinction." Across a broad number of taxa, Keinath (2015) found that species inhabiting small and isolated patches, habitat specialists, and shrubland species (all of which describe the Wyoming pocket gopher) had a higher sensitivity rating, with forest and shrubland species being most sensitive to habitat fragmentation. With specific regard to the Wyoming pocket gopher, Keinath (2015: 87) concluded,

> If we put both exposure and sensitivity on the same scale, one way to calculate relative risk would be the simple arithmetic mean of the two …. Based on this metric, Wyoming pocket gopher is clearly the SGCN [Species of Greatest Conservation Need] with the highest potential risk from energy development. Wyoming Pocket Gopher has an extremely narrow geographic range, with its entire global distribution restricted to portions of two counties in central Wyoming …. Within this area, it is further restricted to a narrow range of habitats, primarily saline basins characterized by Gardner's saltbush, to which it may be limited through competition with the much more common northern pocket gopher (*Thomomys talpoides*). Though demographics and population densities are largely unknown, it appears to occur in disjunct patches and very low densities across its range, and it is absent from many locations where it was previously known to occur.

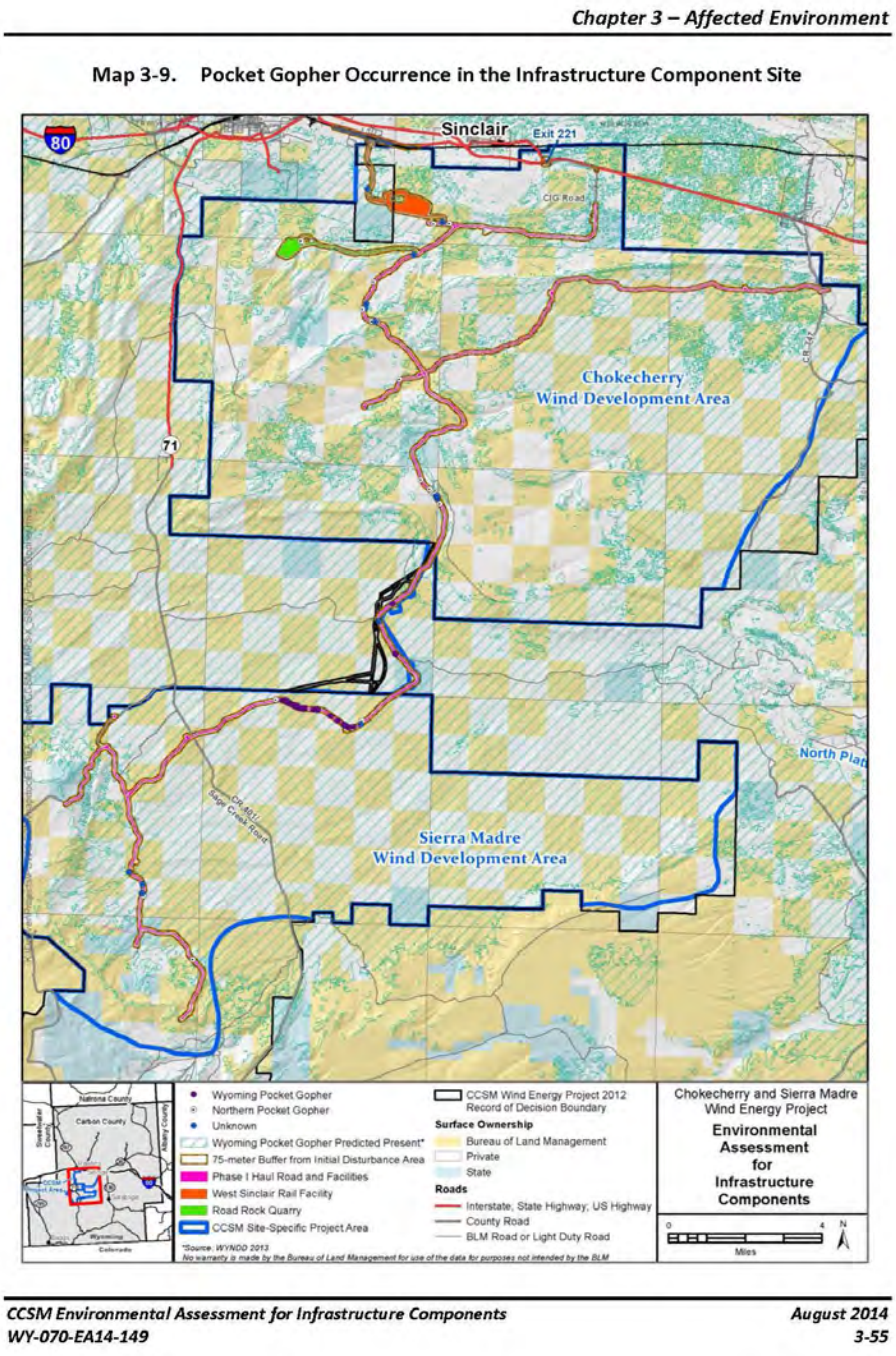

Figure 10. Known occurrences of Wyoming pocket gopher in Chokecherry-Sierra Madre project area.

