Wyoming Pocket Gopher

Thomomys clusius

***Identifiers**:[1]

Integrated Taxonomic Information System Serial Number: 180224

Global Biodiversity Information Facility Taxon Key: 241778

Natural Heritage Network Species Identifier: AMAFC01050

Species2000 Name Code: ITS-180224

Zipcode Zoo Species Identifier: 16729

*Last Revised June 25, 2007

In the Office of Endangered Species

U.S. Fish and Wildlife Service

United States Department of Interior

Petition to the U.S. Fish and Wildlife Service to List the Wyoming Pocket Gopher (*Thomomys clusius*) as an Endangered or Threatened Species Under the Endangered Species Act, 16 U.S.C. § 1531 et Seq. (1973 as amended), and to Designate Critical Habitat.

Submitted

August 7, 2007

Via

Email w/Return Receipt Request

USPS Certified

Fax

[1] ZipcodeZOO.com: http://zipcodezoo.com/Animals/T/Thomomys_clusius.asp

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and via invoking the Freedom of Information Act

Bureau of Land Management , U.S. Fish and Wildlife Service, and U.S.D.A. National Forest Service

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Figure 1. *Thomomys clusius*, Courtesy, Wyoming Natural Diversity Database

I. Introduction

Biodiversity Conservation Alliance, Center for Native Ecosystems, Duane Short, and Erin Robertson hereby petition the Secretary of the Interior and the U.S. Fish and Wildlife Service (FWS) for a rule to list the Wyoming pocket gopher (*Thomomys clusius*) as Threatened or Endangered within its known historic range under the Endangered Species Act (ESA) pursuant to the ESA, 16 U.S.C. § 1531, *et seq.* and regulations promulgated thereunder, and the Administrative Procedure Act, 5 U.S.C. § 553(e), and for the designation of Critical Habitat. Pursuant to 16 U.S.C. §§ 1533(b)(1)(c)(iii) and 1533(b)(7) and 50 C.F.R. § 424.20, .

Petitioners further petition the Secretary and FWS to promulgate a rule listing *T. clusius* on an emergency basis due to significant risks to the well being of this species, as discussed below. *Thomomys clusius* is endemic to Wyoming and thought to exist currently in only a few locations in Carbon and Sweetwater Counties (Keinath and Beauvais 2006). Historical population and distribution records are unreliable due to taxonomic confusion that persisted prior to more recent advances in genetic profiling (Keinath and Beauvais 2006) but by all scientific accounts *T. clusius* is known to exist in an extremely limited range and in very low numbers.

The Wyoming Natural Diversity Database (Keinath and Beauvais 2006), likely the most comprehensive database for *T. clusius* in existence, states that only 21 individuals have been positively identified in recent surveys. *Thomomys clusius* has extremely limited distribution in an area degraded by grazing, poisoning and herbicide applications, oil and gas development, and effects of global warming on temperature and ultraviolet light sensitive and drought intolerant vegetation. The few surviving populations of this species are in imminent danger of being extirpated by future development disturbance. Immediate listing is essential for the continued existence of this species.

A central purpose of the ESA is to "provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved…" (16 U.S.C. § 1531(b)). Pocket gophers are considered keystone species and keystone engineers. They have disproportionate effects on the species composition of ecosystems and must be preserved in order to maintain the integrity of the very ecosystems in which they exist. By listing *T. clusius* under the ESA, FWS will provide needed protections to these ecosystems and the other species that inhabit them.

This petition provides sufficient information to demonstrate that the petitioned actions are warranted. *Thomomys clusius* meets the definition of an Endangered species as defined by the Act.

Wyoming pocket gophers, due their historically restricted range, are seriously threatened by land management practices that allow even slight alteration to the natural order of a landscape that best available science has concluded is essential to their survival as a species. Throughout its small range, the Wyoming pocket gopher is vulnerable to catastrophic population declines and range shrinkage due to habitat encroachment and destruction. Federal land managers are not actively conserving known *T. clusius* colonies (Keinath and Beauvais 2006). Destruction of habitat and potential habitat continues in rural areas, primarily from expanding oil and gas development (existing and proposed).

Threats to Wyoming pocket gophers clearly exist all around and throughout its limited and already fragmented ecosystem. Chief among these threats is oil and gas development that is slated for the entire known Wyoming pocket gopher range (See **Attachment D**, **Map 1**). The Wyoming pocket gopher is possibly a keystone species in that it creates and sustains limited but essential habitat for members of phyla annelida, arthropoda, mollusca, nematoda, nemertea, and platyhelminthes (all foundation or primary species of the *T. clusius* ecosystem and its food chain). *T. clusius* also serves as prey to raptors, reptiles, and mammals. As Wyoming pocket gophers decline so, too, do members of numerous phyla. Insects, birds, reptiles, amphibians, and carnivores that benefit from, and in some unknown cases may require, the keystone habitat provided by the burrowing Wyoming pocket gopher. These interdependent species, until proven otherwise, should also be considered at risk if *T. clusius* is not protected. While most efforts to document *T. clusius* range have been limited to federal lands it is prudent for the Service to consider the potential for *T. clusius* threats, including habitat loss, on private lands as well. The Safe Harbor policy relies on the "enhancement of survival" provisions of 16 U.S.C. § 1539(a)(1)(A) rather than the HCP provisions of 16 U.S.C. § 1539(a)(1)(b) even though the two are closely related (64 Fed. Reg. 32706. June17, 1999).

The signatories of this document understand and agree with the following statement. The fact that the Wyoming pocket gopher (*T. clusius*) is largely "out-of-sight, out" must not be interpreted by the U.S. Fish and Wildlife Service or any other federal agency, department, bureau, or instrumentality thereof as being "out of mind" and, therefore, of lesser significance than any other given more *charismatic* species.

It should be noted at this point that the Wyoming Natural Diversity Database has provided nearly all of the peer-reviewed scientific literature cited in this petition. (**See Attachment C**). With great appreciation to Wyoming Natural Diversity Database (WYNDD), Biodiversity Conservation Alliance is conveying WYNDD's work in terms of literatures searches, laboratory investigations, and on the ground efforts to further understand *T. clusius*. Biodiversity Conservation Alliance also acknowledges, with great appreciation, the body of peer reviewed scientific literature supplied by our co-petitioner, Center for Native Ecosystems, located in Colorado (Center for Native Ecosystems et al. 2003).

The petitioners for the purpose of this specific petition did not seek, as is often the custom, signatures from each state of the United States of America to symbolize a broad scope of support for the diligent protection of the Wyoming pocket gopher (*T. clusius*). Nor did the petitioner and co-petitioner seek to find and present a long list of scientists, conservation organizations, and others to show a broad and deep base of support for our petition. The Wyoming pocket gopher is quite possibly North America's rarest mammal and more likely the least known. Rivaled perhaps only by mammals such as bats, skunks, rats, and our nation's only marsupial, the ubiquitous opossum, the Wyoming pocket gopher, among the few who are aware of its existence, suffers from a palpable lack of charisma.

To the U.S. Fish and Wildlife Service its utter lack of charisma and present insufficient scientific understanding of *T. clusius* represents neither legal, social, ethical, or scientific cause to reject this petition. The discussion below (Buck, et al. 2005) is available online at:
http://www.ncseonline.org/NLE/CRSreports/05apr/IB10144.pdf

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> **Use of "Sound Science".** The ESA requires that decisions to list a species be made "solely on the basis of the best scientific and commercial data available...." (See CRS Report RL31546, *The Endangered Species Act and Science: the Case of Pacific Salmon,*

by Eugene H. Buck, et al.) In several recent situations, legal, economic, and social disputes have resulted from actions taken to list, protect, and recover species under the ESA. Recent examples of these controversies have concerned the Canada lynx, Florida panthers, and Klamath River Basin suckers and coho salmon. Critics in some of these disputes suggest that the science supporting ESA action has been insufficiently rigorous or mishandled by the agencies.

A major issue is how the FWS and NMFS are to proceed when the "available" data are not extensive. Under current law and agency interpretations, a margin of safety is provided dwindling species pending completion of additional studies. Some suggest that considerations other than species conservation should prevail; others seek to change the current posture of the law by changing the role of "science." For others, recent bills are seen as an attempt to undermine the ESA, which they see as having struck a reasonable balance, and they question whether an amendment concerning science is advisable or practical. These considerations are complicated by the costs and time required to acquire more complete data, particularly in connection with many lesser-known species. Many rare and endangered species are little studied because they are hard to find or because it is difficult to locate enough of them to support scientific research. There may be little information on many species facing extinction, and only limited personnel or funds available to conduct studies on many of the less charismatic species, or those of little known economic import. What should be done in such instances?

The ESA does not elaborate on this question, but some argue that, combining the protective purpose of the ESA — to save and recover species — with the wording of "best ... data *available*," arguably dwindling species are to be given the benefit of the doubt and a margin of safety provided. This is the position taken in the *FWS Handbook* at pages 1-6, which states that efforts should be made to develop information, but if a biological opinion must be rendered promptly, it should be based on the available information, "giving the benefit of the doubt to the species," with consultation possibly being reinitiated if additional information becomes available. This phrase is drawn from (H. Rept. 1979 96-697, p. 12), which stated that the "best information available" language was intended to allow the FWS to issue biological opinions even when information was incomplete, rather than being forced to issue negative opinions. The report also states that if a biological opinion is rendered on the basis of inadequate information, the federal agency proposing an action has the duty to show its actions will not jeopardize a species and a continuing obligation to make a reasonable effort to develop information, and that the statutory language "continues to give the benefit of the doubt to the species" (Buck et al. 2005).

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Precedent certainly exists that uncharismatic and poorly understood species have been listed as threatened or endangered based on the scientific facts of their circumstances or lack thereof. Below is an account of one representative "out of sight, out of mind" and "uncharismatic" species listed, first, as Threatened in 1997 and in 1988, as Endangered under the Endangered Species Act. (See **Attachment A**)

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Source: *Endangered and Threatened Species of the Southeastern United States (The Red Book)* FWS Region 4 -- As of 2/91. Also, available online at: http://www.fws.gov/endangered/i/e/sae1c.html

ALABAMA CAVEFISH

(*Speoplatyrhinus poulsoni*)

FAMILY: Amblyopsidae

STATUS: First listed as threatened on October 11, 1977 (42 Federal Register 45526); reclassified as Endangered (Federal Register, September 28, 1988).

DESCRIPTION AND REPRODUCTION: The Alabama cavefish is a blind, white, cave dweller distinguishable from other cavefish by its long, anteriorly-depressed head with flat snout, absence of bifurcate fin rays, notably incised fin membranes, and other features. The maximum known size is 58.3 millimeters standard length. This species' diet probably includes copepods, isopods, amphipods, and small cavefish.

Little information is available on the reproductive cycle of the Alabama cavefish. As their range becomes more restricted, most cavefish show a concurrent decrease in reproductive potential and population growth. However, the longevity of adult cavefish may increase. Of the small percentage of females which reproduce, only a few eggs are produced per female, and reproduction does not occur in some years. Because the Alabama cavefish is endemic to only one cave, all of these life history features are probably more extreme in the Alabama cavefish than in some other amblyopsids.

RANGE AND POPULATION LEVEL: This species is apparently restricted to Key Cave, Lauderdale County, Alabama (Tennessee River drainage). Extensive surveys have been conducted in other area caves with no results. The caves west of Key Cave were inundated by Pickwick Lake. This species' former distribution is unknown. However, this species appears to be the rarest of all American cavefish and one of the rarest freshwater fish. (U.S. Fish and Wildlife Service 1985). Cooper (1985) estimated the Alabama cavefish population in Key Cave to be fewer than 1OO individuals. No more than 1O cavefish have ever been observed on a single visit.

HABITAT: Key Cave is a large multi-level cave with over 1O,OOO feet of mapped passage (Dept. of Interior 1988). Water depths may rise to about 2O feet in late spring (U.S. Fish and Wildlife Service 1985). This cave has a stable environment with low temperature and a lack of visible incident radiation. An underwater species, the Alabama cavefish is less affected by photoperiod and temperature changes within the cave than are surface species. However, seasonal flooding is necessary to trigger hormonal changes within the cavefish for growth and reproduction. Gray bat guano contributes essential nourishment for all species involved in Key Cave's food chain.

CRITICAL HABITAT: Key Cave in Lauderdale County, Alabama. More specific locality data for Federal agencies fulfilling their obligations under Section 7 of the Endangered Species Act can be obtained from the U.S. Fish and Wildlife Service, Post Office Drawer 119O, Daphne, Alabama 36526. Alabama Cavefish 2/91

REASONS FOR CURRENT STATUS: One of the primary threats is interference with the associated bat populations which indirectly contribute to the fish's food chain. Another serious threat is groundwater contamination from agricultural operations and a sewage disposal project for the City of Florence, Alabama. Most of Key Cave's recharge area is in row crops, and the sludge disposal project is also within the recharge area. Natural factors contributing to the vulnerability of this species are its small population size and low reproductive potential. Competition with the more numerous and agressive southern cavefish for food and space is also a problem. Cave crayfish, a known predator of this species, are also abundant in Key Cave.

MANAGEMENT AND PROTECTION: The Tennessee Valley Authority owns the two entrances to Key Cave, and has erected a fence to minimize human disturbance. Key Cave and nearby Bone Slough Cave have been mapped. Other needed measures include further research on the biology and distribution of the species; monitoring of the Key Cave population; and physicochemical monitoring of its habitat. Recovery efforts also need to be implemented or continued to protect the endangered gray bat, an essential link in the cave's ecosystem.

REFERENCES:

Cooper, John E. and R.A. Kuehne. 1974. Speoplatyrhinus poulsoni, a New Genus and Species of Subterranean Fish from Alabama. Copeia, No. 2, pp. 486-493.

Department of the Interior. U.S. Fish and Wildlife Service. September 28,

1988. Endangered and Threatened Wildlife and Plants: Reclassification of the Alabama Cavefish from Threatened to Endangered. Federal Register, 53:188. pp. 37968-3797O

Federal Register, Vol. 42, No. 175. September 9, 1977.

**U.S. Fish and Wildlife Service. 1985. Revised Recovery Plan for the Alabama Cavefish, Speolatyrhinus poulsoni Cooper and Kuehne 1974. Prepared by John E. Cooper, North Carolina Museum of Natural History. U.S. Fish and Wildlife Service, Atlanta, Georgia. 66 pp.

