PETITION TO LIST
Driloleirus americanus
AS A THREATENED OR ENDANGERED SPECIES
PURSUANT TO THE ENDANGERED SPECIES ACT

Steve Paulson
4510 Sunnyside Ln
Lenore, Idaho 83541
208-476-7688

David E. Hall
1334 Wallen Road
Moscow, ID 83843

O. Lynne Nelson, DVM, MS
591 S River Rd
Palouse WA 99161

Palouse Prairie Foundation
P.O. Box 8952
Moscow, ID 83843
509-334-7009

Palouse Audubon Society
PO Box 3606
University Station
Moscow, ID 83844

Friends of the Clearwater
P.O. Box 9241
Moscow, ID 83843
208-882-9755

PETITIONERS,
v.

Dirk Kempthorne
Secretary of the Interior
Department of the Interior
18th and C Street N.W.
Washington D.C., 20240

In Re:
ENDANGERED SPECIES ACT

PETITION TO LIST

AND TO DESIGNATE
CRITICAL HABITAT

for

Driloleirus americanus
GIANT PALOUSE EARTHWORM

AS A THREATENED OR
ENDANGERED SPECIES

Dated-August 18, 2006

Notice of petition to list, August 18, 2006

Dear Secretary of the Interior, Mr. Kempthorne:

The petitioners hereby formally petition to list the Giant Palouse Earthworm (*Driloleirus americanus*) as a threatened or endangered species pursuant to the Endangered Species Act (hereafter referred to as ESA), 16 U.S.C. §1531 et seq. This petition is filed under 5 U.S.C. 553(e) and 50 CFR 424.14 (1990), which grants interested parties the right to petition for issue of a rule from the Secretary of Interior.

Petitioners also petition that critical habitat be designated for the Giant Palouse Earthworm concurrent with the listing, pursuant to 50 CFR 424.12, and pursuant to the Administrative Procedures Act (5 U.S.C. 553).

The Giant Palouse Earthworm (*Driloleirus americanus*) is an endemic species of the Palouse bioregion that utilizes endangered Palouse prairie grassland habitat and nearby associated habitats. Habitat for this species has suffered extreme destruction and modification, due primarily to conversion of native grassland to non-native annual crops. Additionally, grazing, suburban and rural development, road construction and re-construction, and invasive species pose a threat to remaining degraded Palouse habitat and the species. Current and proposed management of the species either does not exist or is inadequate at the federal, state and local levels, to protect the species and its habitat. Without the designation of it as an Endangered Species, the Giant Palouse Earthworm faces an imminent threat to its continued existence in the Palouse bioregion.

The Giant Palouse Earthworm meets all five of the criteria under the Endangered Species Act for consideration as an endangered species: 16 U.S.C. §1533 (a)(1)(A,B,C,D,and E) (Section 4):
A present or threatened destruction, modification, or curtailment of its habitat or range;
B over utilization for commercial, recreational, scientific, or educational purposes;
C disease or predation;
D inadequacy of existing regulatory mechanisms;
E other natural or manmade factors affecting its continued existence.

Factors A, B, C, D, and E play a significant role in endangering the continued existence of the Giant Palouse Earthworm. The most immediate threat to this species is the loss of native habitat from agriculture and development. This leaves the Giant Palouse Earthworm and its habitat vulnerable to exotic species, weather, and disturbance regimes.

The Giant Palouse Earthworm, the native Palouse prairie grassland, and the associated habitats on which it depends face the threat of extinction and are therefore in immediate need of protection under the Endangered Species Act. We request an emergency listing and emergency critical habitat designation pursuant to 16 U.S.C. 1533(b)(7) and 50 CFR 424.20.

On a personal level, you should be proud to promote this particular petition to list the Giant Palouse Earthworm, *Driloleirus americanus*, onto the Endangered Species list. This species was once common and is now rare in the land that you and I know well, and treasure, the Palouse Prairie of northern Idaho.