The exposure (degree to which key habitats overlap with threats) and sensitivity (the vulnerability of a species to these threats based on its biology) of the Wyoming pocket gopher relative to other Wyoming Species of Greatest Conservation Need is illustrated in Figure 11 (from Keinath 2015). Notably, the Wyoming pocket gopher has been found to exceed the greater sage-grouse, which in 2010 was found to be warranted for listing under the Endangered Species Act, in both exposure and sensitivity.

Pocewicz et al. (2014) provided a more generalized assessment of vulnerability for the Wyoming pocket gopher, rating its vulnerability Moderate overall (and also moderate for development and climate change) with a Landscape-Based Vulnerability rated as High.

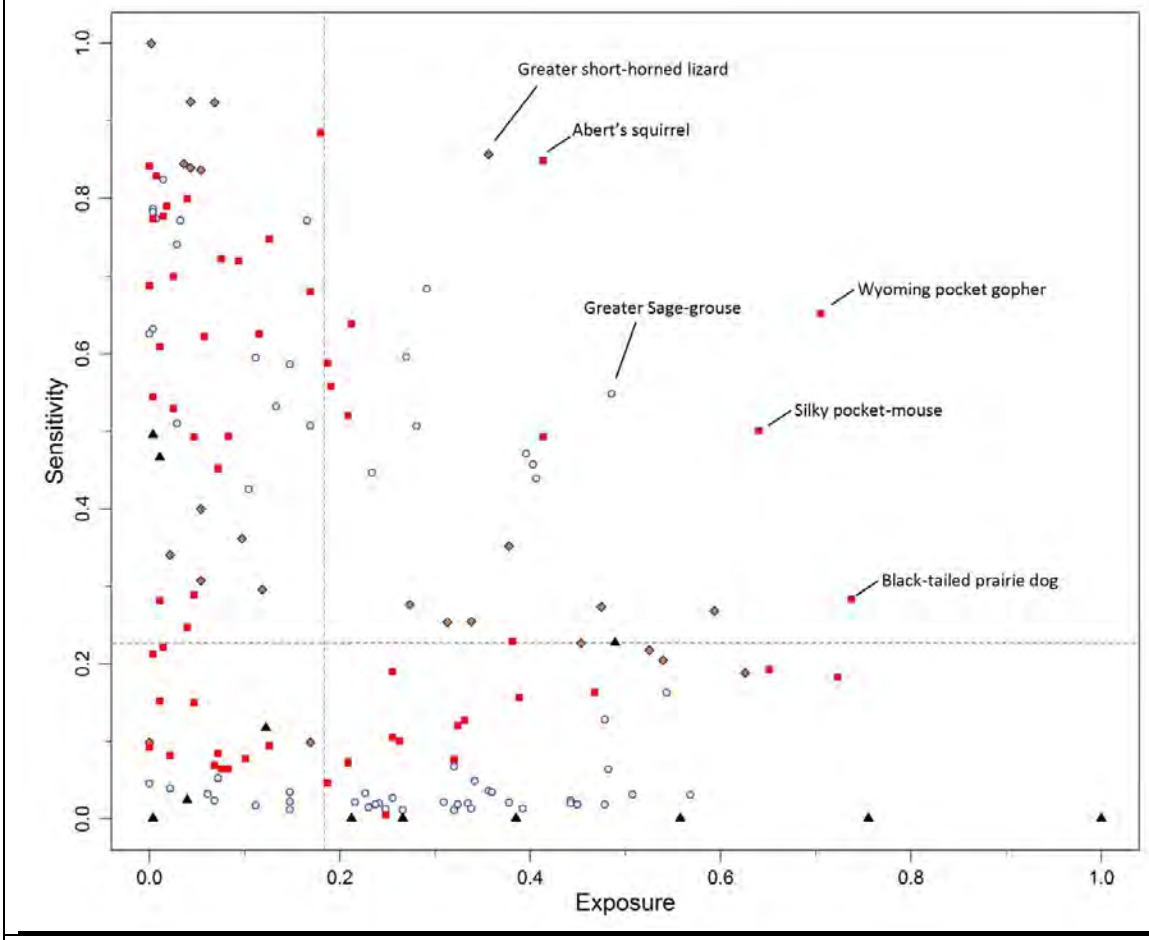

Figure 11. Wyoming's Species of Greatest Conservation Need plotted as a function of their relative exposure to energy development (rescaled to range from 0 to 1) and their predicted sensitivity to habitat disturbance (rescaled to range from 0 to 1). Species closer to the upper right corner of the graph have higher exposure and sensitivity, and are thus at relatively greater risk of being impacted by energy development. Reference lines are median values. Symbols represent amphibians (black triangles), birds (hollow circles), mammals (red squares), and reptiles (tan diamonds). Some of the most at risk species are identified (reproduced from Keinath 2015).