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This petition document reveals and, certainly, the Service's subsequent investigation will reveal, Wyoming pocket gopher (*Thomomys clusius*) shares a similar lack of scientific attention; a relatively equally limited range of critical habitat; a near total absence of protective measures by private and public entities; and a risk of extinction equal to or greater than that which threatened, prior to its Listing, the now E.S.A. Endangered Alabama Cave Fish (*Speoplatyrhinus poulsoni*).

Perhaps the most revealing document is the document, prepared by Biodiversity Conservation Alliance for the National Wildlife Federation which reveals that the Wyoming pocket gopher (*T. clusius*) is not mentioned by the Bureau of Land Management as a species of concern nor does the Bureau recognize the existence or even possible existence of T. clusius in BLM lands, leased for oil and gas exploration and drilling, within or around the Great Divide which includes known T. clusius populations (Biodiversity Conservation Alliance. 2005)(also, **See Attachment F**).

This petition document's limited, but sound, scientific and strong legal bases for listing the Wyoming pocket gopher as an Endangered or Threatened species under the ESA. This petition announces a near absence of scientific literature concerning the ecology of *T. clusius*. Biodiversity Conservation Alliance FOIA requests of the Bureau of Land Management and USFWS each produced virtually no scientific literature on *T. clusius*. The U.S. Forest Service produced very limited information (See **Attachment B**). The glaring lack of life cycle, general ecological, and evolutionary knowledge about *T. clusius* combined with well accepted scientific knowledge of this species' severely and quite probably naturally limited range is more than sufficient to raise *T. clusius* to the level of Endangered Species Act consideration for listing as endangered or threatened. In two separate Forest Service Routt National Forest Small Mammal Inventory project proposals *T. clusius* is included. Both 2006 and 2007 proposals included the following as justification for the projects (USDA Forest Service 2006, 2007).

> "*Petitioners are requesting listing of the Wyoming pocket gopher under the Endangered Species Act as threatened or endangered and request the designation of critical habitat for this species. Best available scientific information and rapidly expanding oil and gas field development indicates at least a significant potential for rapid population declines and range shrinkage of T. clusius. Across their limited range, acreage occupied by Wyoming pocket gophers appears to have declined in less than a century. In short, T. clusius possesses intrinsic threats and faces rapidly intensifying extrinsic threats*."

In his *Description of the Proposal* Responsible Officer, Robert Skorkowsky also stated in both 2006 and 2007,

> "There are several Sensitive Species listed on the 2005 Regional Foresters Sensitive Species List for the Routt National Forest with little to no data. These obscure small mammals include the pygmy shrew (*Sorex hoyi*), fringed myotis (*Myotis thysanodes),* Townsend's big-eared bat (*Plecotus townsendii)* and the Wyoming pocket gopher (*Thomomys clusius)*. The proposal is to conduct a systematic inventory on the Routt Forest to determine if and where these species occur. The project will also involve specific sampling at historic observation locations to determine if the species is still present at historic known locations." (USDA Forest Service 2006, 2007)

One emerging intrinsic threat adding impetus to the need to list and further study *T. clusius* is a pathophysiological threat from endoparasites (Todd and Lepp 1971). Because of research conducted in Park County Wyoming on the much more common Northern pocket gopher (*Thomomys talpoides*) it is incumbent upon the U.S. Fish and Wildlife Service to consider that Wyoming pocket gopher (*T. clusius*) populations are likely impacted by endoparasites, *Eimeria fitzgera/di and E. tizomomysis. In 1971* the finding of *E. thomomysis* in *T. talpoides* was deemed "evidently a new host and geographic record (Todd and Lepp 1971). This is evidently the only other record of larval tapeworms from *Thomomys.* The rare and obscure nature of *T. clusius* has precluded it from studies such as those conducted involving *T. talpoides* and other more common species of pocket gophers. Small population size, alone, is a fundamental threat to any given species and has long been recognized as such by biologists and even lay persons.

T. clusius populations are known to exist on ridge tops where, often, the Northern pocket gopher, *T. talpoides*, a more physically robust species, populates an area that essentially surrounds *T. clusius* habitat (Keinath and Beauvais 2006).

Anthropogenic sourced habitat destruction is also a very real threat to Wyoming pocket gophers, largely in the form of oil and gas operations on Bureau of Land Management (BLM) lands. (See Exhibit B - National Wildlife Federation and Biodiversity Conservation Alliance: Great Divide Special Values Report. March 2005.) Oil and gas exploration and extraction causes harm to Wyoming pocket gophers from habitat loss (especially from road-building) and human disturbance. While much of this leasing is occurring on federal lands, public land managers and those sworn to protect threatened and endangered species are categorically failing to do so. While this situation exists
in various degrees within agencies, departments, and other instrumentalities at federal, state, and local levels, recent Office of Inspector General investigations have concluded that responsible officials at high levels have manipulated science to delist or deny listing of species that are now being reviewed. This kind

of hostile political environment, alone, must be recognized for what it is, a threat to species at risk. Former Deputy Assistant Secretary for Fish and Wildlife and Parks, Julie MacDonald, resigned earlier this year in the wake of what could be an incriminating investigation by Department of Interior Inspector General, Earl E. Devaney. Devaney's report revealed a pattern of abuse of authority, intimidation of US Fish and Wildlife staff, and tampering with science used to determine whether plants and animals should be listed or delisted as threatened or endangered species under the Endangered Species Act (Devaney 2007) (See **Attachment G**).

The decline of *T. clusius* from historic levels, combined with the severe, multiple threats that currently face remaining populations, provide a sound biological basis for listing this species under the Endangered Species Act. In fact, Wyoming pocket gophers will likely have difficulty sustaining their populations due to their small numbers alone. Other anthropogenic threats compounding the impact of declining numbers and – poisoning, shooting, and rapid habitat destruction – must be addressed. Listing under the federal Endangered Species Act is the most effect way to address and harness these threats and alter their course to extinction, from one where Wyoming pocket gophers are essentially "out of sight and out of mind" to one which acknowledges their imperiled status and their important, if not keystone, role in native ecosystems.

> Section 424 of the regulations implementing the Endangered Species Act (50 C.F.R. § 424) is applicable to this petition. Subsections that concern the formal listing of the Wyoming pocket gopher as an Endangered or Threatened species are:
>
> 424.02(e) "Endangered species" means a species that is in danger of extinction throughout all or a significant portion of its range."…(k) "species" includes any species or subspecies that interbreeds when mature.
>
> "Threatened species" means a species 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)).
>
> 424.11(c) "A species shall be listed…because of any one or a combination of the following factors:
>
> 1. The present or threatened destruction, modification, or curtailment of habitat or range;

2. Overutilization for commercial, recreational, scientific, or educational purposes;
3. Disease or predation;
4. The inadequacy of existing regulatory mechanisms; and
5. Other natural or manmade factors affecting its continued existence.”

All five of the factors set forth in 424.11(c) have resulted in the continued decline of the Wyoming pocket gopher. At least four factors are causing the species to face endangerment and extinction. Effects of disease and predation are essentially unknown but cannot be considered to insignificant because the Northern pocket gopher is known to be susceptible to endoparasites that produce lower fecundity and even death in individuals. It is reasonable to expect similar effects of endoparasites on *T. clusius*.

The purposes of the ESA are two-fold, to conserve threatened and endangered species and the ecosystems on which they depend. The Act’s Section 2 reads:

> *"The purposes of this chapter are to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved, to provide a program for the conservation of such endangered species and threatened species…"*

See 16 U.S.C.A. § 1531(b). This is set forth as the purpose and cornerstone of the ESA and our petition therefore goes to the very heart of this visionary law.

There is sufficient literature on pocket gophers in general as playing keystone roles in the ecosystems where they are found (Kotliar et al. 1999; Kotliar 2000; Miller et al. 2000; Lomolino and Smith 2003).

Given its possible status as a keystone species, listing the Wyoming pocket gopher as an Endangered or Threatened species under the ESA would further the ecosystem protection purpose of this law and should therefore be a high priority listing action. FWS has committed itself to the principle of ecosystem management (e.g., GAO 1994; FWS 1997), and federal protection for the Wyoming pocket gopher is an important manner in which the agency could fulfill this commitment.

II. Petitioners

Biodiversity Conservation Alliance

The mission of the Biodiversity Conservation Alliance is to protect and restore biological diversity, habitat for wildlife and fish, rare plants, and roadless lands in Wyoming and surrounding states. We started doing conservation work in 1988 to preserve the natural character of the Medicine Bow National Forest in southeastern Wyoming. Although we continue to fill this niche today, by the early 1990's our work had expanded far beyond the 'Bow, with increasing attention to wildlife issues. In 1994 we legally incorporated as Biodiversity Associates, but we have recently changed our name to Biodiversity Conservation Alliance to better reflect our strong advocacy work and the growing nature of our organization. We are a lean, efficient non-profit organization with a current full time staff of five.

We concentrate our efforts on the forests, prairies, and rivers of Wyoming, western South Dakota, and northern Colorado. Our focus is on entire ecosystems and on individual species, particularly those which are in need of immediate conservation help but lack a constituency and do not have a high public profile. The Biodiversity Conservation Alliances' guiding principle is that all species and ecosystems deserve protection. For example, numerous groups are working to gain protection for the Yellowstone ecosystem and charismatic species such as the Grizzly Bear, but few are advocating for protection of the Desert Yellowhead (a rare plant known to exist in only one small area in central Wyoming), Vertigo snails in the Black Hills, or the Bluehead Sucker in the Little Snake River. Biodiversity Conservation Alliance, along with other conservation groups, continues to work at its original mission of protecting the Medicine Bow ecosystem and its critical forested links to the Rocky Mountains in Colorado.

We use outreach and education to foster public support for biodiversity and wild areas. And we use science and the law to hold public managers and decision-makers accountable for protecting the nation's natural heritage and upholding the public trust. Our three primary strategies to gain increased protection for wild species and their habitats are:

(1) educating the public and decision makers (like the U.S. Forest Service and Bureau of Land Management) about the importance of conserving biological diversity and wild lands,
(2) advocating directly through citizen alerts, written comments, meetings, technical analyses, etc., for the conservation of wildlife and sensitive habitats, and concurrently advocating for less damaging alternatives to ill-conceived development proposals,
and

(3) opposing by lawsuit and administrative protest developments that threaten rare species or sensitive ecosystems.

Of course, to do these things, it is necessary to first determine where sensitive species and sensitive habitats exist, so an important part of our work is dedicated to this task as well. This component involves field work, literature searches, interviews with scientists, and analysis using Geographic Information Systems (GIS) and computer mapping. We also provide technical assistance on legal issues, conservation science, and GIS to a number of citizen groups.

Although we work collaboratively with a large number of other conservation groups, The Biodiversity Conservation Alliance is not affiliated with any other local, regional, or national organizations. Biodiversity Conservation Alliance is interested in the conservation of species that face high levels of imperilment, especially those who play important umbrella and keystone functions within their ranges. The Wyoming pocket gopher is therefore a high priority species for Biodiversity Conservation Alliance. In addition, Biodiversity Conservation Alliance strives for the restoration and preservation of all naturally occurring components and processes within native ecosystems.

Center for Native Ecosystems

We are dedicated to conserving and recovering the native species and ecosystems of our region. We value the clean water, fresh air, healthy communities, sources of food and medicine, and recreational opportunities provided by native biological diversity. We also passionately believe that all species and their natural communities have the right to exist and thrive. We use the best available science to forward our mission through participation in policy, public outreach and organizing, administrative processes, legal action, and education.

III. <u>ESA listing criteria</u>

Under the ESA, imperiled species need to meet only one of the following listing criteria to merit formal listing (16 U.S.C. § 1533(a)(1)). *Thomomys clusius* meets all five listing criteria and therefore clearly warrants designation as an Endangered or Threatened species under the ESA. Moreover, given the imminent risk of extinction of *T. clusius*, it should be provided with emergency listing under the Act.

A. <u>The present or threatened destruction, modification, or curtailment of the species' habitat or range</u>

Development pressure including grazing and, in particular, oil and gas development have degraded and destroyed *T.clusius* habitat (Keinath and Beauvais 2006). These threats are ongoing as many areas of remaining undeveloped land in Carbon and Sweetwater Counties, in Wyoming, have been purchased or leased, and reserved for future development.

<u>B. Overutilization for commercial, recreational, scientific, or educational Purposes</u>

Development, habitat conversion, recreational, and other activities may have resulted in the destruction of individual *T. clusius* populations during the pursuit of commercial or recreational activities (Keinath and Beauvais 2006). Remaining individuals are similarly threatened. The preferred habitat of this species occupies an area with high potential for alternate use [oil and gas development] (Keinath and Beauvais 2006). Destruction of property as a result of burrowing activity in residential and commercial areas may lead to increased poisoning and trapping of *T. clusius* (Keinath and Beauvais 2006).

C. <u>Disease or predation</u>

Residential and commercial development and other human activities may increase rates of predation by domestic cats and dogs and by disturbance-tolerant predators such as raccoons and coyotes. Furthermore, additional and more varied raptor perches created by commercial and residential development increases predation risks from above ground (Keinath and Beauvais 2006). Recent studies indicate endoparasites common to pocket gophers are having harmful effects not before seen (Todd and Lepp 1971). While the underlying cause remains unknown, the threat to populations is clear.

D. Inadequacy of existing regulatory mechanisms

State and federal agencies have failed to conduct even basic monitoring for this rare species, let alone protect it from development, recreational, and other pressures. Remaining populations of *T. clusius* are at least partly on private land, and no regulations pertaining to *T. clusius* apply to these lands. While some populations may be partly on land owned by public entities including cities, recreational districts, and water districts, these lands are generally managed for either active recreation or municipal use rather than for maintenance of wildlife habitat (Keinath and Beauvais 2006).

E. Other natural or man-made factors affecting the species' continued existence

The small size of all remaining populations of *T. clusius* makes them extremely vulnerable to extirpation due to factors such as environmental and demographic stochasticity and the loss of genetic variability (Keinath and Beauvais 2006). Increases in soil moisture and stochastic events such as flooding could potentially extirpate entire populations of this species (Keinath and Beauvais 2006). Changes in climate such as warmer average temperatures and drought can create potentially drastic changes to *T. clusius* habitat (Keinath and Beauvais 2006). Stress resulting from continuous habitat disturbance has been documented to affect biological processes, such as birth rates, in a wide variety of species (Keinath and Beauvais 2006). *Thomomys clusius* is no exception.