I happened to be in Guatemala when President Bush announced your appointment to the Secretary position. People in Guatemala heard that you were married on Moscow Mountain, and that you treasured the environment. People asked me about Moscow Mountain and your qualifications. I have family that has been living on Moscow Mountain for four generations. As you are well aware, Moscow Mountain encompasses some associated Palouse Prairie native habitat. Your prompt attention to this petition will give the world that second answer.

I am the contact person for any questions that you may have concerning this petition and I will be representing the petitioners concerning this petition. Please do not hesitate to contact me, for any reason.

I look forward to reading your timely response, pursuant to the order of law and the Endangered Species Act.

Sincerely,
Steve Paulson, for the petitioners

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Executive Summary

The Giant Palouse Earthworm (*Driloleirus americanus*) is an endemic species of the Palouse bioregion that utilizes Palouse prairie grassland and its associated habitats. Habitat for this species has suffered extreme destruction and modification, due primarily to conversion of native grassland to non-native annual crops. Additionally, grazing, rural and suburban development, highway expansion projects, and invasive species pose a threat to the remaining Palouse prairie habitats and the species. Current and proposed management of the species either does not exist or is inadequate at the local, state, and federal levels, to protect the species and its habitats. Without the designation as an Endangered Species, the Giant Palouse Earthworm faces an imminent threat to its continued existence in the Palouse bioregion.

Introduction

Referred to as "the intestines of the earth" (Aristotle), "nature's plough," and "gardener's friend," the earthworm has been recognized for centuries and throughout the world as being one of the most important animals that live in the soil. It is ironic that agricultural technology, human development, and the introduction of exotic species throughout the world increasingly threaten to destroy native earthworms and their habitat. The Giant Palouse Earthworm (*Driloleirus americanus*) is no exception, as it faces the immediate threat of extinction. A native endemic of the Palouse prairie grassland in the Palouse bioregion of eastern Washington, northwest Idaho, and eastern Oregon, it is endangered by the loss of habitat due to agriculture and development, and the invasion of non-native exotic species. The United States Department of Agriculture (USDA) at one time recommended to farmers that, "anything that kills earthworms should be shunned by all farmers." (Oliver 1941, Part 3, Lesson 1) Today, roughly 99.99% of Palouse prairie grassland habitat has been converted to non-native annual crops and agricultural practices, such as the use of machinery, commercial fertilizers and pesticides, suburban and rural development, and the invasion of exotic species pose a serious threat to what remains. This has left the species vulnerable to a variety of contributing factors that threaten its existence. Additionally, there are no current regulations at the federal, state, or local levels that protect the Giant Palouse Earthworm from extinction.

Taxonomy

The Giant Palouse Earthworm (*Driloleirus americanus*) is in the family Megascolecidae within the order Opisthophora of the Kingdom Animalia and the Subclass Oligochaeta.

Kingdom *Animalia*
Phylum *Annelida*
Class *Oligochaeta*
Order *Opisthophora*
Family *Megascolecidae*
Genus *Driloleirus*
Species *americanus*

Species Description

"The Giant Palouse Earthworm (Driloleirus americanus), a large earthworm three feet or more in length and light pink in color was first described in 1897 by taxonomist Frank Smith, University of Illinois, in The American Naturalist." He wrote that Mr. R. W. Doane of the Washington Agricultural College and School of Science at Pullman, Washington sent him four specimens for examination, which he referred to as the genus *Megascolides*, believing that it was a close relative of the giant Australian earthworm *Megascolides australis*. Not actually closely related to its Australian cousin, the Giant Palouse Earthworm was renamed *Driloleirus*, which means "lily-like worm," because of its unique sweet fragrance (PBI).

Smith writes:

> Mr. Doane writes me that this species is very abundant in that region of country and that their burrows are sometimes seen extending to a depth of over fifteen feet, in cuts for new roads. I am also informed that much larger specimens than those sent me, are often found. (Smith 1897, p. 203)

Additionally, Smith writes that *M. americanus* is similar to three other native species of earthworms known to exist in the Pacific Northwest at that time. He notes, however, that *M. americanus* differs from the others by the presence of "numerous small nephridi*a* in each somite instead of two large ones., in the extent of the clitellum and in several other characters." (p.204) Smith additionally published descriptions of *Megascolides macelfreshi*, *Megascolides cascadensis*, *Megascolides eiseni*, and *Megascolides michaelseni* in 1937 (Fender and McKey-Fender 1990, p. 372).