(Factor B) Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

Wyoming pocket gophers are not known to be the target for hunting, collection for the pet trade, or other commercial or recreational uses. This species is increasingly the subject of collection for scientific and monitoring purposes, typically involving live traps and live release following capture. Griscom and Keinath (2010) reported several instances of mortality as a result of handling Wyoming pocket gophers in associated with a radio telemetry study. Keinath et al. (2014) noted that Wyoming pocket gophers could be definitively be differentiated from northern pocket gophers based on pelage differences. This, however, requires the capture and handling of pocket gophers on a project-by-project basis during the environmental review phase in order to gain these important baseline data. As the project review and approval process moves forward on a site-specific basis for thousands of drilling permits and wind turbines awaiting final approval across the Wyoming pocket gopher range, efforts to capture, handle, and identify Wyoming pocket gophers will inevitably result in additional mortality and injuries of pocket gophers. The Service should investigate post-release mortality and determine the extent to which collection and handling for scientific purposes could potentially pose a threat to this species.

(Factor C) Disease or Predation

Disease. Fleas, mites, and chewing lice are common parasites of northern pocket gophers (Todd and Tryon 1971, Verts and Callaway 1999). In Colorado, two species of mites, five lice and two fleas appear to be restricted primarily to pocket gophers (Miller and Ward 1960). Dermatyomycosis (ringworm) is a fungal infection that is common in rodents and has been documented in the closely-related northern pocket gopher, but the rarity of such infections suggest that they may be infrequent (Proulx and Onderka 1997). Endoparasites include a variety of worms and microbes (Verts and Callaway 1999). Miller and Ward (1960) reported a close correlation between pocket gopher weights and parasite loads, indicating a close association between parasite and host. The degree of threat to Wyoming pocket gophers posed by diseases and parasites is unknown at this time; Pocewicz et al. (2014) rated vulnerability of disease as “low” for the Wyoming pocket gopher.

Predation. Goldman (1939) observed that pocket gophers do not comprise a major portion in the diet of predators that specialize in small mammals, hypothesizing that the small amount of time that these animals spend aboveground makes them less available to predators. Predators likely to occur in Wyoming pocket gopher habitat known or suspected to prey on pocket gophers include coyotes (*Canis latrans*), Great Basin gopher snakes (*Pituophis catenifer*), bobcats (*Lynx rufus*), long-tailed weasels (*Mustela frenata*), badgers (*Taxidea taxus*), burrowing owls (*Athene cunicularea*), great horned owls (*Bubo virginianus*), in addition to foxes and skunks (Verts and Callaway 1999). The erection of tall structures and the increase in vehicle traffic is known to increase the concentration of raptor and corvid predation in and around energy development, potentially increasing