IV. Classification and nomenclature

Thomomys clusius is known as the Wyoming pocket gopher. Pocket gophers are part of the family Geomyidae (Keinath and Beauvais 2006). Pocket gophers comprise the family *Geomyidae*, within which there are currently six recognized genera: *Cratogeomys* (eight species), *Geomys* (nine species), *Orthogeomys* (11 species), *Pappogeomys* (two species), *Thomomys* (nine species), and *Zygogeomys* (one species) (Keinath and Beauvais 2006). Species of the genus *Thomomys* have recently been allocated to two subgenera based on chromosome number and molecular characters: (Wilson and Reeder, eds. 2005) *Megascapheus* (four species) and *Thomomys* (five species, including the Wyoming pocket gopher and its close relative the Northern pocket gopher). (Keinath and Beauvais. 2006).

The placement of the Wyoming pocket gopher in this scheme has changed somewhat over time, and the name *clusius* has been variously applied at both the species and subspecies level to pocket gophers whose range centered roughly on southern Wyoming (Keinath and Beauvais 2006). The type specimen was collected in 1857 by Dr. W. A. Hammond about 18 miles southwest of

Rawlins, Wyoming, but it was not described until 18 years later when it was given the name *Thomomys clusius* (Coues, E. 1875). After that, it was sometimes referenced as a subspecies of the northern pocket gopher (*T. talpoides clusius*) until investigators Thaeler and Hinesley clarified its taxonomy and range boundaries by conducting karyotype analyses (Thaeler and Hinesley 1979). These analyses also showed that specimens assumed to be *T. clusius* in earlier publications (Bailey, V. 1915, Long, C.A. 1965) were in fact *T. talpoides*. Even after the terminology was solidified and a reasonable estimate of range was formed through the work of Thaeler and Hinesley some authors persisted using the subspecific classification of *T. t. clusius* (Hall, E.R. 1981). *Thomomys clusius* is now widely recognized as a unique species (Wilson, D.E. and D.M. Reeder, editors. 2005) whose range is more-or-less completely encompassed by the range of *T. talpoides* (See **Attachment C**: (Keinath et al, 2006.) **Figure 2**, **Figure 3**, **Figure 4**). Its distinctiveness is mainly based on the unique karyotype of 2n = 46, with support from the more pale and yellowish pelage and generally small size.

The reader should note this confusing taxonomic history when reviewing literature and specimen locations, since most collections labeled as *Thomomys clusius* are no longer thought to be Wyoming pocket gophers. Further, some references to *T. talpoides clusius* may refer to the Wyoming pocket gopher while others would now be considered belonging to different subspecies of northern pocket gopher, likely *T. t. ocius* (Keinath and Beauvais. 2006).

V. Description

A. General description

Pocket gophers are powerfully built mammals, characterized by a heavily muscled head and shoulders that taper into relatively narrow hips and short legs (See **Attachment C**: Keinath et al, 2006. **Figure 1**). As typified by both the northern and Wyoming pocket gophers, they have small eyes and ears and fur-lined cheek pouches that open external to the mouth. Front feet are strong with claw-like nails used for digging (Verts and Carraway. 1999).

The Wyoming pocket gopher is smaller and paler than other pocket gophers in its geographic range (Keinath and Beauvais. 2006. See **Attachment C**: Keinath et al, 2006. **Figure 1**), with a yellow cast to the pelage, especially in younger animals (Clark and Stromberg 1987). Dorsal pelage is uniform in color, and the margins of the pinnae are fringed with whitish hairs (Thaeler and Hinesley 1979). Adults may attain the following dimensions: total body length

161 to 184 mm, tail length 50 to 70 mm, hind foot length 20 to 22 mm, ear length 5 to 6 mm, and a weight of 44 to 72 grams.

Pocket gophers appear to have extreme interpopulation chromosomal variation relative to other mammals, with proximate populations of the same species often exhibiting different karyotypes (Thaeler 1974a, b, and Patton and Dingman 1968). However, diploid chromosome count appears to be a distinguishing feature at the species level (Patton and Dingman 1968, Thaeler 1974a) which holds true for Wyoming pocket gophers (Thaeler and Hinesley 1979). Thus, given the difficulty of distinguishing gophers in the field (described above), positive identification of Wyoming pocket gopher requires karyotype analysis (i.e., a count of the number of diploid chromosomes). The Wyoming pocket gopher has a karyotype of 2n = 46 chromosomes while the northern pocket gopher has a karyotype of 2n = 48 and the Idaho pocket gopher has a karyotype of 2n = 58 (Thaeler and Hinesley 1979, Thaeler 1972). This is a straightforward procedure, but it does require some technical expertise and equipment and, under typical circumstances, cannot be accomplished in the field. Given appropriate time and funding, it is possible that further genetic research on the Wyoming pocket gopher could develop genetic markers capable of distinguishing it from related species, thus eliminating the need for highly invasive karyotype analyses, but the feasibility of this is highly speculative (Keinath and Beauvais 2006).

B. Morphological differences between male and female *T. clusius*

There is no sexual dimorphism displayed in this species (Clark and Stromberg 1987). Mammals.

C. Morphological differences between *T. clusius* and other species of Thomomys

Four species of pocket gopher occur in Wyoming: the Wyoming pocket gopher (*Thomomys clusius*), the northern pocket gopher (*T. talpoides*), the Idaho pocket gopher (*T. idahoensis pygmaeus*), and the plains pocket gopher (*Geomys bursarius*) (Keinath and Beauvais. 2006). The plains pocket gopher (*G. bursarius*) occupies only far eastern Wyoming; aside from this wide geographic separation, *G. bursarius* is easily distinguished from *T. clusius* by distinctive parallel grooves on the front surface of its protruding incisor teeth (Clark and Stromberg 1987). Characteristics separating the remaining three taxa are presented in ((Keinath and Beauvais. 2006. **Attachment C, Table 1).** The ranges of *T. clusius* and *T. idahoensis* *pygmaeus* are close but likely do not overlap, leaving *T. talpoides* as the primary taxon of confusion. Despite some differences, the potential for confusing these two taxa in the field is high. **The range of *T. clusius* lies almost entirely within the range of *T. talpoides*, but the two species are suspected to occupy different habitats** (Thaeler and Hinesley 1979); *Thomomys clusius* prefers well-drained, gravelly soils on ridge tops while *T. talpoides* occurs in sandy soils proximal to watercourses (Patton and Dingman 1968, Wison and Reeder eds. 1993). Morphometric characteristics recorded in the field (e.g., weight, body length, hind foot length, pelage characteristics, gross skull morphology) can be helpful, but they are often not diagnostic due to overlap between species, especially in the presence of juvenile *T. talpoides*.

VI. Population dynamics

Even less is known about the demographics of pocket gopher populations than other aspects of their biology and ecology (Keinath and Beauvais 2006). Other than coarse scale habitat availability, it is unclear what limits the structure and growth of populations. The extremely varied diets of various pocket gopher species have led to the conclusion that food is seldom a limiting factor in pocket gopher distribution, but the nature and amount of vegetation may affect local population densities (Miller 1964).

There is not enough known about pocket gophers in general, and Wyoming pocket gophers in particular, to confidently assess the spatial dynamics of populations. This issue, however, is intriguing given the apparent karyotypic differences within the same genus, wherein morphologically and geographically proximate species or sub-species can have radically different chromosome numbers (see Taxonomy section above). Such cellular divergence is likely facilitated by the limited dispersal ability of pocket gophers and a resultant high rate of inbreeding for some species (Patton and Dingman. 1968). All these factors (e.g., low dispersal ability, high inbreeding, and high variation over small geographic area) suggest that pocket gophers could have an easily disrupted metapopulation structure wherein local populations are readily isolated over relatively short distances. The magnitude of these distances, however, is unknown. **This is particularly important for small and isolated taxa, such as the Wyoming pocket gopher, where isolation may also raise the risk of local extinction.** Although the management implications of this situation are unclear, it would likely mean that continuity of suitable habitat would be an important component in the conservation of pocket gopher populations.

A. Reproduction

Breeding behavior and phenology

Studies of reproduction of the Wyoming pocket gopher are lacking, but presumably, its reproductive biology closely resembles that of the northern pocket gopher (Keinath and Beauvais 2006). Northern pocket gophers are solitary creatures, except during the breeding season (Keinath and Beauvais 2006). Male northern pocket gophers are polygamous, exploring the burrows of females living next to them, but females will only permit the males to remain in their burrow during the breeding season (Miller 1964). Very little is known regarding the courtship practices of pocket gophers. Sex ratios for adult pocket gophers are generally close to 50:50, but estimation of sex ratios may be biased depending upon when sampling is done in the annual population cycle (Reid 1973).

The precise phenology of reproduction is unclear, but the breeding season of northern pocket gophers in Colorado is thought to extend from mid-March to mid-June (Hansen 1960, Vaughan 1969) and (Vaughan 1964) claimed that it occurred in May or June at elevations of 3,020 meters 18 and noted that most litters in Colorado were probably born in June. Pregnant northern pocket gophers have been captured in June in Sweetwater County, Wyoming, which is near the range of the Wyoming pocket gophers, but they were captured as late as July in the Black Hills (Clark, and Stromberg 1987). The northern pocket gopher is thought to have a gestation period of 19 to 20 days (Reid 1973). Young are born hairless into subterranean nests within the burrow system, their eyes open at about 26 days of age, and they are weaned by 35 to 40 days of age (Andersen 1978, Chase et al. 1982).

Young northern pocket gophers can appear above ground as early as June but they often remain with the mother for 6 to 8 weeks. Clark and Stromberg (1987) indicated that young in Sweetwater County disperse from maternity burrows in early June, but this could occur much later, perhaps even late July, if females are still pregnant in June. It takes about 180 days for newborns to reach near-adult weights, at which point young of the year can only be distinguished from adults by the size of their reproductive organs (Hanson and Reid 1973).

Fecundity

No data are available regarding the fecundity of the Wyoming pocket gopher, so the best one can do is assume general similarity with the closely related northern pocket gopher. Litter size of northern pocket gophers is highly variable, averaging 4 to 6 young in Wyoming (Verts and Carraway 1999, Tryon and Cunningham 1968, Wirtz 1954, Andersen 1978). Studies in Colorado suggest similar litter sizes that are likely influenced by habitat, averaging 6.4 young in irrigated alfalfa fields and 4 to 5 young in native forb-grass rangelands (Reid 1973, Hansen, R.M. 1960). It has been suggested that some female northern pocket gophers may produce more than one litter per year, based largely on the synchronous capture of pregnant females and juveniles in the same burrow systems (Miller 1946, Burt 1933). However, Hansen (1960) found no evidence of more than one annual litter per female in the Rocky Mountain region, and Miller (1964) suggested that this only occurred in southern climates. It is therefore unlikely that multiple litters would occur in Wyoming pocket gopher populations. Young northern pocket gophers are able to reproduce in the calendar year following their birth (Moore and Reid 1951). The proportion of females that produce litters every year can vary greatly (Verts and Carraway. 1999). In a study conducted in Utah, 62.5 to 100 percent bred annually during a 4-year period, and differences among the years were not significant (Andersen and MacMahon. 1981). Seventy-nine percent of 112 females collected from mid-March to mid-April were found to be reproductively active (Wight 1930).

B. Mortality

Survivorship

Very little is known generally regarding survivorship and mortality in pocket gophers, much less for Wyoming pocket gophers in particular (Keinath and Beauvais 2006). As with many small mammals, individual pocket gophers often do not live more than two breeding seasons, typically surviving 18 to 20 months in the wild; however, they are capable of living longer, perhaps up to 5 years under favorable circumstances (Reid, V.H. 1973, Clark and Stromberg 1987). About 75 percent of a breeding population of northern pocket gophers were yearlings, and only 25 percent were two years or older (Lechleitner 1969). In a 4-year study of northern pocket gophers in Utah, annual survival rates were 0.27, 0.18, 0.23, and 0.70, with weekly survivorship greater in summer than winter (Andersen and MacMahon. 1981). In Colorado, Hansen (1965) studied an introduced population of northern pocket gophers in a controlled exclosure; mortality was approximately 10 percent per month from June through September and approximately 13 percent per month from September through June. Sixty-three percent of the study population survived the summer, but only 17 percent survived the winter. One of the very few studies investigating natal pocket gopher mortality occurred in Oregon, where pocket gophers (then classified as *Thomomys quadratus*) were repeatedly trapped within individual burrow systems (Wight 1930). This resulted in an average of 2.8 young being captured, which was well below the mean natal litter size of 6.3, causing the author to suggest that young pocket gophers experienced heavy mortality or dispersed before sampling occurred. Researchers also stated that sub-adult pocket gophers appeared to be exposed to unusually heavy mortality as they were forced to live in marginal habitats (Howard, W.E. and H.E. Childs 1959). Moreover, although Wight and Howard and Childs did not study species closely related to the Wyoming pocket gopher, the results suggest the possibility of high juvenile mortality (Keinath and Beauvais 2006).

C. Effects of climate

Based on studies of *T. t. macrotis*, (Vaughan 1967) climate may be a factor in *T. clusius* survival and recruitment. Vaughan (1967) noted that pocket gophers are generally more abundant in years of normal or above-normal moisture and lower in years of below-normal precipitation. Snowpack can also provide northern pocket gophers with access to vegetation and protective cover from predators (Reid 1973). On the other hand, when soils are too wet, due to excessive water levels in snowpack, early snowpack melting, or a rising groundwater table, northern pocket gophers may perish or be dislocated (Reid, V.H. 1973, Chase, et al. 1982, Hansen and Reid 1973). Particularly harsh winters lead to sub-optimal burrowing conditions, affecting survivorship. Freezing temperatures combined with moist soil make burrowing nearly impossible (Andersen and MacMahon 1981) and pocket gophers may avoid moist soils to prevent the heat loss associated with wet fur (Vaughan 1966).

VII. Ecology

As a group, pocket gophers have been widely recognized for their impacts on the ecosystems they inhabit. These effects primarily result from their extensive tunneling activity, which can affect soil formation, hydrology, and nutrient flows, and their consumption of below ground plant biomass, which can alter the competitive interactions of plants and thereby influence vegetation patterns and aboveground herbivory (Keinath and Beauvais 2006). Like other "ecosystem engineers" (e.g., ants, beavers, prairie dogs), pocket gopher activities can drive ecosystem function, making them important to native ecosystems while simultaneously causing them to be labeled as pests in many areas where they occur in abundance and coincide with humans. For example, due to potentially detrimental impacts on agricultural production, such effects have been studied for pocket gopher species occurring in agrarian landscapes. Such a discussion, although interesting, is not directly pertinent to this assessment, particularly since no such investigation has studied the impact of Wyoming pocket gophers and since the purported habitat of this species is sufficiently different than that of studied species to make comparisons rather tenuous. Parties interested in such information are encouraged to consult the following literature: (Keinath and Beauvais 2006) (See Supplemental Literature Cited).