The endemic Giant Palouse Earthworm is known to dig deep burrows and to feed in areas rich in fresh organic matter (James 2000, p.10). Therefore, it is has been described as an Anecic earthworm, one of three basic types, based on its functional role in the soil ecosystem. Anecic earthworms are also the largest and longest lived type of earthworm (James 2000, p.8-10, 1995, p. 6).

Anecic earthworms uniquely contribute to the soil ecosystem by transporting fresh plant material from the soil surface to subterranean levels. The deep burrows also aid water infiltration (James 2000, p.9, Edwards 2004, p. 30-31). The excreta of anecic earthworms, like all earthworms, have higher levels of available macronutrients and cations than the organic food material (Lee 1985 in James 1995, p. 11). Other organisms, such as endogeic worms benefit from this process, as the castings are deposited where they can be utilized as food (James 2000, p. 9, Edwards et al. 1995, p.195) and such deposits enrich the soil to benefit other beneficial plants and animals (Edwards and Bohlen 1996, p.196-217).

At the time of this petition, no other native endemic species is classified within the same genus, no sub-species or varieties are known to exist, and there are no distinct population segments.

Biogeography

Palouse Bioregion

The Palouse bioregion is located in southeastern Washington, west central Idaho, and northeastern Oregon. Covering an area of approximately 16,000 sq. km., the Palouse bioregion lies between the western Rocky Mountains and the Columbia River basin (fig.1).

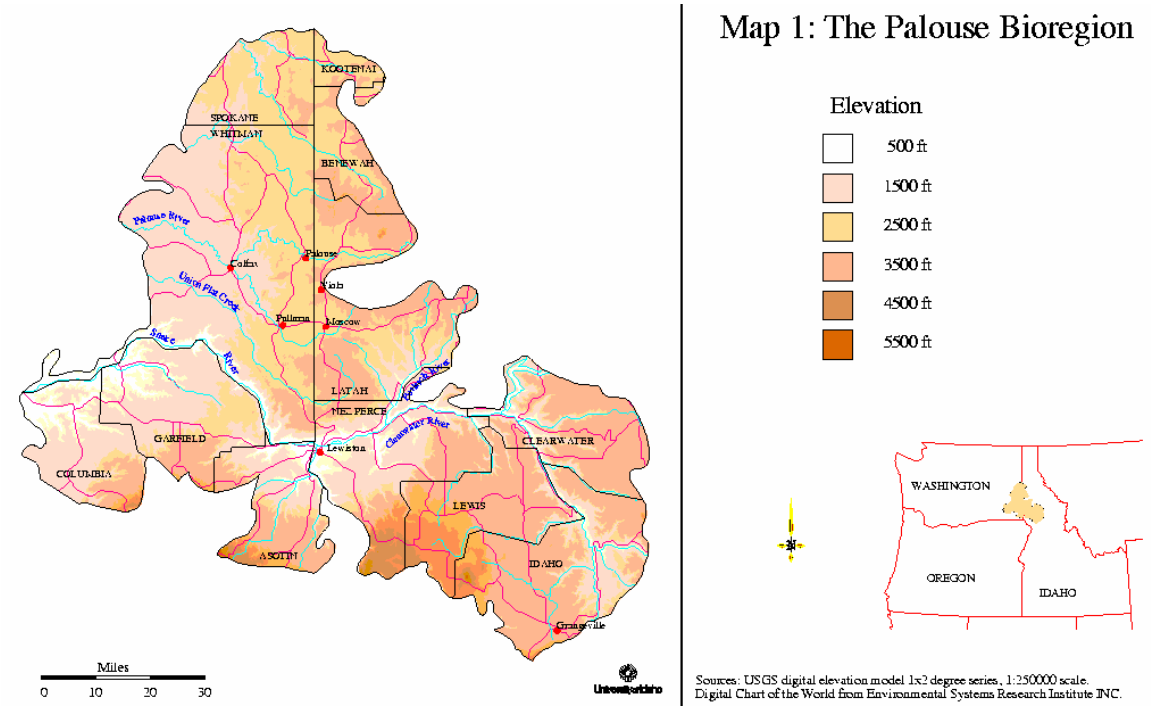

Figure 1: Figure 1: The Palouse Bioregion (USGS LUHNA)