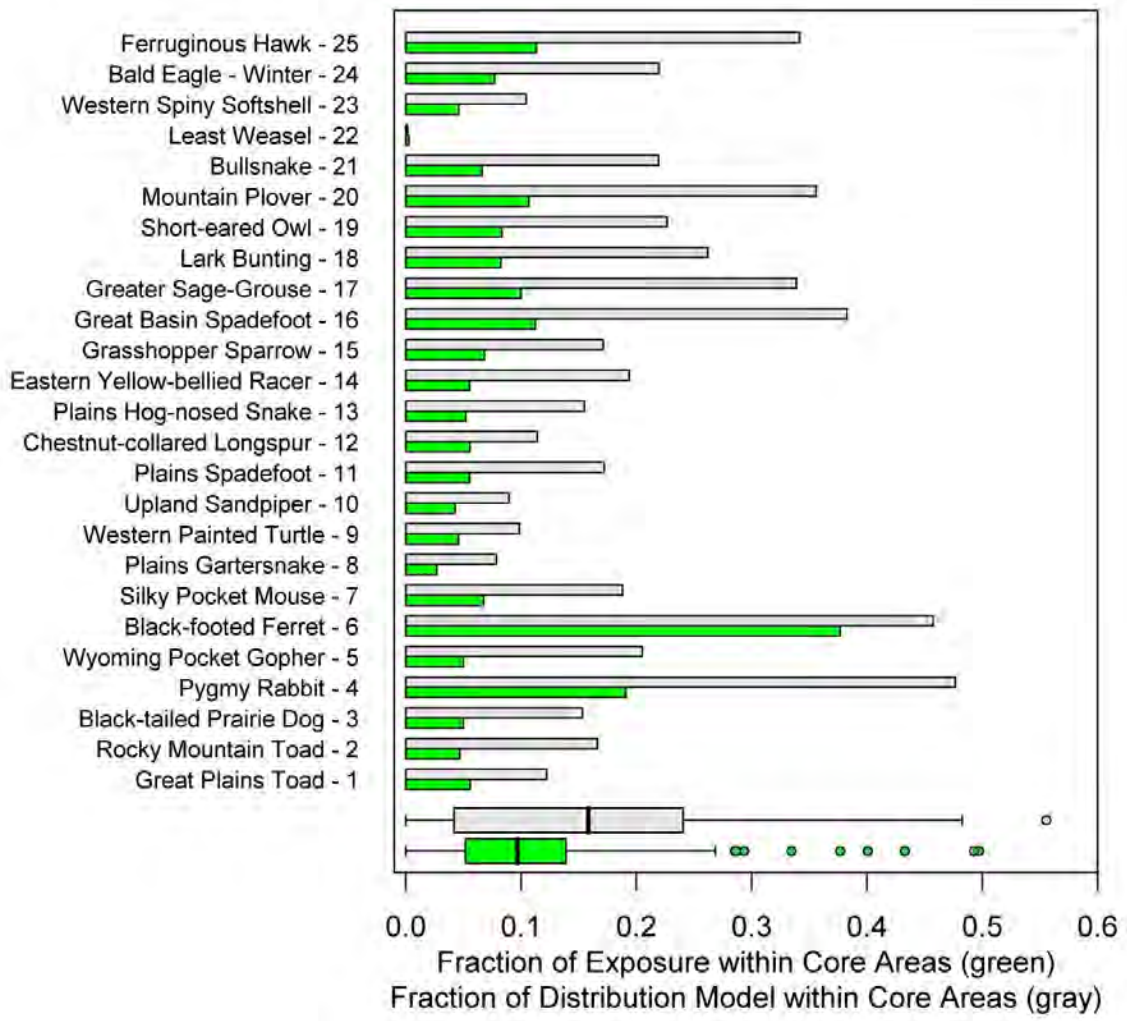

Figure 12. Fraction of the total 2030 Exposure Index (EI; green) and distribution model values (gray) falling within core areas of Greater Sage-Grouse. Bars represent the 25 most-exposed species in our study. Box plots represent a synthesis of all 156 species. Note that these values are best-case figures that assume a complete cessation of all development in core areas. The actual core area policy limits certain types of development but does not prohibit them (reproduced from Keinath 2015).

mortality for pocket gophers as they venture aboveground (Bui et al. 2010). The Service should consider potential impacts from predation while assessing threats to the species.

(Factor D) The Inadequacy of Existing Regulatory Mechanisms

As Keinath and Beauvais (2006:3) pointed out:

> Immediate conservation action can be taken by limiting additional disturbance to areas containing known, active Wyoming pocket gopher burrow complexes. However, effective long-term conservation requires a

> better understanding of the species' distribution, ecology, and population status.

A decade ago, Keinath and Beauvais (2006: 7) reported that "to date, there are no management plans or conservation strategies pertaining explicitly to the Wyoming pocket gopher although one status assessment has been drafted with support of the Wyoming State Office of the BLM and WYNDD (Beauvais and Dark-Smiley 2005)." This is still true today.

The sage grouse Core Area strategy. The greater sage grouse (*Centrocercus urophasianus*) has been the focus of development of conservation strategies at both the state and federal levels based on the designation of Core Areas at the state level (also designated as Priority Habitat Management Areas in federal plans) to be managed for an elevated level of protection from energy development and other threats. However, analysis by Keinath (2015:43) reveals that "species like Wyoming pocket gopher and Great Plains toad have sufficiently small portions of their distribution within sage grouse core areas that they are unlikely to benefit from core area policies." *See* Figure 12. According to Keinath (2015: 42):

> Conservation action for species having exposure caused by intensive development in areas highly-similar to occupied habitat (e.g., Pygmy Rabbit or Black-footed Ferret) will likely be different than for species where exposure is due to larger portions of their distribution overlapping less-intense development (e.g., Wyoming Pocket Gopher or Great Plains Toad). In particular, the former might benefit greatly from site-specific conservation action (e.g., conservation easements or retirement of mineral rights) targeted toward core areas of distribution, similar to the approach taken for Sage Grouse. In contrast, the latter might require more broad-scale mitigation in the form of development stipulations (e.g., avoiding key habitat features wherever development occurs).