A. Habitat requirements

Apparent habitat requirements

Pocket gophers are strongly fossorial, living most of their lives in burrow systems and underground tunnels (Keinath and Beauvais 2006). Based on the very limited information base, the Wyoming pocket gopher appears to segregate from northern pocket gophers by preferentially occupying dry, gravelly, shallow-soil ridge tops rather than deeper soiled swales and valley bottoms (Clark and Stromberg 1987). Many existing capture locations are from greasewood (*Sarcobatus* spp.) communities on the edges of eroding washes (Thaeler and Hinesley 1979). However, this information is predominantly the result of inference from specimen tags and anecdotal accounts rather than from actual habitat studies. Moreover, it is not known if such accounts represent actual habitat preference by Wyoming pocket gophers since unknown biases could be masked by such *ad hoc* reports (Keinath and Beavais 2006). For example, documented specimen locations could represent a biased geographic sample, Wyoming pocket gophers could be more readily captured in marginal habitats, or there may have been unaccounted for competitive exclusion from preferred habitats by other species of pocket gophers. In any case, the above habitat description should be viewed as hypothetical.

Beyond this, nothing is known regarding the habitat affinity of the Wyoming pocket gopher. In the absence of data, we can draw some basic inferences on habitat use from the northern pocket gopher, but we must realize that such comparisons are tenuous and useful mainly to inform further investigation. In general, pocket gopher habitat appears to be limited by two factors: the presence of a soil layer deep and tractable enough to hold burrow systems and enough herbaceous plants to form a food base. Northern pocket gophers are very adaptable and occur across much of the western United States at various elevations, vegetation types, and soil types (Verts and Carraway 1999, Clark and Stromberg 1987). They apparently prefer deep and tractable soils, but they also occupy heavily compacted soils and shallow gravels (Miller 1964) that are more reminiscent of suspected Wyoming pocket gopher habitat.

In some regions, pocket gophers appear to preferentially occupy habitat dominated by “mima mounds” (i.e., circular to oval mounds each 4 to 30 meters in diameter, up to 2 meters higher than the surrounding soil, and occurring at various densities on the order of 25 to 50 mounds per hectare (Cox and Hunt 1990, Knight 1994). There is ongoing debate whether burrowing mammals, typically gophers, caused these mounds through their diggings or inhabit mounds that previously existed in the landscape due to other processes, such as post-glacial cycles of freezing and thawing that cause differential soil development based on substrate characteristics. No one has reported whether the Wyoming pocket gopher is preferentially found in habitat reminiscent of mima mounds. Although such mounds are much less common in the range of Wyoming pocket gophers than in the deeper soils of eastern Wyoming, this is a possibility worthy of investigation (Keinath and Beauvais 2006).

Pocket gophers use burrow systems consisting of a network of feeding tunnels connected to a smaller and deeper system of chambers that are used for nesting and food storage (Miller 1964). In general, pocket gopher tunnels vary from 6 inches to a foot below the surface of the ground and are 1.5 to 3 inches in diameter, depending on the size of the gopher (Bailey, V. 1915). Unlike ground squirrels and many rodents, which have regular tunnel openings, the surface tunnels of pocket gopher burrows are kept plugged with loose soil (Clark and Stromberg 1987). Pocket gopher burrow systems are typically found in areas with large herbage yields of succulent forbs with fleshy underground storage structures, such as alfalfa fields (Reid 1973). However, it is assumed that because such cultivation is relatively rare in southern Wyoming and occurs primarily in valley bottoms occupied by northern pocket gophers, such habitats do not substantially influence populations of Wyoming pocket gophers.

Movement, territoriality and area requirements

Given their fossorial nature, once pocket gophers establish territories and burrows, they move very little over the course of their entire lives, except for minor alterations of territory boundaries (Miller 1964, Reichman et al. 1982). Moreover, the long distance movement and dispersal capabilities of pocket gophers are limited since they stay underground most of the time, foraging above ground only at night or on overcast days (Verts and Carraway. 1999). Also, despite their considerable tunneling capability, the energetic costs of burrowing are high enough to be a physiological limitation to movement (Vleck 1979). Vaughan (1963) recorded distances dispersed by northern pocket gophers and valley pocket gophers (*Thomomys bottae*) when they were released into unfamiliar habitat. He found that over the course of a year northern pocket gophers moved much farther from the release area (mean of 13 individuals = 785 m; range 50-2590 m) than valley pocket gophers (mean of 18 individuals = 198 m; range 0-900 m) (Vaughan 1963). This demonstrates that, although movement of both pocket gopher species was very restricted, there is substantial interspecies variation in dispersal. This variation could be attributed to either (or both) innate interspecies' differences in propensity for dispersal or variable restrictions on dispersal caused by the different environments used by the two species. If the main restriction on dispersal is environment (admittedly a large assumption) and if we consider that northern pocket gophers appear to occupy areas with looser soils that are presumably more amenable to long-distance movements than the gravelly ridge-top soils occupied by Wyoming pocket gophers, then we can hypothesize that Wyoming pocket gophers could be more restricted in their movements than northern pocket gophers. In this case, the figures presented above likely represent the upper limit of Wyoming pocket gopher dispersal. All speculation aside, in the absence of additional information, it is reasonable to assume that the dispersal distances recorded by Vaughan (1963) represent bounding estimates for the dispersal capabilities of Wyoming pocket gophers. Pocket gophers are active year-round, and some have suggested that longer-distance dispersals may occur beneath the snow (Vaughan 1963, Marshall 1941). This does not seem likely for the Wyoming pocket gopher because the dry ridges presumed to be its preferred habitat have typically low snow accumulation due to low winter precipitation and wind scouring that tends to deposit existing snow in depressions.

The territory of a pocket gopher is essentially equivalent to the extent of its active burrow complex. Pocket gophers such as the northern pocket gopher generally defend against intrusion into their burrow system by other gophers (Verts and Carraway. 1999, Tryon 1947) but during the breeding season territoriality appears to be somewhat relaxed. Observations on the plural occupancy of pocket gopher burrow systems. Journal of Mammalogy 40:577-584.) (Hansen and Miller 1959, Miller and Bond. 1960).

The defense and maintenance of a territory usually involve some form of aggressive behavior or display. Once a pocket gopher establishes a territory and has lived in its burrow for one breeding season, it tends to remain in that burrow for life, with only minor boundary changes (Miller 1964). Many animals alter their tolerance of neighbors in response to resource availability; home ranges often are smaller and closer together in resource-rich areas than resource-poor areas. However, an investigator found that pocket gophers in a northern Arizona study area altered burrow length but did not change territory spacing to compensate for differences in forage production (Reichman et al. 1982). Despite defense of their burrows, burrow systems of valley pocket gophers (particularly those of reproductive males) are generally configured to contact numerous other territories, presumably to facilitate finding mates, which is assumed to hold true for other species (Keinath and Beauvais 2006).

The home ranges of the Wyoming pocket gophers are assumed to be similar in size and nature to those of the northern pocket gopher, which are very small. The home range of the northern pocket gopher has been documented to be 0.015 hectares (Banfield, 1974). In Utah, density estimates for populations of northern pocket gophers in early summer were 5.3 to 16.9 per hectare (2 years) in meadow, 2.1 to 14.4 per hectare (3 years) in aspen, 6.3 per hectare (1 year) in fir, and 0.4 per hectare (1 year) in spruce (Andersen and MacMahon. 1981). During a 3-year study at 3,020 meters in subalpine parks in Colorado, densities of northern pocket gophers in early summer were 6.2 to 12.4 per hectare and 14.8 to 34.6 per hectare in late summer; much of the variation in late summer was attributed to differences in survival of young (Vaughan 1969). It has been observed that male territories in a population of valley pocket gophers averaged 0.025 hectares and were considerably larger than those of females and sub-adult males (Howard, W.E. and H.E. Childs 1959). This assessment has been confirmed, noting that reproductive males had longer burrow systems, greater home ranges, and a greater number of neighbors than either females or non-reproductive individuals (Reichman et al. 1982).

Landscape pattern

Considering that very little information is known regarding pocket gopher habitat use in general, it is hard to say what may constitute a suitable landscape pattern for Wyoming pocket gophers. “Soil depth and texture, and interspecies competition are clearly the most critical factors in both the geographic and habitat distributions of pocket gophers” (Miller 1964). Also, population density and body size of pocket gophers is related to food quantity and quality (Smith and Patton 1988). For example, because fields of alfalfa produce more and more consistently available food than fields of annual cereals, they support more and larger pocket gophers (Reid 1973). This likely occurs because gophers in these resource-rich areas can thrive in smaller burrow systems than in resource-poor areas, although the spacing and arrangement of individual territories likely does not change with resource availability (Reichman et al. 1982).

In this context, a suitable landscape for Wyoming pocket gophers may be loosely defined as a dry upland with gravelly, yet still tractable, soils (i.e., which presumably favors Wyoming pocket gophers over northern pocket gophers; see the above section on Apparent habitat requirements) and relatively high productivity of grasses and forbs (i.e., high food availability). Given relatively small home ranges (see previous section), the continuous area of such habitat capable of supporting a local population of pocket gophers may be relatively small, perhaps on the order of tens of hectares. However, long-term persistence of gophers would likely depend on larger areas of such habitat arranged in patches of sufficient proximity to allow dispersal between patches. Since no supporting information exists, the necessary scale and arrangement of such a landscape are conjecture.

B. Social behavior

Interspecific interactions

Species of pocket gophers are generally distributed so that their ranges do not overlap (Bailey 1915, Vaughan 1967, Thaeler 1968a). However, given that the Wyoming pocket gopher's range is completely subsumed within that of the northern pocket gopher, it is possible that sympatry could exist (Keinath and Beauvais 2006). However, the species are thought to exclude one another from particular environments in a classic competitive exclusion manner based on differential habitat preferences and requirements (i.e., soil type and depth) (Miller 1964). Given its highly restricted distribution, if populations of Wyoming pocket gophers are found to be declining, competition with northern pocket gophers could become a limiting factor in their persistence. This is, of course, very speculative, as no studies have been published that suggest this.

C. Population densities

Population demographics

Even less is known about the demographics of pocket gopher populations than other aspects of their biology and ecology (Keinath and Beauvais 2006). Other than coarse scale habitat availability, it is unclear what limits the structure and growth of populations. The extremely varied diets of various pocket gopher species have led to the conclusion that food is seldom a limiting factor in pocket gopher distribution, but the nature and amount of vegetation may affect local population densities (Miller 1964).

There is not enough known about pocket gophers in general, and Wyoming pocket gophers in particular, to confidently assess the spatial dynamics of populations. This issue, however, is intriguing given the apparent karyotypic differences within the same genus, wherein morphologically and geographically proximate species or sub-species can have radically different chromosome numbers. Such cellular divergence is likely facilitated by the limited dispersal ability of pocket gophers and a resultant high rate of inbreeding for some species (Patton and Dingman 1968). All these factors (e.g., low dispersal ability, high inbreeding, and high variation over small geographic area) suggest that pocket gophers could have an easily disrupted metapopulation structure wherein local populations are readily isolated over relatively short distances. The magnitude of these distances, however, is unknown. This is particularly important for small and isolated taxa, such as the Wyoming pocket gopher, where isolation may also raise the risk of local extinction. Although the management implications of this situation are unclear, it would likely mean that continuity of suitable habitat would be an important component in the conservation of pocket gopher populations.

D. Food habits

Food and feeding habits

As with most other aspects of Wyoming pocket gopher biology, food habits have not been studied. Roughly speaking, diet is assumed to be similar in variety and opportunistic composition to other pocket gophers in the region, with a general reliance on roots, shoots, and leaves of forbs, and a lower utilization of grasses and other plants (Ward and Keith. 1962). In general, pocket gophers are strictly herbivorous (Reid 1973) eating roots and tubers while underground and, to a lesser extent, harvesting surface vegetation occurring near burrow entrances (Verts and Carraway. 1999). A large part of their diet throughout the year is comprised of belowground plant material (i.e., roots, tubers, bulbs, corms), but it appears that in summer they tend to include green plants and aboveground material to a greater extent than in winter (Reid 1973, Aldous 1951). For example, the summer diet of northern pocket gophers in one sub-alpine habitat in Colorado consisted of 87 percent forb leaves, 12 percent roots, and 1 percent grasses (Vaughan 1974). In another location in Colorado, their summer diet consisted of 93 percent forbs, 6 percent grasses, and 1 percent shrubs, with 74 percent of this material being aboveground plant parts and 26 percent roots (Verts and Carraway 1999). Reports document that forbs occurred in northern pocket gopher diet disproportionate to their occurrence in the environment, representing over 92 percent of stomach contents but only 42 percent of site biomass (Ward and Keith 1962). Experimentally confirmed is the importance of forbs to northern pocket gophers, as gophers forced to eat a larger dietary proportion of grasses lost body mass (Tietjen 1973).

In general, pocket gophers can subsist on a very wide variety of plant species, but they have a strong preference for forbs (Keinath and Beauvais 2006). It makes sense that the relative consumption of specific species of forbs is likely different for Wyoming pocket gophers than for other pocket gophers, simply because they inhabit a different environment with different vegetation. The overwhelming preference by other gophers for forbs, however, provides strong evidence that forbs are likely to be an important component of Wyoming pocket gopher diet. The northern pocket gopher probably eats most species of succulent plants within its range, but it is capable of selecting plants with higher levels of protein and fat from those available (Tryon and 1968). Alfalfa fields are known to provide large amounts of high quality, succulent vegetation to pocket gophers in Colorado (Reid 1973). In a shortgrass prairie region of Colorado, northern pocket gophers consumed 67 percent forbs, 30 percent grasses, and 3 percent shrubs; the major components of the diet included prickly pear (*Opuntia polyacantha*) (49.9 percent), needle-and-thread grass (*Stipa comata*) (12.1 percent), red globe-mallow (*Sphaeralcea coccinea*) (10.3 percent), bluestem wheatgrass (*Agropyron smithii*) (10.1 percent), blue grama (*Bouteloua gracilis*) (3.0 percent), and fourwing saltbush (*Atriplex canescens*) (2.5 percent) (Vaughan 1967). At elevations between 2,750 and 3,050 meters in Utah, the species consumed most frequently and in the greatest amounts were dandelion (*Taraxacum* spp.), penstemon (*Penstemon rydbergii*), sweet sage (*Artemisia discolor*), meadowrue (*Thalictrum fendleri*), and slender wheatgrass (*Agropyron trachycaulum*) (Aldous 1951).