Palouse Prairie grassland

The Palouse Prairie grasslands lie north of the Clearwater River on the eastern edge of the Palouse bioregion. According to McNab and Avers, (USDA Forest Service 1994):

> **Geomorphology.** This Section comprises moderately to strongly dissected loess-covered basalt plains, hills with large steptoes, undulating plateaus, and some river breaklands. Mountains occur in the southeast part of the Section. This Section is within the Columbia Plateau physiographic province. Elevation ranges from 1,200 to 6,000 ft (366 to 1,830 m).
>
> **Lithology and Stratigraphy.** There is Tertiary basalt with some Paleozoic granitic and metasedimentary outcrops in breaklands. Granitoid rocks of the Blue Mountain uplift are evident, as well as sedimentary rocks which occur at the boundaries of the flood basalt deposits.

Soil Taxa. Soils include mesic Xerolls with some Xeralfs, Albolls, and Aquolls. These soils are generally deep, loamy to silty, and have formed in loess, alluvium, or glacial outwash. Soils in mountainous areas are shallower and contain rock fragments.

Potential Natural Vegetation. Grasslands and meadow-steppe vegetation dominated by grasses are the prototypical vegetation of the Palouse. Woodlands and forests occur in the eastern portion of the Section on hills and low mountains. The relatively arid western portion of the Section is dominated by grassland, where bluebunch wheatgrass and Idaho fescue are the most prominent. Meadow-steppe vegetation characterized by Idaho fescue and common snowberry dominates areas with more precipitation, but still too dry to support forest vegetation on deep loamy soils. Most of this meadow-steppe, as well as the grassland to the west, has been converted to crop lands. Ponderosa pine woodlands and forests form the lower timberline in the eastern portion of the Section on hills and low mountains. The transition zone between forest and meadow-steppe consists of a complex interfingering between these two vegetation types. Douglas-fir series forests dominate at higher elevations in the mountains. Isolated fragments of the Western Red Cedar series and Grand Fir series occur on sheltered north slopes in the mountains.

Climate. Precipitation ranges from 10 to 30 in (250 to 760 mm), evenly distributed throughout fall, winter, and spring. Winter precipitation is mostly snow; summers are relatively dry. Climate is warm temperate with a maritime influence. Temperature averages 45 to 54 of (7 to 12 degrees C). The growing season lasts 100 to 170 days.

Surface Water Characteristics. There are scattered coulees and deeply-incised major drainages. Loess plains have low to medium density dendritic drainage patterns. Rapid changes in runoff volumes are possible on basalt due to gain or loss of water to gravel interbeds. The Snake River flows through this Section.

Disturbance Regimes. Wind is the principal source of natural disturbance.

Land Use. Dry farming and livestock grazing occurs on about 90 percent of the area.

European Settlement

It is widely known that the Palouse bioregion has undergone extensive changes since the first European settlement in the late 1800's. Prior to that, the Nez Perce Indians and their ancestors lived in the river canyons and harvested salmon, camas bulbs, and other native plants and animals from the bioregion. A review based on early settlers' descriptions of the flora and fauna of the region and of more recent botanical assessments of prairie remnants by the USGS shows that perennial bunchgrasses dominated the

Palouse bioregion prior to European settlement (USGS LUHNA) (Figure 2).

Changes in vegetation. Figure 3 illustrates that prior to European-American settlement, perennial bunchgrass prairie was the dominant vegetative type in the basin.