In any case, the sage grouse Core Area strategy provides limited protection from oil and gas development because the vast majority of energy development by 2030 is predicted to occur outside Core Area boundaries (Keinath 2015, see Figure 13).

Federal regulations

Bureau of Land Management. The Wyoming pocket gopher was listed as a BLM Sensitive Species by the Wyoming State Office in 2001 (Beauvais and Dark-Smiley 2005). The goal of the BLM Sensitive Species policy is to maintain vulnerable species and habitat components in functional BLM ecosystems, ensure sensitive species are considered in land management decisions, prevent a need for species listing under the Endangered Species Act, and prioritize needed conservation work with an emphasis on habitat (BLM 2010). For the Sensitive Species policy, "[t]he goal is to ensure that any actions on public lands consider the overall welfare of these species and do not contribute to their decline" (BLM 2005: E-10). According to BLM (2010: 7), "Wyoming pocket

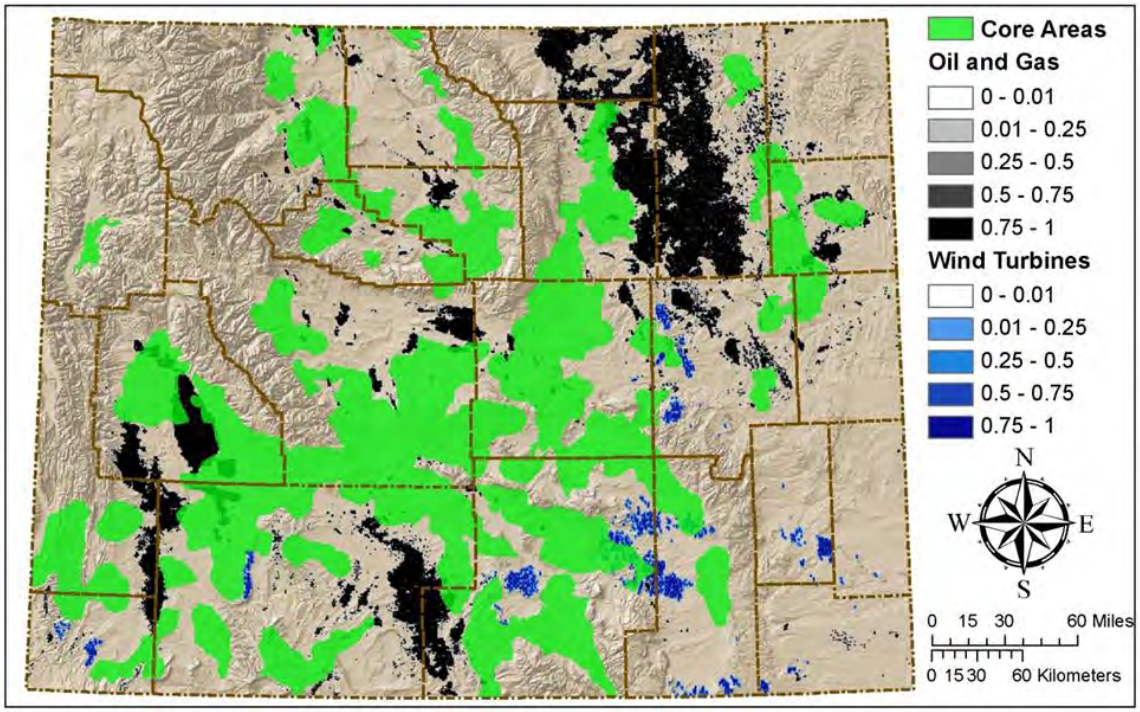

Figure 13. Map of greater sage grouse 'core areas' (green shading) as defined by Wyoming Executive Order 2011-5. Also displayed are the 2030 predicted exposure surface for oil and gas wells and wind-power turbines, a shaded topographic relief map, and county boundaries (reproduced from Keinath 2015).

gopher occurs in geographically restricted and specialized areas that are threatened by human activities, and this species is thereby designated as Sensitive in Wyoming." Thus far, monitoring efforts by BLM for this species have been lax. According to BLM (2013: 102):

> Although habitat has been identified within the [Continental Divide – Wamsutter II, Atlantic Rim, Desolation Flats, and Creston – Blue Gap] EIS areas, to date, the BLM field office biologists have not thoroughly inventoried potential habitats for the Wyoming pocket gopher within the EIS areas. In addition, monitoring potential impacts to the Wyoming pocket gopher as a result of natural gas development has not occurred to date.