Pocket gophers tend to change their diet seasonally in response to habitat conditions and the availability and nutritional quality of food (Reid 1973). A summer preference for aboveground plant parts was found in Colorado's shortgrass prairies, where 70 percent of foods consumed by northern pocket gophers were from above ground (Vaughan 1967). In winter, diet is assumed to shift more toward belowground forage, unless sufficient subnivean space is available in which case aboveground components of forbs and grasses may be supplemented by woody material (Verts and Carraway 1999).

The northern pocket gopher normally forages in underground burrows, but it occasionally forages above ground, in close proximity to a burrow entrance, at night or on overcast days. Some experts have suggested that pocket gophers rarely forage above ground beyond where they can reach by keeping their hind feet in the burrow entrance, suggesting that virtually all aboveground vegetation is taken in the immediate vicinity of entrance mounds (Aldous 1951).

Many of the plants cut by gophers, particularly above ground, are not immediately consumed, often being cut into small pieces and carried in the cheek pouches back to the burrow where they are either consumed, stored for winter, used for nest building, or taken into runways and later pushed to the surface (Verts and Carraway 1999, Aldous 1951). Pocket gophers generally cache food collected in late summer. In Utah, five food caches of northern pocket gophers collected in late summer contained an average of 380g of stored food items (Aldous 1945).

E. Pocket gopher roles within their ecosystems

Northern pocket gophers have been described as a "biological excavation service" (Armstrong 1987) and the actions of pocket gophers have been likened to those of "an animated bulldozer" (Hansen and Reid 1973). The reasons for such metaphors are becoming increasingly clear, as studies indicate the important relationships between pocket gophers and the ecosystems in which they are found. One study concluded "the activities of pocket gophers cascade through the trophic web" (Huntly and Inouye 1988). Pocket gophers play important roles in soil formation and movement (Huntly and Inouye 1988, Armstrong 1987) and consequent plant diversity; as a prey base for avian, mammalian, and reptilian predators (CDOW 2000); and their burrows provide habitat for other species (Chase et al. 1982, Vaughan 1961, CDOW 2000).

The northern pocket gopher has been described as a keystone species (Sherrod 1999) which is defined as "one that makes an unusually strong contribution to community structure or processes" (Meffe and Carroll 1994).

Additionally, pocket gophers have been described as ecosystem engineers (Sherrod 1999). defined as "capable of altering the normal functioning of ecosystems or the interactions of organisms even in relatively small numbers"(Byers et al. 2002). Therefore, the northern pocket gopher may be considered to be a keystone engineer (Sherrod 1999).

1. Soil impacts

Pocket gophers alter their ecosystems by increasing soil aeration and fertility, and the ability of surface soils to absorb groundwater (Hafner et al. 1998). Pocket gophers move large amounts of soil, modify its qualities, and create mima mounds (described below), all of which significantly impact the ecosystems in which pocket gophers reside (Center for Native Ecosystems 2003).

Per capita estimates are that three tons of soil may be excavated for one pocket gopher burrow system measuring 150 meters in length, and 10-45 cm from the surface (Armstrong 1987). Other approximations suggest similarly massive soil movement conducted by pocket gophers. Another studies shows an annual per capita soil movement of 1,130 kg (Chase et al. 1982). Turner (1973) and Chase et al. (1982) cite an estimate of over 93 tons of soil being moved on one hectare with 74 pocket gophers. Turner (1973: 51) states, “Pocket gophers have markedly influenced the development of rangeland soils during the thousands of years they have inhabited North America. By continually burrowing and pushing soil to the surface, they promote vertical cycling and mixing of soil constituents.”

Others estimate that the impact of pocket gophers on western rangelands dates back multiple millions of years, to the Pliocene Epoch (Chase et al. 1982). Whatever the timeline, researchers have described how pocket gophers have significantly shaped the ecosystems in which they are found (Center for Native Ecosystems 2003).

This characterization is corroborated by other investigators as well. “Mammals also affect vegetative composition and structure by disturbing the soil. Wallowing by bison and digging by badgers, pocket gophers, prairie dogs, and other mammals provide unique microhabitats, affect soil conditions, and break the dominance of perennial grasses to provide habitat for annual forbs and grasses…” (Benedict et al. 1996)

The abundance of these disturbances on the prairies of the past certainly led to a substantial increase in vegetative diversity and further enhanced the mosaic nature of grasslands. Of the three most important groups of mammals involved in soil disturbance (pocket gophers, prairie dogs, and bison), the latter two have been drastically reduced in number. Mutually beneficial relationships among the faunal shapers of the prairie have been observed. Prairie dogs (Cynomys spp.) and bison (Bison bison) benefit each other (Krueger, Kirsten. 1986). Corroborating this idea, “…the bison…grazed and trampled the dense prairie vegetation, accelerating forb growth, on which the gophers thrived. The gopher, in turn, worked the soil, thus increasing soil fertility and stimulating vegetative growth, increasing food for the bison” (Chase et al. 1982).

The impact of pocket gophers on soils goes beyond their movement of the soil to their fundamental effects on soil condition. These changes in soil condition result in important and ecologically significant alterations in plant growth and diversity. Pocket gophers alter plant diversity by modifying soil nutrients. They create heterogeneous levels of soil nitrogen by bringing nitrogen-poor subsurface soils to the surface. In addition, backfilling activities may result in different soil densities and nutritional content than undisturbed soils. Uneaten food caches, located in sealed compartments only 3-4 inches below ground (Ward 1973) and excrement can also provide areas of high nutrient content (Ward 1973). “Food habits (Turner 1973). It is not uncommon for pocket gophers to leave food caches unutilized (Ward 1973) thus providing more opportunity for their transformation into soil nutrients.

A fascinating component of pocket gopher soil impacts is the mima mound. Mima mounds are circular soil formations up to two meters in height, 25-50 meters in diameter, found in densities of 50-100 per hectare. Mima mounds accumulate over long periods from the activities of burrowing mammals, particularly pocket gophers (Cox and Hunt 1990, Huntly and Inouye 1988).

Investigations of Mima mounds in western North America support the hypothesis that mounds are formed by the gradual translocation of soil by pocket gophers (Rodentia: Geomyidae) toward deep, well-drained microsites… Pocket gophers center their activities and locate their nests in such microsites. Moundward translocation results from the backward displacement of soil that occurs during outward tunneling from activity centers.

In northern Oregon, 0-6 individual northern pocket gophers inhabited each mima mound (n=18) (Cox and Hunt 1990). Mounds with single pocket gopher inhabitants tended to feature centripetal soil translocation, with the mound growing upward and outward in a proportional relationship. Once the mound reached a large enough diameter, there was greater potential for occupancy by two animals and a consequent flattening of the shape of the mound.

Soils within these mounds are deeper and more fertile, primary productivity is higher, and they host a different species composition than surrounding areas. These mounds create an undulating topography, may serve as hotspots of activity for other small mammals and ungulates, and may lessen soil erosion (Turner 1973).

Another soil impact involves winter casts. Pocket gophers dig tunnels through the snow to store the soil that they excavate during the winter. When the snow melts, ropes of excavated soil are left on the surface of the ground (Hansen and Ward. 1966). All of these soil impacts reflect the important ecological services that *T. clusius* likely provides in its role as a keystone species.

2. Plant diversity and succession

Pocket gopher impacts on soils result in lower than average nitrogen content as lower-nitrogen subsurface soils are brought to the surface. In addition to alteration of the level of nitrogen in the soil, pocket gophers cause a more heterogeneous distribution of nitrogen in their ecosystems. (Center for Native Ecosystems 2003, Huntly and Inouye 1988).

Pocket gophers also impact the availability of light in the microclimates they create. Their grazing and burying of vegetation results in increased light filtration to remaining plants. Moreover, their reduction of nitrogen levels results in decreased plant growth and biomass, and consequently higher light infiltration. The combination of more variability in nitrogen levels and distribution and light infiltration results in increased plant diversity. Plant diversity was significantly higher near or on pocket gopher mounds because of pocket gopher impacts on nitrogen and light availability. Vegetation around gopher mounds also shows signs of increased primary productivity (Grant et al. 1980, Spencer et al. 1985). High nitrogen environments are conducive to invading noxious weed populations, such as cheatgrass, and decreased yields of native flora such as bluebunch wheatgrass (Wilson et al.).

Evidence suggests winter casts suppress the growth of some plants and thereby impact plant succession (Armstrong 1987).

Pocket gopher activities often benefit their favorite forage species. For example, pocket gopher diggings bury vegetation, which some plant species cannot tolerate. Pocket gopher forage species are resistant to burial, and benefit from the decreased competition that results from gopher digging. This interdependent relationship where pocket gophers improve conditions for their own forage has often been likened to farming (Sherrod 1999, Cortinas and Seastedt. 1996).

3. Prey base

Predation

Pocket gophers are preyed upon by a number of birds and mammals, but it is suspected that natural predation is not a factor limiting pocket gopher distribution and abundance (Chase et al. 1982). This hypothesis is logical since gophers evolved with natural predators, making it unlikely that such predation would play a role in population declines unless accompanied by other extenuating circumstances (Keinath and Beauvais 2006). Such extenuating circumstances might include increased predation from generalist predators whose distributional expansion has been facilitated by human alteration of the landscape (e.g., feral cats, coyotes, raccoons) (Keinath and Beauvais 2006). Also, in the event that Wyoming pocket gopher populations become small and/or isolated, even natural predation events could cause a marked population decline (Wilcove 1985, Sinclair et al. 1998).

Documented predators of pocket gophers include gopher snakes (*Pituophis catenifer*), rattlesnakes (*Crotalus viridis*), long-tailed weasels (*Mustela frenata*), coyotes (*Canis latrans*), bobcats (*Lynx rufus*), martens (*Martes americana*), badgers (*Taxidea taxus*), foxes, skunks, and numerous owls (Clark and Stromberg 1987, Criddle 1930, Young 1958, Vaughn 1961, Hansen and Ward 1966, Marti 1969, Bull and Wright 1989).

4. Burrows and other species

The extensive burrow systems described above provide habitat for numerous other burrowing and opportunistic species. Abandoned pocket gopher burrows provide habitat for salamanders, snakes, insects, and other rodents (Center for Native Ecosystems 2003, Armstrong 1987). Other researchers similarly describe the use of burrows by amphibians, reptiles, and other mammals (Huntly and Inouye 1988, Vaughan 1961.) The most complete list of species occupying both abandoned and active pocket gopher burrows includes: tiger salamander (Ambysoma tigrinum), spadefoot toad (Scaphiopus spp.), ornate box turtle (Terrapene ornate), six-lined racerunner (Cnemidophorus sexlineatus), earless lizard (Holbrook maculata), gopher snake (Pituophis catenifer), prairie rattlesnake (Crotalus viridus), eastern mole (Scalopus aquaticus), desert cottontail (Sylvilagus auduboni), ground squirrels (Spermophilus spp.), Ord's kangaroo rat (Dipodomys ordii), deer mouse (Peromyscus maniculatus), meadow voles (Microtus spp.), and long-tailed weasel (Mustela frenata). Less frequent inhabitants of these burrows include plains toad (Bufo cognatus), burrowing owl (Athene cunicularia), northern grasshopper mouse (Onychomys leucogaster), and striped skunk (Mephitis mephitis) (Chase et al. 1982).

5. Other associations

Higher grasshopper (Melanoplus spp.) populations have been linked to pocket gopher mounds. Grasshoppers utilize gopher mounds for reproduction, as they oviposit in the open soil (Center for Native Ecosystems 2003). Additionally, the mosaic of low- and high-density vegetation in pocket gopher-occupied areas creates conditions where grasshoppers can more efficiently forage (Huntly and Inouye 1988). Recent research also suggests that harvester ants (Pogonomyrmex occidentalis) select for old northern pocket gopher mounds as sites for new ant-mounds (Hopton 2001). The mutually beneficial relationship between bison and pocket gophers has been described above, and the petitioners note that other native ungulates who prefer forbs, such as pronghorn (Antilocapra americana), would likely benefit from pocket gopher impacts on vegetative composition and succession (Center for Native Ecosystems 2003).

VIII. Geographic distribution and abundance

The general distribution of the Geomyidae family in North America is limited only by suitable soils, but particular species may also be limited by climatic factors or other factors associated with altitude and latitude (Keinath and Beauvais 2006, Miller 1964).

Pocket gophers of the genus *Thomomys* can be found in much of the central and southern Rocky Mountains, and from the Pacific coast in Washington to Minnesota and Manitoba in the central plains (Hall, E.R. 1981, Tryon, C.A., Jr. and H.N. Cunningham 1968). However, the Wyoming pocket gopher is known to occur only in Sweetwater and Carbon counties in Wyoming (See **Attachment C**: **Figures 3, 4 & 5**), although there is some indication (pending further investigation) of occurrences in northern Colorado (Clark and Stromberg 1987). In comparison, the Idaho pocket gopher is found in southwestern Wyoming (Lincoln, Uinta, and Sublette counties) and adjacent portions of Idaho; the northern pocket gopher occurs throughout Wyoming and adjacent states in virtually all vegetation types underlain by loose soil; and the plains pocket gopher occupies true grasslands of the Great Plains including far eastern Wyoming (Keinath and Beauvais 2006, Clark and Stromberg 1987). It is important to recognize that all *Thomomys* in this region are undersampled, and additional field inventory may dramatically alter the limits of known range for any taxon, including the Wyoming pocket gopher (Keinath and Beauvais 2006).

As its range is currently defined, the Wyoming pocket gopher appears to occur primarily on multiple-use lands managed by the U.S. BLM; these lands are extensively intermixed with parcels of private land.

Little, if any, of this species' supposed distribution falls on lands managed by the USFS (See **Attachment C**: **Figure 4**). However, this may be an artifact of the lack of field inventory, and it is possible that survey efforts could document the species on National Forest System lands. The highest probability of such occurrence would likely be in lower elevations of the Medicine Bow – Routt National Forest (Region 2) near Rawlins and Saratoga, Wyoming, but the possibility also exists for the species to occur on lands administered by the Ashley and Wasatch National forests (Region 4) of southwestern Wyoming (Keinath and Beauvais 2006).