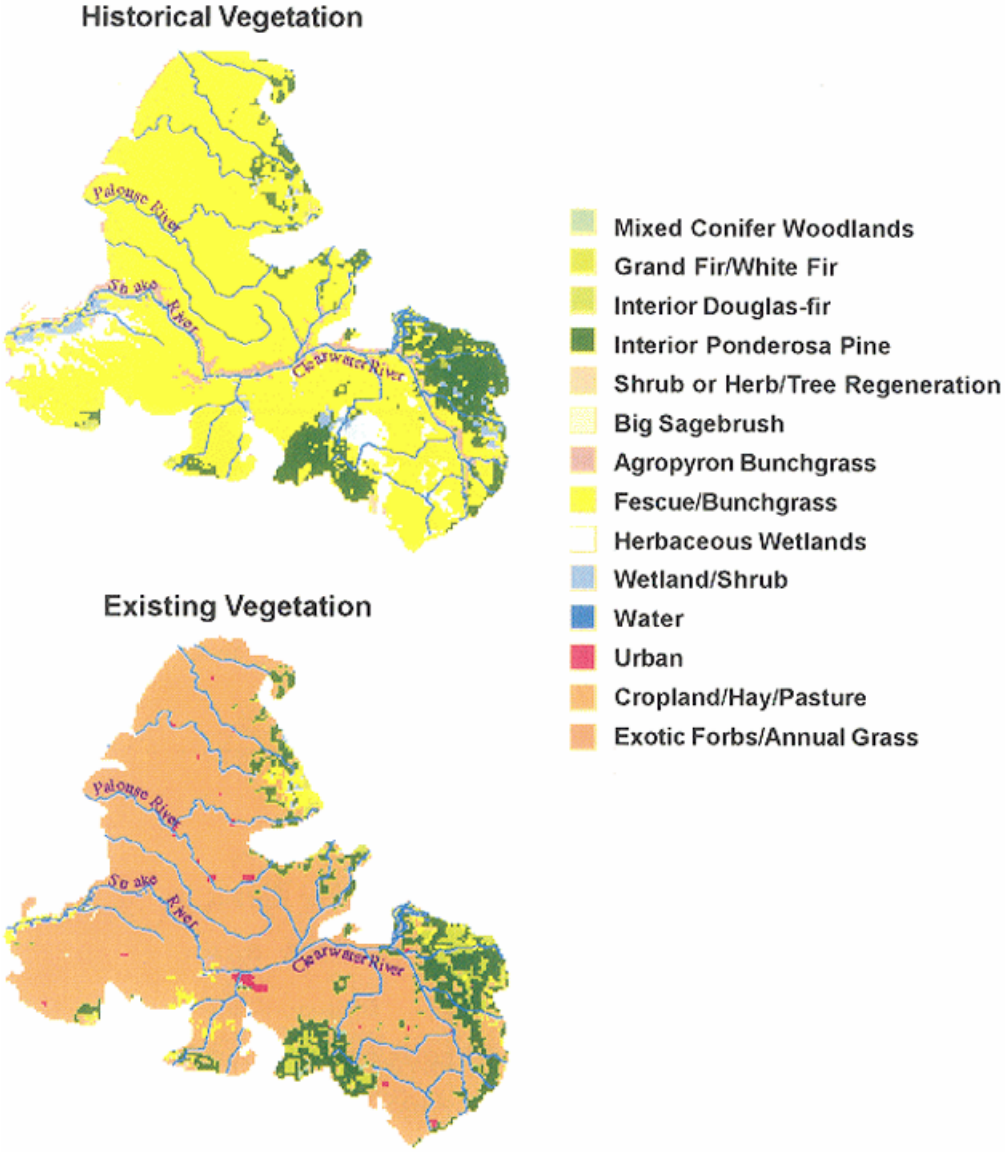

Figure 2: Change in vegetation in Palouse Bioregion (USGS LUHNA)

The introduction of agriculture immediately followed settlement of the Palouse prairie by European Americans. Instead of living in river valleys, as did the Nez Perce, European Americans lived on the prairies (USGS LUHNA). Initially used for pasture and orchards, it was soon discovered that the highly fertile prairie was well suited to dry land grain farming (USGS LUHNA). Horse-powered agriculture dominated from 1901-

1930, after which began the era of industrialized agriculture from 1931-1970. From 1971 to the present the intensity of agriculture production has continued to increase, as has the size of the average farm, but pressure from rural and suburban development is also a threat as people move to surrounding rural areas from urban centers (USGS LUHNA).