The following conservation measures have been reported by the BLM Rawlins Field Office for selected projects (Continental Divide – Wamsutter II, Atlantic Rim, and Desolation Flats) involving Wyoming pocket gopher habitat (BLM 2013: 134):

> To protect potential Wyoming pocket gopher habitat, prior to any surface disturbance, a presence/absence survey for active pocket gopher mounds will be conducted in all potential habitat within the area proposed for surface disturbance. Surveys are to be performed by a wildlife biologist

> familiar with pocket gopher life history and their associated habitat. The survey protocol is available from the BLM RFO upon request. If evidence of pocket gophers is found during the preconstruction survey, then additional stipulations may apply.
>
> In the event that active pocket gopher mounds have been identified by the presence/absence survey, the proposed surface disturbing activities will avoid the active pocket gopher mounds by 75-meters.
>
> Eight t-posts or rebar stakes will be placed at a 75-meter radius around the active pocket gopher mounds prior to any other ground disturbing activities. The posts/stakes will be used to identify the area of avoidance associated with the active pocket gopher mounds. The posts/stakes shall remain in place until completion of the associated surface disturbing activity.
>
> The proponent for this surface disturbing activity does not wish to avoid the active pocket gopher mounds by 75-meters; therefore, a classification survey (via live capture) must be completed to identify the associated pocket gopher to the species level. If the results conclude that the associated species is a Wyoming pocket gopher then the "Occupied Wyoming Pocket Gopher Habitat Protection Measures" will apply. If the results conclude that the associated species is a Northern pocket gopher, then the proposed surface disturbance may proceed without any mitigation. If the classification survey fails to conclusively identify the associated pocket gopher to the species level, then it will be assumed that the species is a Wyoming pocket gopher and the "Occupied Wyoming Pocket Gopher Habitat Protection Measures" will apply.
>
> To protect the potential Wyoming pocket gopher habitat, mitigation will be required as determined by the BLM.

This Monitoring Report provides no information regarding number of Wyoming pocket gophers captured, extent of Wyoming pocket gopher habitats identified, extent of application of the above-listed conservation measures, or effectiveness of the above-listed conservation measures in preventing impacts to Wyoming pocket gophers. According to BLM (2013: 101),

> Although BLM wildlife biologists do map identified Wyoming pocket gopher locations when they are in the field, the CD/WII, DF and AR EIS areas have not been mapped in their entirety for this species at this time. The BLM wildlife biologists determine if Wyoming pocket gopher habitat is or is not located on or adjacent to proposed APDs, ROWs and other projects within the EIS areas, map the identified habitats, and identify required protection measures at the site-specific level.

The absence of monitoring data or analysis of the effectiveness of conservation measures is indicative that the listing of the Wyoming pocket gopher as a BLM Sensitive Species in Wyoming has not resulted in a tangible conservation framework or plan, or even minimally adequate gathering of baseline information.

USDA Forest Service. The Wyoming pocket gopher was listed as a Forest Service Sensitive Species in Region 2 (the Rocky Mountain Region) in 2005 (Keinath and Beauvais 2006). It remains on the list today (USDA Forest Service 2013). Forest Service Sensitive Species are designated in accordance with eight criteria, and

> the available information must provide a compelling argument that population viability is of concern as evidenced by known or predicted downward trends. A species merits inclusion on the Regional list if it is at risk over a substantial part of its range.

(USDA Forest Service 2013). The Medicine Bow National Forest is the only Forest Service unit that potentially supports the Wyoming pocket gopher (Beauvais and Dark-Smiley 2005).

Wyoming state regulations. In the Wyoming Comprehensive Wildlife Conservation Strategy, the Wyoming pocket gopher is listed as a Species of Greatest Conservation Need by the State of Wyoming (WGFD 2005, *and see* WGFD 2010). This strategy "was produced to provide a long-range conservation plan to conserve Wyoming's Species of Greatest Conservation Need (SGCN) and meet the requirements of the Congressionally-authorized State Wildlife Grants (SWG) Program" (WGFD 2005: 1). To be so designated, mammals must meet the following population criteria: "1) populations are greatly restricted or declining–extirpation appears possible; 2) populations are declining or restricted in numbers and or distribution–extirpation is not imminent; 3) species is widely distributed: population status and trends are unknown but are suspected to be stable; and 4) populations are either stable or increasing and are not restricted in either numbers or distribution." For habitat, the following criteria are considered: "1) ongoing significant loss of habitat; 2) habitat is restricted or vulnerable, but no recent or ongoing significant loss; species may be sensitive to human disturbance; 3) habitat is not restricted, the habitat is vulnerable but there is no loss, and the species is not sensitive to human disturbance; and 4) habitat is stable and not restricted" (WGFD 2005: 6). According to the state, "Pocket gophers are considered pests by many, and they have no protection under Wyoming State law" (WGFD 2005: 250).