No information exists on the abundance of the Wyoming pocket gopher in any portion of its restricted range. No one has surveyed extensively for pocket gophers within this species' range in at least the last 30 years, and there has never been a systematic survey of the Wyoming pocket gopher. The entire assumption of this species' distribution is based on a handful of museum records and anecdotal reports from about 30 years ago (See **Attachment C**: **Figure 4**). Given this paucity of information, in the summer of 2005 the Wyoming Natural Diversity Database revisited some locations of former occurrence. Each site was searched for the presence of gopher mounds, and sites with mounds were trapped using Victor EasySet™ Gopher traps http://www.victorpest.com/. **Only one site of 17 sites showed evidence of recent gopher activity**. Of the remaining 16 sites, half showed no evidence whatsoever of gophers, and the rest had only scattered mounds and collapsed tunnels that probably had not been used for several seasons (See **Attachment C**: **Figure 5**). Moreover, no gophers were captured at any site, despite about 500 trap days expended at sites where mounds were witnessed (Wyoming Natural Diversity Database unpublished data). Since the effort expended was minimal and not uniform, such *ad hoc* surveys cannot be used to make a definitive determination of Wyoming pocket gopher status. However, they suggest that this species is likely quite rare. They also suggest that the gophers could be absent from many areas where they were heretofore presumed present, raising the disturbing possibility of a population decline since the mid-1900's (Keinath and Beauvais 2006).

Mostly, the 2005 survey results highlight the need for a thorough, systematic survey for Wyoming pocket gophers throughout their known range. (See **Attachment C**: **Figure 2**). Karyotype map adapted from Thaeler and Hinseley (1979; Copyright American Society of Mammalogists, Journal of Mammalogy, by C.S. Thaeler and Hinseley. Reprinted by permission of Alliance Communications Group, a division of Allen Press, Inc.) showing the distribution of samples analyzed in their study and the differences in chromosome number among taxonomic groups of *Thomomys* in central Wyoming. Open symbols represent localities where chromosome material was examined and closed symbols represent localities were it was not examined. Legend in upper left provides a species key to symbology, with chromosome count (2n) noted in parentheses (Thaeler and Hinseley 1979).

IX. Current population status throughout the range of T. clusius

A. Carbon and Sweetwater Counties

(See **Attachment C**: **Figures 3, 4 & 5** and accompanying text. pp. 11-16)

Critical to this petition (emphasis added) for listing is the comparison of *T. clusius*' extremely limited range with proposed U.S. Dep't of Interior Bureau of Land Management (Rawlins Wyoming Field Office) drilling projects. See **Map 1**: RAWLINS FIELD OFFICE - MINERALS & LANDS PROJECTS.*

This comparison makes exceedingly clear the present threat posed by gas and oil development overlapping T. clusius populations located, specifically, within and near to the Continental Divide – Creston, Atlantic Rim, and Desolation Flats proposed projects on Bureau of Land Management (public) land.

X. *Thomomys clusius* meets all five criteria for listing

A. Threats

Abundance and trends

Virtually nothing is known regarding the actual abundance of the Wyoming pocket gopher within its range, and even the boundaries of its range are questionable. Therefore, all published statements estimating the prevalence of this species are conjecture, and more information is needed for a confident assessment. For example, Clark and Stromberg (1987) stated that it may be abundant within its range, but their analysis included locations currently believed to be occupied by northern pocket gophers rather than Wyoming pocket gophers (See **Attachment C**: **Figure 4**). **There are now only 14 known locations where specimens of the Wyoming pocket gopher have been documented, representing 21 captured and positively identified individuals**. The Wyoming Game and Fish Department used this information to list the Wyoming pocket gopher as an uncommon resident (Oakleaf, B., A. Cerovski, and M. Grenier. 2002) while Wyoming Natural Diversity Database currently categorizes the abundance of the Wyoming pocket gopher as rare and possibly declining (See **Attachment C**: **Figure 5**, and the previous section on Distribution and abundance).

The Wyoming pocket gopher has an exceedingly small global range, essentially being endemic to one or two counties in Wyoming, with a possible small extension into northern Colorado (See **Attachment C**: **Figure 3**, **Figure 4**). Given the overall lack of field inventory, the bounds of this range are not well defined. Even if additional field efforts document significant range expansions and moderate or high abundances within that range, the overall population of Wyoming pocket gophers is still likely to be very small.

Population trends of Wyoming pocket gophers are essentially unknown across both the historical and recent periods. Recent *ad hoc* evidence, however, suggests a possible decline based on an absence from historic locations (Keinath and Beauvais 2006). Similarly, very little is known about habitat trends for this species. A small amount of habitat may have been lost to urbanization and other disturbances such as road and pipeline construction, but a substantial amount of generally undisturbed habitat probably remains. It is likely that remaining available habitat has been fragmented and/or degraded by these same processes, as well as vegetative shifts caused by grazing, drought, and global climate change, but we have no information to support or refute this hypothesis.

Intrinsic vulnerability

A variety of biological factors can make animals intrinsically susceptible to disturbance. These factors include narrow distribution, habitat specificity, restrictive territoriality and area requirements, susceptibility to disease, lower dispersal capability, high site fidelity, and low reproductive capacity. After reviewing available information (summarized below), Keinath et al. (2003) considered the intrinsic vulnerability of Wyoming pocket gophers to be moderate. This was due to their highly limited distribution, their limited dispersal ability, and the uncertainty surrounding many aspects of their biology (e.g., habitat use) (Keinath and Beauvais 2006).

Small mammals with restricted distributions and/or narrow habitat requirements are more vulnerable than others to habitat loss (Hafner 1998). Since the habitat requirements of the Wyoming pocket gopher are so poorly understood, it is not clear how restrictive they are. It appears to be an upland species dependent on habitat that is not uncommon in southern Wyoming (i.e., ridges with gravely, loose soils in sparse shrubland). However, the paucity of information requires extreme caution when interpreting habitat patterns, as they may be responding to subtle factors of soil texture or vegetation that are not apparent based on scant available information. Moreover, their highly restricted distribution and apparently low abundance suggest that this could be the case. Until we learn otherwise, it makes sense to interpret their habitat use conservatively/ Therefore, for purposes of estimating intrinsic vulnerability, we assume that they have some, as yet undefined, habitat requirements that restrict their occurrence and make them potentially vulnerable to disturbance (Keinath and Beauvais 2006).

Given their fossorial existence, and the fact that dispersal capabilities of other species of pocket gophers are rather limited (Vaughan 1963) it can be assumed that the Wyoming pocket gopher is similarly restricted. Because of this limit, it may be relatively easy to fragment suitable habitat, as relatively small habitat disturbances could be a movement barrier. (Emphasis added).

Very little information exists to make further determinations of vulnerability for Wyoming pocket gophers. If we consider them similar to northern pocket gophers, other biological factors do not seem to predispose them to harm from disturbance. In general, pocket gophers can persist in fairly small areas (Howard and Childs 1959, Banfield 1974, Ingles 1952) so it is not likely that area requirements are a major limiting factor. Neither does the literature suggest that disease is a major factor in pocket gopher persistence, although research is sparse. The northern pocket gopher shows somewhat lower fecundity than other small mammals, but in the absence of major neonatal mortality, it does not appear restrictive. For example, the northern pocket gopher is able to reproduce one calendar year after birth, has a gestation of only 19 to 20 days, and has a relatively long breeding season (March to June), but it generally produces only one litter of four to seven young per year (Verts and Carraway 1999, Moore and Reid. 1951).

1. Present and threatened destruction, modification, and curtailment of habitat and range

Habitat destruction is the primary threat to *T. clusius*. The following quote represent the convention in the biological sciences: “Axiomatic that species with small geographic distributions and low ecological tolerances are most vulnerable to habitat loss” (Center for Native Ecosystems 2003, Hafner 1998) Reflecting a circumstance similar to that of *T. clusius* in Wyoming, Colorado’s Dep’t of Wildlife’s COVERS REPORT indicates that this subspecies’s range is very limited and is in an area undergoing rapid development "which will likely impact any resident pocket gophers" (CDOW 2000).

Habitat fragmentation and isolation also threaten *T. clusius*. Continued oil and gas development creates increasingly dense road networks, diminishes corridors suitable for *Thomomys* dispersal, and further separates *T. clusius* populations. Roads act as barriers to finding mates, leading to inbreeding and loss of gene flow within individual populations. Habitat fragmentation results in shrinking islands of intact habitat with increased exposure to edge effects. The impacts of the disturbances associated with oil and gas development will only increase, given the tremendous municipal development pressures within *T. clusius* geographic range.

Moreover, development is not just destroying and fragmenting habitat; it is also causing habitat degradation. Soil disturbances typical of oil and gas development projects, motorized recreation, and other high soil impact activities are known to exacerbate the introduction and subsequent spread of noxious weeds. Noxious weeds threaten half of the imperiled species in the U.S. (Wilcove et al. 1998, Wilcox 1985), and *T. clusius* is likely no exception.

Noxious weeds have been shown to limit population density in other fossorial mammals (Slobodchikoff et al. 1988). For example, Gunnison's prairie dog (<u>Cynomys gunnisoni</u>) burrow densities at six sites and found that burrow density was significantly negatively correlated with the number of noxious weed species present. In fact, number of noxious weed species present accounted for 45.3% of burrow density variability (Groves and Steenhof 1988, Yensen et al. 1992). Other investigators have discovered numbers of active Townsend's ground squirrel (<u>Spermophilus townsendii idahoensis</u>) burrows significantly declined in areas where fire frequency and intensity increased because of cheatgrass presence.

Herbicide use that invariably precedes and follows most forms of development also degrades pocket gopher habitat. Research has demonstrated that herbicides used for forb control have negatively impacted, for example, *T. talpoides* population levels in the past (Reid 1973, Hansen and Ward 1966, Tietjen 1973, Chase et al. 1982, Miller 1964, Tietjen et al. 1967). For example, an early study demonstrated that an application of the toxicant 2,4-D on a Colorado northern pocket gopher site caused an 87% decrease in the gopher population when the production of perennial forbs had decreased by 83%.(Miller 1964). *T. talpoides* prefer foods such as lupine (<u>Lupinus</u> sp.), western yarrow (<u>Achillea lanulosa</u>), penstemon (<u>Penstemon redbergii</u>), and agoseris (<u>Agoseris</u> sp.), but eat a wide variety of plants (Miller 1964).

Where these plants exist on *T.clusius* sites, herbicide application may be especially pernicious. Habitat destruction in the range of *T. t. macrotis* will and perhaps already has also disrupted natural water run-off patterns. This may pose a threat to *T. clusisus* by altering soil moisture and limiting habitat availability.

The petitioners assert, based on best available scientific and commercial information, "habitat degradation, fragmentation, and loss associated with proposed oil and gas development, in particular, is threatening *T. clusius* with imminent extinction" (emphasis added).

2. Overutilization for commercial and recreational purposes

Individual pocket gophers are killed in the pursuit of commercial and residential development. Individuals may also be killed for agricultural purposes. Finally, individuals may be destroyed to create recreational facilities.

a. Residential and commercial development kills individual pocket gophers

Pocket gophers are known to be killed as land development occurs (CDOW 2000). The cultivation of gardens and other planned landscaping projects in residential areas may also result in poisoning or trapping of pocket gophers. It follows that large scale industrial and commercial developments (slated for the entire known T. clusius range) such as those proposed on Bureau of Land Management public lands (e.g., Pinedale Anticline, Continental-Creston, and Atlantic Rim gas fields) will have certain devastating effects on *T. clusius* and its extremely limited habitat and range (See **Attachment D**, **Map 1**).

b. Pocket gophers are poisoned in an attempt to increase productivity on farmland and ranchland

Given the extremely difficult field and even laboratory distinction of *T. clusius* from both *T. t. macrotis* and *T. idahoensis* it is clear that the best trained pesticide applications technicians cannot possibly prevent inadvertent pesticide contact with *T. clusius* (emphasis added).

Chemical toxicants continue to be available for pocket gopher control. As a case in point, the Colorado Division of Wildlife cites poisoning as a threat to T. t. macrotis (CDOW 2000). It is common knowledge that pocket gophers are widely regarded as an agricultural pest. Within the U.S. Department of Agriculture's Animal Plant Health Inspection Service, Wildlife Services (previously called Animal Damage Control) manufactures and disseminates toxicants to federal agencies, non-federal agencies, organizations, and private applicators (USDA/WS 1995, Wildlife Services 2001) to control pocket gopher populations for agricultural and silvicultural activities.

Wildlife Services's researchers have described an effective lethal control program as resulting in 90% annual mortality rates of targeted pocket gopher populations (Engeman and Gary 2000).

To further imperil *T. clusius*, a wide range of toxicants and traps are available for lethal control of pocket gophers. The favored methods of controlling pocket gophers are kill-traps, fumigants, and poisoned baits. The tunnel of a pocket gopher is located, and the toxicant or trap is applied (Tietjen 1973, Chase et al. 1982). These methods are legal and fully available to landowners and managers of the five known remaining populations of this subspecies. More specifically, toxicants and traps available for use on pocket gophers include the oral toxicants strychnine alkaloid, zinc phosphide, warfarin, chlorophacinone, and diphacinone; the fumigants carbon monoxide/dioxide and aluminum phosphide; pincher traps, which crush pocket gophers with two spring-loaded jaws, or box chokers, which pin pocket gophers to the floor of the trap with a spring-loaded wire jaw (Engeman and Witmer. 2000).

While pocket gophers may be considered a pest in rangelands, their actual impact on those lands is unclear. Two divergent perspectives, each possessing some degree of experimental evidence. According to the first viewpoint, pocket gophers are pests on rangeland and should be controlled, while the second view is that pocket gophers cause insignificant detrimental impact and therefore should not be controlled (Tietjen 1973). Given the extreme rarity of *T. clusius* it is essentially inconceivable to view this species as pest of any significance.

c. Constructing and maintaining recreational facilities may kill individual gophers

Since data is non-existent for *T. clusius* is should be noted that in Colorado where four of the five sites where *T. t. macrotis* has been found in the past decade, the development and maintenance of recreational facilities may have destroyed individual gophers (Center for Native Ecosystems 2003).

3. Disease and predation

Parasites and disease

According to Wyoming Natural Diversity Database, parasites and/or disease have not been shown to limit pocket gopher populations and are thus not suspected to be a factor in the conservation of Wyoming pocket gophers. Pocket gophers carry a typical complement of endoparasites and exoparasites, most of which have been documented incidentally to other research. Lists of such are presented by several investigators (Reid 1973, Chase et al. 1982, Engeman and Witmer 2000, Verts and Carraway 1999, Miller and Ward 1964). Although most parasitic infestations appear to be minor and non-lethal, the northern pocket gopher has been found to be infested with warbles of the botfly, sometimes severely enough to cause mortality and occasionally involving 25 to 37 percent of local populations (Richens 1965a.). This same cause of mortality cannot be ruled out for *T. clusius*.

Although, historically, parasites and disease have not be considered a major threat to *T. clusius* more recent research suggests physiological stress created from habitat loss and degradation may be increasing Thomomys vulnerability to both. (emphasis added).

The following excerpt clearly illustrates the degree of uncertainty associated with the significance of endoparasites, in particular, to the health of pocket gophers. Although Wyoming Natural Diversity Database reports parasites and/or disease have not been suspected to be a factor in the conservation of Wyoming pocket gophers, this may not be the case and should be considered in light of saving this species from imminent extinction.

> [*Eimeria fitzgeraldi* was described from this population of pocket gophers by Todd and Tryon." They also found oocysts of *E. tizomomysis* in 25 of the same 65 fecal samples from which *E. fitzgeraldi* was described (Todd, unpublished data). The finding of *E. thomomysis* in *T. talpoides* is evidently a new host and geographic record. *Eimeria 1zomomysis* was described from *Thomomys bottae* in Arizona by Levine et al."
>
> The only other report of coccidia from pocket gophers was by Skidmore, who described *Eimeria geomydis* from *Geomys bursarius* in Nebraska. Lubinsky" reported cysticerci of *Taenia mustelae* Gmelin, 1790 from *T. talpoides* from Alberta. This is evidently the only other record of larval tapeworms from *Thomomys. Paranoplocephala variabalis* and *P. infrequens* were described by Douthitt from *Geomys bursarius.* Rausch and Schiller reviewed the literature on *Paranoplocephala* spp. in rodents. The finding of these is a new geographic record.

> *Ransomus rodentorum* was originally described by Hall as a species of *Chabertia* from *T. talpoides* in Colorado, but he later assigned the specimens to a new genus and species. This species is still the only one in the genus. *Ransotnus rodentorum* has since been reported from *T. talpoides* and *T. umbrinus* in Utah. Our finding is evidently a new geographic record.
>
> *Longistriata vexillata* was described by Hall from *T. talpoides* from Colorado, and since then the taxonomic position of this species has been frequently changed. A review of the literature concerning this parasite is given by Skrjabin et al.'6 Evidently the only other report of this parasite, other than that by Hall' and the present study, was by Travassos and Darriba,'8 who found it in *Ranus norvegicus.* The present finding is a new geographic record. *Protospirura ascaroidea* was described by Hall from *Geomys breviceps* and has since been reported from *T. talpoides* by Lubinsky." The present finding is evidently a new geographic record.
>
> Journal of Wildlife Diseases Vol. 7, April, 1971 103. Hall' described *T. fossor* from *T. talpoides* collected in Utah; since then the species has been reported from the following hosts: *T. bottae* from California,2" *T. talpoides* from Alberta and *T. talpoides* and *T. umbrinus* from Utah.' *Triclzuris fossor* from Wyoming is a new geographic record.
>
> *Capillaria Izepatica* has been reported from many species of mammals. A summary of North American host and locality records was given by Layne. The parasite has previously been reported from *T. talpoides* in Wyoming by Dikmans and Rausch."
>
> The differences in prevalence of parasitism by different groups or species of parasites are of interest. Although the sample size was small (46), there seem to be some trends. The high prevalence of coccidia from animals collected at 8400 ft., the absence of cestodes in animals from 6800 ft. and the apparent altitudinal distribution of *R. rodentorum*, *T. fossor* and *C. lzepatica* need further study. The complex relationships of the host, intermediate host and environment are all interrelated factors which determine the prevalence and distribution of parasites of *Peromyscus floridanus* by Layne is an example of the types of information that are needed to properly evaluate the interaction between hosts, parasites and the environment.] (Todd and Lepp 1971)

A variety of mammalian, avian, and reptilian species prey on northern pocket gophers. Predation is generally not a limiting factor for pocket gopher abundance or distribution, however, "[p]ocket gophers are more important as a prey item to predators than predators are as a controlling factor of gophers (Chase et al. 1982)." However, this may not be as true of avian predators, as studies have indicated raptors can significantly reduce pocket gopher populations (Chase et al. 1982)." For example, predation has not historically been documented as limiting *T. t. macrotis* numbers or range but, given the extraordinarily small size of the remaining population, and new predation threats associated with municipal development, it may pose a limitation currently. How much more true this concern for *T. clusius* (Emphasis added).

Three-dimensional structures like powerlines and buildings create raptor perches (Bureau of Land Management 2003). Such development has transformed pocket gopher habitat from a largely flat plane to a three-dimensional world with increased opportunities for raptor predation. Residential, commercial, and industrial development also raises the risk of predation from domesticated predators such as cats and dogs (Yensen et al. 1998).

Thomomys talpoides serves as a host for several endoparasites (internal parasites) and ectoparasites (external parasites). Internal parasites include roundworms and tapeworms, while external parasites include lice, fleas, ticks, and mites (Reid 1973). Endoparasites and ectoparasites of *Thomomys talpoides* are as follows: Protozoa (Eimeria spp.), Cestoda (Cysticerci, Paranoplocephala spp.), Nematoda (Ransomus rodentorum, Longistriata vexillata, Protospirura ascaroidea, Trichuris fossor, Capillaria hepatica), Diptera (botfly: Cuterebra spp.), Acarina (mites and ticks: Haemogamasus ambulans, Hirstionyssus geomydis, Haemolaelaps geomys, Ixodes sculptus), Mallophaga (lice: Geomydoecus spp.), Siphonaptera (flea: Foxella ignota). These are established as a significant limiting factor on the abundance or distribution of the *T. t. macrotis* (and the petitioners suggest, likely, *T. clusisus*).

While predation is a natural part of *T. clusisus* and all pocket gopher ecology, the influx of people, the introduction of new predators, noxious weeds, soil disturbance and pollution, water pollution and redirection to its habitat may threaten this species with population declines because of elevated predation rates.

4. The inadequacy of existing regulatory mechanisms per Wyoming Natural Diversity Database

Petitioners agree with the WYNND assessment (Keinath and Beauvais 2006) and add: The Wyoming BLM has been issuing unprecedented numbers of oil and gas exploration and drilling permits since 2000 and in the range of *T. clusius*.) In the Atlantic Rim Coalbed Methane project, alone, 2000 wells would be drilled and at a density of 8 wells per square mile. The Atlantic Rim, the Continential Divide-Creston, and the Desolations Flats projects each include the known and potential *T. clusius* range. In spite of this fact, the BLM's Final Environmental Impact Statement for this project does not even mention the Wyoming Pocket Gopher (*Thomomys clusius*) much less discuss protection measures (Bureau of Land Management 2006) (Emphasis added).

MANAGEMENT STATUS AND NATURAL HISTORY

Management Status

Federal Endangered Species Act

The U.S. Fish and Wildlife Service does not give any special status to the Wyoming pocket gopher at this time (Keinath and Beauvais 2006).

USDA Forest Service

Beginning in 2001, Region 2 of the USFS undertook a major revision of its sensitive species list, which was finalized in December 2003; this list subsequently underwent a minor revision in May 2005 (Keinath and Beauvais 2006).

As of the last revision, the Wyoming pocket gopher was listed as a sensitive species in Region 2 (USDA Forest Service 2005, http://www.fs.fed.us/r2/projects/scp/assessments/index.shtml). Sensitive species are defined by the USFS as "those animal species identified by the Regional Forester for which population viability is a concern as evidenced by: (a) significant current of predicted downward trends in population numbers or density, and/or (b) significant current or predicted downward trends in habitat capability that would reduce a species' existing distribution" (USDA Forest Service 1994). The Region 2 area in Wyoming includes the Bighorn, Black Hills, Medicine Bow, and Shoshone national forests and the Thunder Basin National Grassland. Based on known distribution, the Medicine Bow–Routt National Forest is the only National Forest System unit in Region 2 that possibly supports the Wyoming pocket gopher, but we are not aware of any known occurrences on USFS lands (Keinath and Beauvais 2006).

Bureau of Land Management

The Wyoming Bureau of Land Management (BLM) developed their sensitive species list in 2001 and assigned the Wyoming pocket gopher to that list. The

BLM developed the list to "ensure that any actions on public lands consider the overall welfare of these sensitive species and do not contribute to their decline." The BLM's sensitive species management will include:

- determining the distribution and current habitat needs of each species
- incorporating sensitive species in land use and activity plans
- developing conservation strategies
- ensuring that sensitive species are considered in National Environmental Policy Act analysis
- prioritizing what conservation work is needed (Bureau of Land Management Wyoming 2001).

To date, however, no such action has been taken for the Wyoming pocket gopher, and the authors are not aware of plans to do so (Keinath and Beauvais 2006).

State Wildlife Agencies

The Wyoming Game and Fish Department classifies the Wyoming pocket gopher as NSS4 and includes it on a long list of species of concern under Wyoming's Comprehensive Wildlife Conservation Strategy (Wyoming Game and Fish Department 2005). In general, this ranking means that although populations appear to be restricted in distribution, the species' habitat does not appear to be declining, and there are no known sensitivities to human disturbance (Oakleaf et al. 2002). The primary issues identified by the conservation strategy regarding this species were a need for more information on its status, trends, and habitat use.

Natural Heritage Program

The Wyoming Natural Diversity Database (WYNDD) has assigned the Wyoming pocket gopher a rank of G2/S2 (http://uwadmnweb.uwyo.edu/wyndd/; Keinath et al. 2003). The G2 refers to a relatively high probability of global extinction, based primarily on the taxon's extremely small global range. The S2 rank refers to a relatively high probability of extinction from Wyoming, based largely on range restriction, but also considering apparently low range occupation, uncertain abundance trends, and moderate biological vulnerability. Further, WYNDD assigns a Wyoming Significance Rank of Very High to the Wyoming pocket gopher (Keinath et al. 2003a, b), which reflects the extremely high contribution of Wyoming population segments to continental persistence of the species. Clearly, because the species is thought to occur only within the state of Wyoming (possibly extending slightly into northern Colorado pending further investigation), the fate of Wyoming populations is synonymous with the fate of the species as a whole.

Existing Regulatory Mechanisms, Management Plans, and Conservation Strategies

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). With its listing on most major sensitive species lists in Wyoming (see above section on Management Status), there appears to be consensus among management agencies of the importance of conserving this species and some leverage to initiate such action. The tenants of such lists generally require that the agencies maintaining those lists consider the welfare of those species when developing land use and resource management plans and in planning project actions. This generally includes, but is not limited to:

- evaluating current distribution and status of sensitive species, including sensitive species concerns in NEPA analyses
- employing best management practices for conserving sensitive species
- monitoring the status of populations and/or habitat for sensitive species
- collaborating with other agencies to further exchange of information beneficial for conserving sensitive species (e.g., USDA Forest Service 1994, Bureau of Land Management Wyoming 2001, Wyoming Game and Fish Department 2005).

If such mandates are rigorously adhered to, there appear to be sufficient mechanisms by which conservation of Wyoming pocket gopher could be achieved. However, conservation will only be effective if the mandates are given

> institutional priority by the agencies in question, whereby collection of needed information is funded and the data from such research are allowed to influence management actions. The primary issue stated by most studies looking at this species is the lack of information on virtually all aspects of its biology and ecology (e.g., this report, Keinath et al. 2003, Beauvais et al. 2004, Wyoming Game and Fish Department 2005). Without such information, decisions regarding its conservation are not likely to be effective or enforceable. Unfortunately, given other issues of management concern, no efforts have been taken to date by any agency to resolve this lack of information. Thus, the mechanisms by which conservation can be achieved (at least on public lands) are in place, but their efficacy depends on the rigor with which responsible agencies implement them, which has yet to be determined (Keinath and Beauvais 2006).

Given the circumstances stated above, the petitioners request expeditious consideration of listing *Thomomys clusius* as threatened or endangered and its known and potential habitat designated as Critical Habitat. (emphasis added).

5. Other natural or manmade factors affecting its continued existence

a. Vulnerability of small populations

This species occupies an extremely narrow range. **Only fourteen (14) locations are known where twenty-one (21) specimens** of *T. clusius* have been documented recently, and substantial barriers have been created between these populations. *T. clusius* is clearly extremely vulnerable to extinction (emphasis added).

Stochastic or random events pose a great threat to small populations because they often simply do not possess the resources to recover. Three main forms of stochasticity have been recognized as increasing extinction risk: demographic, environmental, and genetic (Brussard and Gilpin 1989, Miller et al. 1996). These factors often work synergistically (Vucetich and Waite 1999). As Lacy (1997: 329) states, "Genetic instability and decline can cause demographic instability and decline, and greater susceptibility to environmental fluctuations and catastrophes. Demographic fluctuations and catastrophe-caused bottlenecks can in turn cause more genetic instability and depletion of genetic variation." *Thomomys clusius* is vulnerable to each of these three forms of stochasticity.

i. Demographic stochasticity

Demographic stochasticity represents events influencing individual birth and death rates, such as random variability in the sex ratio of offspring. Demographic events are generally not important in large populations, but they can be significant in extremely small populations where one individual represents a substantial proportion of the population.

ii. Environmental stochasticity

Environmental stochasticity refers to random events influencing all individuals in a given population, such as weather events, fires, disease outbreaks, or unusual predation events. Environmental events can have a substantial impact on even relatively large populations, but small or geographically restricted populations are in far more danger of becoming extinct from such events.

iii. Genetic stochasticity

Genetic stochasticity refers to variability in random recombination in the gene pool of a particular species and is generally not a problem in normal, heterozygotic populations. However, in very small and/or isolated populations, it can result in loss of fitness due to inbreeding depression and the resultant expression of deleterious alleles (Lacy 1997).

Small, fragmented, and isolated populations have fewer opportunities for genetic flow. Breeding partners are often limited to those found in the immediate area, and loss of fitness due to inbreeding depression can result. Lacy (1997:321) states:

> Inbreeding has been observed to cause higher mortality, lower fecundity, reduced mating ability, slower growth, developmental instability, more frequent developmental defects, greater susceptibility to disease, lowered ability to withstand stress, and reduced intra- and inter-specific competitive ability (Allendorf and Leary 1986, Darwin 1868, 1876, Falconer 1989, Ledig 1986, Lerner 1954, Ralls et al. 1988, Wright 1977).
>
> More highly inbred wild common shrews (*Sorex araneus*) were smaller at time of weaning and had a decreased probability of reaching adulthood (Lacy 1997, Stockley et al. 1993).