In its State Wildlife Action Plan, the State of Wyoming has rated the Wyoming pocket gopher as NSS3 [Native Sensitive Species class 3] (Bb), which corresponds with "SEVERE" limiting factors ("limiting factors are severe and not increasing significantly") and "VULNERABLE" population status ("population size or distribution is restricted or declining but extirpation is not imminent") (WGFD 2010). "SEVERE" limiting factors are further described as follows: habitat "restricted, significant loss of habitat;" human activity "sensitive, disturbance significantly impacting populations;" genetics "restricted, unaltered genetic base is severely restricted geographically or

genetically;" invasive species "restricted, invasive species causing significant population impacts or loss of habitat" (WGFD 2010: IV-1-3, 4). According to BLM (2010: 3), "The purpose of this plan is to serve as a point of reference in the management and conservation of Wyoming's wildlife and their habitats." No particular state regulations apply that would protect the Wyoming pocket gopher or its obligate habitats as a result of state Native Sensitive Species designation.

Non-regulatory rankings. The International Union for the Conservation of Nature (IUCN) lists the Wyoming pocket gopher as a species of Least Concern on the IUCN Red List.

NatureServe rates the Wyoming pocket gopher G2 (globally imperiled), N2 (nationally imperiled), and S2 (state imperiled in Wyoming). The NatureServe entry for the gopher was last reviewed in 2006 and the national status was last reviewing in 2000. Reasons for the rating include the fact that the range of the Wyoming pocket gopher is confined to two counties in Wyoming, its status is not well known, and the assessment that it evidently not threatened.

The Service regards NatureServe as an authoritative source for conservation ranks for species in the United States. NatureServe presents information developed by biologists in state and provincial natural heritage programs and conservation data centers and by staff of The Nature Conservancy and NatureServe. These programs rely on collaboration with, and contributions of data from, scientists at universities, conservation organizations, natural history museums, botanical gardens, and state and federal agencies (NatureServe 2007). We hereby incorporate all analysis, references, and documentation provided by NatureServe in its on-line database at http://www.natureserve.org/explorer into this Petition by reference, including all data and analysis underlying its conservation status classification scheme.

NatureServe rankings do not provide any regulatory or policy mechanisms to protect *T. clusius*. However, NatureServe's ranking of "imperiled" for this species supports our conclusion that it needs greater protections. The Service should consider all of the information presented in this petition alongside NatureServe, IUCN, and other non-profit rankings.

The Wyoming Natural Diversity Database ranks the Wyoming pocket gopher G2/S2 (imperiled at the state and global scales) under Heritage Status (WYNDD, no date). According to Smithsonian Institution (n.d.), "The Wyoming Natural Diversity Database has ranked this species as G2/S2, a reflection of concern that the species is at risk of extinction within the state, and that since no examples have been proven outside the state, such an event would mark global extinction as well."

(Factor E) Other Natural or Man-made Factors Affecting its Continued Existence

Drought and climate change. Vulnerability of a species to climate change is mediated by that species' exposure and sensitivity, which is exacerbated in populations that are

small or isolated (Williams et al. 2008). Hadly (1997) demonstrated through cave deposits of bones that pocket gopher abundances changes significantly from arid to moderate climate periods across the past 3,200 years, becoming scarcer during drier periods. Griscom and Keinath (2010: 6) placed climate change on the same level of threat as oil and gas development, as it "could shift or degrade *T. clusius* habitat in a relatively short period of time." For sagebrush ecosystems as a whole (of which the Gardner's saltbush plant community is a part), Neilson et al. (2005) found that sagebrush habitats are vulnerable to climate change, but the Red Desert of Wyoming was modeled to remain in sagebrush habitat under all eight climate change simulation models examined. A changing climate is expected to result in more intense and more prolonged drought in this region (Neilson et al. 2005), impacting the productivity of vegetation upon which *T. clusius* relies for sustenance.

Small, isolated populations. The Service has previously recognized that small population size and small, isolated populations increases the likelihood of extinction.[1] For example, in reference to the Sisi snail (*Ostodes strigatus*), the Service noted that "[e]ven if the threats responsible for the decline of this species were controlled, the persistence of existing populations is hampered by the small number of extant populations and the small geographic range of the known populations." Heightened risk of extinction is "inherent in low numbers," a basic tenet that has been a cornerstone of conservation biology (Caughley 1994: 216). Small, isolated populations such as those of the Wyoming pocket gopher are particularly vulnerable to: 1) demographic fluctuations, 2) environmental fluctuation in resource or habitat availability, predation, competitive interactions and catastrophes, 3) reduction in cooperative interactions and subsequent decline in fertility and survival, 4) inbreeding depression reducing reproductive fitness, and 5) loss of genetic diversity reducing the ability to evolve and cope with environmental change (Traill et al. 2010: 29).