Inbreeding depression is often more severe when coupled with harsh or variable environmental conditions (Lacy 1997, Lerner 1954, Schmitt and Ehrhardt 1990, Keller et al. 1994, Miller 1994, Frankham 1998). As fitness is lost from inbreeding, population size continues to diminish, and further inbreeding becomes even more likely (Brussard, Peter F. and Michael E. Gilpin. 1989) while at the same time survivors become more vulnerable to extinction from demographic or environmental stochasticity (Lacy 1997, Goodman 1987).

There are several mechanisms that cause inbreeding depression. Without reliable sources of immigration, genetic diversity may quickly be lost through the random process of genetic drift, and deleterious mutations and alleles may spread throughout a population. These deleterious alleles can become fixed in small populations because allele frequencies in populations with fewer than a thousand breeding individuals are usually influenced more by random genetic drift than natural selection (Lacy 1997, Kimura 1983). As these maladaptive genes accumulate, populations decline and genetic drift may occur even more rapidly, creating the positive feedback termed "mutational meltdown." (Lacy 1997, Frankham 1998, Vucetich and Waite. 1999). When only a few individuals establish a new population or survive a population bottleneck, their progeny are highly vulnerable to the effects of genetic drift and loss of genetic variability (Lande 1995, Lacy 1997). Many populations of mammalian species that have experienced bottlenecks have been shown to experience lower fitness compared to populations that did not experience bottlenecks (Lacy 1997). While inbreeding in some plants that reproduce by self-fertilization has been found to purge populations of maladaptive recessive alleles, there is little evidence that this occurs in mammals (Lacy 1997, Ralls et al. 1988, Barrett and Charlesworth. 1991, Barrett and Kohn. 1991).

Inbreeding depression may also result from the loss of the competitive advantage conveyed by heterozygosity, or heterosis. White-tailed deer (Odocoileus virginianus) with a greater number of heterozygous allozyme loci also had higher rates of twin births, more massive pregnant females, and faster fetal growth (Lacy 1997, Cothran et al. 1983). Faster horn growth is reported in bighorn sheep with higher levels of heterozygosity (Fitzsimmons, et al. 1995). Higher measures of population size, heterozygosity, and genetic variation were all “positively and significantly correlated with population fitness” (Reed, D.H., and R. Frankham 2003).

As heterozygosity is lost, populations are less able to adapt to change because there are simply fewer combinations of alleles available (Lande and Shannon. 1996, Myers 1996). As Lacy (1997:321) summarizes:

Fluctuations in genetic variance in small populations can reduce the rate of adaptation sufficiently to cause small populations to go extinct in the face of environmental change to which large populations would be able to adapt (Bürger and Lynch 1995). We cannot know what adaptations will be required for persistence in future environments, but we do know that the rate of environmental change is much more rapid presently than perhaps at any time in past evolutionary history (Bürger and Lynch 1995).

Effective population sizes of 5,000 individuals may be necessary to maintain potentially adaptive genetic variation, which means that actual population sizes should be even larger (Lande 1995). Effective breeding populations often only include one-quarter of the individuals in mammal populations because young and old individuals are not involved in breeding and certain mature individuals are more likely to pass on their genetic material (Groves and Clark. 1986, Noss and Cooperrider 1994, Brussard and Gilpin. 1989). It is highly likely that considerable loss of heterozygosity has already occurred given the small number of *T. clusius* individuals that probably remain.

Since physical barriers separate the remaining *T. clusius* sites, dispersal between them is unlikely. The total number of remaining individuals of this species is very low. Therefore, the results of inbreeding depression may be irreversible. Lacy (1997:331) writes, "When a population is the only representative of its taxon, or exchange with other populations is not possible, then reversal of genetic depletion would come about only if the population can recover to large numbers and survive the 100s- 1000s of generations needed for new mutations to restore variation" (Lacy 1997). Clearly this will not be possible if *T. clusius* habitat and population loss continues.

b. Climate change

Of these three types of stochasticity, only environmental events are likely to be of current import to Wyoming pocket gopher populations. In the event that populations decrease to the verge of extinction, demographic and genetic stochasticity could become major concerns. Weather and its influence on food and cover [i]s a dominant factor in determining annual populations of pocket gophers. Although extreme climatic events can affect pocket gopher populations, their overall effects are not well understood (Howard, W.E. and H.E. Childs 1959). Pocket gophers are more abundant in years of normal or above-normal moisture and lower in years of below-normal precipitation, suggesting a potentially negative impact from prolonged drought (Vaughan 1967). This effect can be extended to include impacts from global climate change if it results in a general desiccation of habitat within the range of the Wyoming pocket gopher. Runoff from melting snow and high groundwater tables can force temporary redistribution of pocket gophers (Reid 1973). Harsh winters and late spring/ early fall freezes can also affect pocket gopher populations, (Reid 1973) probably mostly by increasing juvenile mortality.

A small amount of habitat may have been lost to urbanization and other disturbances such as road and pipeline construction, but a substantial amount of generally undisturbed habitat probably remains. It is likely that remaining available habitat has been fragmented and/or degraded by these same processes, as well as vegetative shifts caused by grazing, drought, and global climate change, but we have no information to support or refute this hypothesis. It is likely that remaining available habitat has been fragmented and/or degraded by these same processes, as well as vegetative shifts caused by grazing, drought, and global climate change, but we have no information to support or refute this hypothesis.

c. Stress

Many of the factors endangering *T. clusius* habitat could also contribute directly to increased pocket gopher stress levels. Development and the overall increase in human presence leads to increases in general surface disturbance. Additionally, noxious weed invasion and drought can lead to physical stressors such as malnutrition. "Many stresses have a metabolic cost and this should tend to make the effects of different stresses cumulative…." (Hoffmann, A.A., and P.A. Parsons. 1991). Studies in other fossorial species, such as the white-tailed prairie dog, have shown reduced birth rates due to resorptions and abortions in pregnant females when exposed to environmental stressors (Foreman, D. 1962). Stress similarly impacts *T. clusius* reproduction and/or survival rates.

B. Continued oil and gas exploration and development within the range of *T. clusius* translates to imminent, high magnitude threats

1. Carbon and Sweetwater Counties oil and gas development

Petitioner, Biodiversity Conservation Alliance, has long monitored and advocated for ecologically and environmentally responsible oil and gas development on Bureau of Land Management lands in Wyoming and surrounding states. The collective Jonah Field oil and gas project in southwestern Wyoming is widely recognized as no less than an environmental disaster even with several organizations like Biodiversity Conservation Alliance constant official pleas for restraint on the part of the BLM and energy interests. In spite of strong scientific evidence that should have resulted in the restraint called for by Biodiversity Conservation Alliance and its partners, the BLM and energy interests have virtually destroyed any hope for the sustained survival of many species of wildlife in the Jonah Field project region. The Jonah Field precedent is described in brief in Biodiversity Conservation Alliance's fact sheet, The Jonah Field – Poster child for Drilling Gone Wrong. (**See Attachment E**) Petitioners request the Service review the voluminous historical and scientific information provided on Biodiversity Conservation Alliance's website concerning the destruction of wildlife habitat in the Jonah Filed project area. Please view: http://www.voiceforthewild.org/blm/Jonah_field/index.html and follow links to additional information.

Biodiversity Conservation Alliance's compelling historical account of "out-of-control" oil and gas development in Wyoming, particularly on BLM lands, provides impetus to this petition to list and thus protect Thomomys clusius under the Endangered Species Act.

Virtually the entire known range of the Wyoming pocket gopher is leased for oil and gas development, and BLM has approved or is currently approving full-field oil and gas development, specifically the Atlantic Rim, Desolation Flats, and Continental Divide - Creston Projects totaling 11,335 wells and covering most of the known range of this species (Biodiversity

Conservation Alliance 2005) (also, **See Attachment D**, **Map 1**.). Given that oil and gas development has been recognized as a primary threat to the viability of this species, together with the lack of specific measures to protect the Wyoming pocket gopher in the documents approving these projects to date, emergency listing is needed to prevent the potential loss of the species.

The BLM approved 2,000 natural gas and coalbed methane wells and 1,000 miles of roads with pipelines buried beneath them across 270,000 acres under the Atlantic Rim Coalbed Natural Gas Project on May 21, 2007 (BLM 2007). The BLM approved 385 wells, 542 miles of road and 360 miles of pipeline across 233,542 acres under Desolation Flats Natural Gas Field Development Project on July 27, 2004 (BLM 2004). The agency is proposing 8,950 wells and an undisclosed mileage of roads and pipelines across 1.1 million acres under the Continental Divide - Creston Project (BLM 2006).

XI. Summary

Petitioners have demonstrated that the species *Thomomys clusius* meets multiple criteria for protection under the ESA as either an Endangered or Threatened species. *Thomomys clusius* meets the definition of an Endangered species as defined CNE et al. ESA listing petition for *T. clusius* by the Act. “The term "endangered species" means any species which is in danger of extinction throughout all or a significant portion of its range other than a species of the Class Insecta determined by the Secretary to constitute a pest whose protection under the provisions of this Act would present an overwhelming and overriding risk to man” (16 U.S.C. § 1532(6)).

The number of known remaining populations (i.e., **only fourteen** locations producing **only twenty-one** documented specimens) and its presumed extremely low total population (which produces inherent genetic variability issues) in consideration with the fact that *T. clusius* is thought to occupy a total of only 1,102 km2 or 0.44% of Wyoming’s land base (See **Attachment C: Appendix -** *Predictive Distribution Model for Wyoming Pocket Gopher***)** and considered alongside the multiple imminent and high-magnitude threats of habitat loss and degradation (<u>due primarily to oil and gas development</u>), potential eradication from chemical toxicants, invasive noxious vegetation, impacts from human recreation and companion animals, climate change, and a variety of other intrinsic and extrinsic threats, present a collection of irrefutable facts and factors that combine to force the conclusion that *T. clusius* is facing imminent threat of extinction.

If *T. clusius* is not provided with ESA protections, it is extremely likely the species will go extinct. On this basis, petitioners request ESA listing for the *T. clusius* species of the Wyoming pocket gopher. The Wyoming pocket gopher is a keystone engineer species that actively shapes plant community structure and soil characteristics, and that serves as prey to a variety of predators.

Pocket gophers have played foundational roles, alongside prairie dogs and bison, in shaping North American grasslands. It is therefore with humility and foresight that we must safeguard those life forms threatened by on-going anthropogenic threats such as habitat destruction.

XII. Requested designation

Petitioners hereby petition the USFWS to list the Wyoming pocket gopher, *Thomomys clusius*, as a Threatened or Endangered species throughout its range pursuant to the Endangered Species Act.

XIII. Request for emergency listing rule

The ESA provides authority for the Secretary to issue temporary listing rules in the event of “any emergency posing a significant risk to the well being of any species of fish or wildlife or plants” (16 U.S.C. § 1533(b)(7)). Indeed, the Secretary is commanded to make “prompt use” of this authority “to prevent a significant risk to the well being of any such species” (16 U.S.C. § 1533(b)(3)(C)(iii)).

Extremely rare *Thomomys clusius* is not protected by any state or federal regulations. Yet this species is more imperiled than ever as continued human development and subsequent habitat degradation continue at a furious pace in Sweetwater and Carbon Counties. The remaining populations of *T. clusius* are dangerously close to being extirpated, if they have not been already. The extent of undeveloped *T. clusius* range remaining in Sweetwater and Carbon Counties is deceiving, as many areas have already been leased by the energy sector for future development.

The introduction of exotic grasses and noxious weeds further imperils *T. clusius* by jeopardizing the continued availability of food and suitable soil conditions. No regulatory mechanisms currently exist to protect this species from continued residential and commercial development. Current regulatory mechanisms are not adequate to protect this highly imperiled species from extinction, and the magnitude and imminence of the threats involved require immediate attention; irrevocable harm will likely occur in the period of time (usually multiple years) expended during the standard listing process.

Therefore, in addition to requesting ESA listing, Petitioners further request that an emergency listing rule be promulgated immediately.

XIV. Benefits of ESA listing

The benefits of ESA listing for *T. clusius* will be substantial, as we suggest in earlier sections of this petition.

• Listing will require that federal agencies, in conjunction with FWS, carefully consider the potential impacts to *T. clusius* of ongoing and proposed activities under their jurisdictions. The result will be significantly improved protection from commercial and residential development, noxious weeds, and other human disturbance.

• The designation of critical habitat, yet another exclusive benefit of ESA listing, will result in significant additional protection not only for occupied *T. clusius* habitat but also for other habitat areas deemed essential to the recovery of the species but currently unoccupied.

• Listing will result in the development of a *T. clusius* recovery plan aimed at biological recovery (and, if possible, delisting).

• Listing will help spur research (and the required funding and scientific interest) necessary to fully understand how biological recovery of *T. clusius* can be achieved. This research may further the recovery of similar imperiled species.

• Listing will help improve and standardize *T. clusius* management.

• The Bureau of Land Management, State of Wyoming, and Sweetwater and Carbon Counties have failed to adopt conservation measures to ensure *T. clusius* recovery. Listing will significantly increase the likelihood that necessary measures are adopted.

• Listing will require protections that are not occurring now and will not occur otherwise through requirements for section 7 consultation for federal projects or projects with federal funding and section 9 prohibitions on take by government or private parties.

• Listing is necessary to ensure the persistence of *T. clusius* given the ferocious rate of residential and commercial development throughout its range.

• Even the most ambitious scenario involving state and federal agencies adopting their own conservation measures would, at best, result in the reduction of threats to *T. clusius*, not biological recovery.

• Listing *T. clusius* may reduce the loss of other native wildlife species from development and secondary poisoning and trapping.

• Listing *T. clusius* would be a step toward ecosystem protection, given the Wyoming pocket gopher's status as a keystone species.

XV. Critical Habitat

This petition requests that critical habitat be designated for *T. clusius* concurrent with final ESA listing.

XVI. Documents cited

Petitioners hereby incorporate by reference every document cited in this petition and/or cited in the References below. We are happy to provide copies of any of these documents upon request.

XVII. 90 day petition finding

This petition and accompanying material provide substantial scientific and commercial information indicating that ESA listing for *Thomomys clusius* may be warranted. Petitioners expect to receive a formal acknowledgment of this petition and a decision within 90 days of its receipt.

Respectfully submitted,

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