The Service, in their final rule listing the streaked horned lark and Taylor's checkerspot butterfly, considered both species at risk due to small population size or small, isolated populations (USFWS 2013a: 61,489).

> Populations that are small, fragmented, or isolated by habitat loss or modification of naturally patchy habitat, and other human-related factors, are more vulnerable to extirpation by natural, randomly occurring events, to cumulative effects, and to genetic effects that plague small populations, collectively known as small population effects. These effects can include genetic drift (loss of recessive alleles), founder effects (over time, an increasing percentage of the population inheriting a narrow range of traits), and genetic bottlenecks leading to increasingly lower genetic diversity, with consequent negative effects on evolutionary potential. (USFWS 2013a: 61,488)

The Service found similar threats when listing the Florida bonneted bat:

[1] For examples, see candidate assessment forms for *Ostodes strigatus* (Sisi snail, June 2013), *Porzana tabuensis* (spotless crake, June 2013), *Vagrans egistina* (Mariana wandering butterfly, June 2013), *Gallicolumba stairi* (friendly ground-dove, June 2013), and *Hyla wrightorum* (Arizona treefrog, April 2013) (Available at http://ecos.fws.gov/tess_public/pub/SpeciesReport.do?listingType=C&mapstatus=1)

> In general, isolation, whether caused by geographic distance, ecological factors, or reproductive strategy, will likely prevent the influx of new genetic material and can result in low diversity, which may impact viability and fecundity. Distance between subpopulations or colonies, the small sizes of colonies, and the general low number of bats may make recolonization unlikely if any site is extirpated. Isolation of habitat can prevent recolonization from other sites and potentially result in extinction. The probability of extinction increases with decreasing habitat availability. Although changes in the environment may cause populations to fluctuate naturally, small and low-density populations are more likely to fluctuate below a minimum viable population (i.e., the minimum or threshold number of individuals needed in a population to persist in a viable state for a given interval). If populations become fragmented, genetic diversity will be lost as smaller populations become more isolated. (USFWS, 2013b: 61,037, *internal citations omitted*)

The Wyoming pocket gopher has small, isolated populations and fragmented habitat, and thus is facing a similar risk of extinction.

Cumulative threats. The Service should consider whether the array of aforementioned threats intersect and act synergistically, therefore increasing the likelihood of extinction or endangerment of the Wyoming pocket gopher in the foreseeable future.

For example, threats from energy development are exacerbated by climate-induced reductions in palatable vegetation, which may impact the species in a synergistic way. These are just examples of intersecting threats facing the Wyoming pocket gopher

> Traits such as ecological specialization and low population density act synergistically to elevate extinction risk above that expected from their additive contributions, because rarity itself imparts higher risk and specialization reduces the capacity of a species to adapt to habitat loss by shifting range or changing diet. Similarly, interactions between environmental factors and intrinsic characteristics make large-bodied, long-generation and low-fecundity species particularly predisposed to anthropogenic threats given their lower replacement rates. (Brook et al., 2008, p. 455, *internal citations omitted*)

> [O]nly by treating extinction as a synergistic process will predictions of risk for most species approximate reality, and conservation efforts therefore be effective. However challenging it is, policy to mitigate biodiversity loss must accept the need to manage multiple threatening processes simultaneously over longer terms. Habitat preservation, restoring degraded landscapes, maintaining or creating connectivity, avoiding overharvest, reducing fire risk and cutting carbon emissions have to be planned in unison. Otherwise, conservation actions which only tackle individual threats risk becoming half-measures which end in failure, due to uncontrolled cascading effects. (Brook et al., 2008, p. 459, *internal citations omitted*)

CONCLUSION AND REQUESTED DESIGNATION

WildEarth Guardians hereby petitions the U.S. Fish and Wildlife Service under the Department of Interior to list the full species, the Wyoming pocket gopher (*Thomomys clusius*), as an "endangered" species pursuant to the Endangered Species Act. This listing action is warranted, given the rarity of the species and possible declines in abundance, limited range, fragmented nature of suitable habitats, and multiple range-wide threats to the species and its habitat particularly from oil and gas, uranium, and wind energy development. Adequate regulatory mechanisms do not exist to protect this species from further population declines. The Wyoming pocket gopher is threatened by at least three of the five listing factors under the ESA: the present or threatened destruction, modification, or curtailment of habitat or range (Factor A), the inadequacy of existing regulatory mechanisms (Factor D), and other natural or man-made factors affecting its continued existence (Factor E).

Habitat degradation and loss is a leading threat to the Wyoming pocket gopher. This petition therefore requests that critical habitat be designated for *Thomomys clusius* concurrent with ESA listing. Designating critical habitat for the Wyoming pocket gopher will support its recovery and protect areas crucial to long-term survival of Wyoming pocket gopher populations.

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