Ecological Change

The result of the nearly total conversion from native prairie to agriculture is that the Palouse prairie is currently one of the most endangered ecosystems in the United States (Noss et al. 1995, p.75). Of the original native bunchgrass habitat, approximately <1% remains. Changes in vegetation, biodiversity, ecological resources, and disturbance regimes are extensive. Figure 3 illustrates the nearly total conversion of native grassland during the last 125 years.

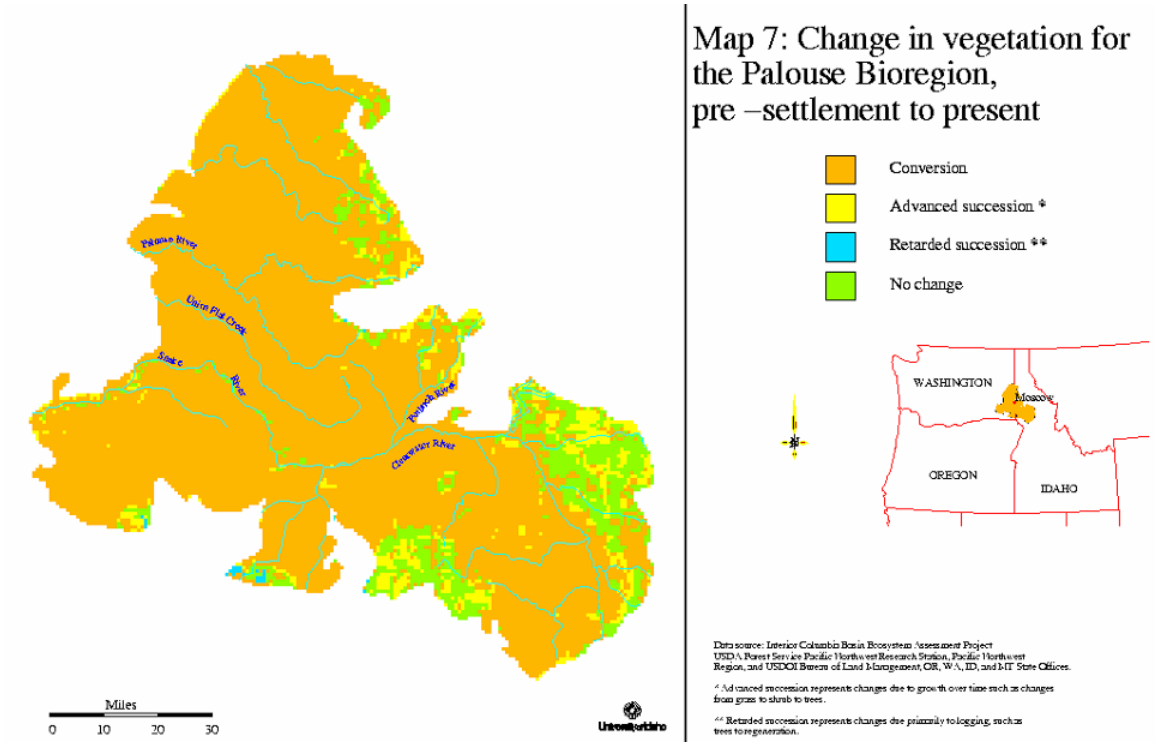

Figure 3: Change in vegetation for the Palouse Bioregion, pre-settlement to present. (USGS LUHNA)

USGS LUHNA suggests that the large-scale maps in Figs. 2 and 3, showing that 94 % of grassland and 97% of the wetlands in the Palouse bioregion have been converted to crop, hay, or pasture lands, is descriptive, but incomplete. "We believe that these results vastly underestimate the past abundance of riparian areas and the small patches of wetlands and shrubs once common on the Palouse Prairie." As such, the USGS LUHNA project also performed a fine-scale analysis of an 875-ha area near Viola, Idaho, using aerial photographs (Fig. 4, Viola Quadrangle Map). "Although significant conversions of riparian areas to fields and pastures probably occurred between 1880 and 1940, 61% of existing riparian areas in 1940 were gone by 1989." (USGS LUHNA)

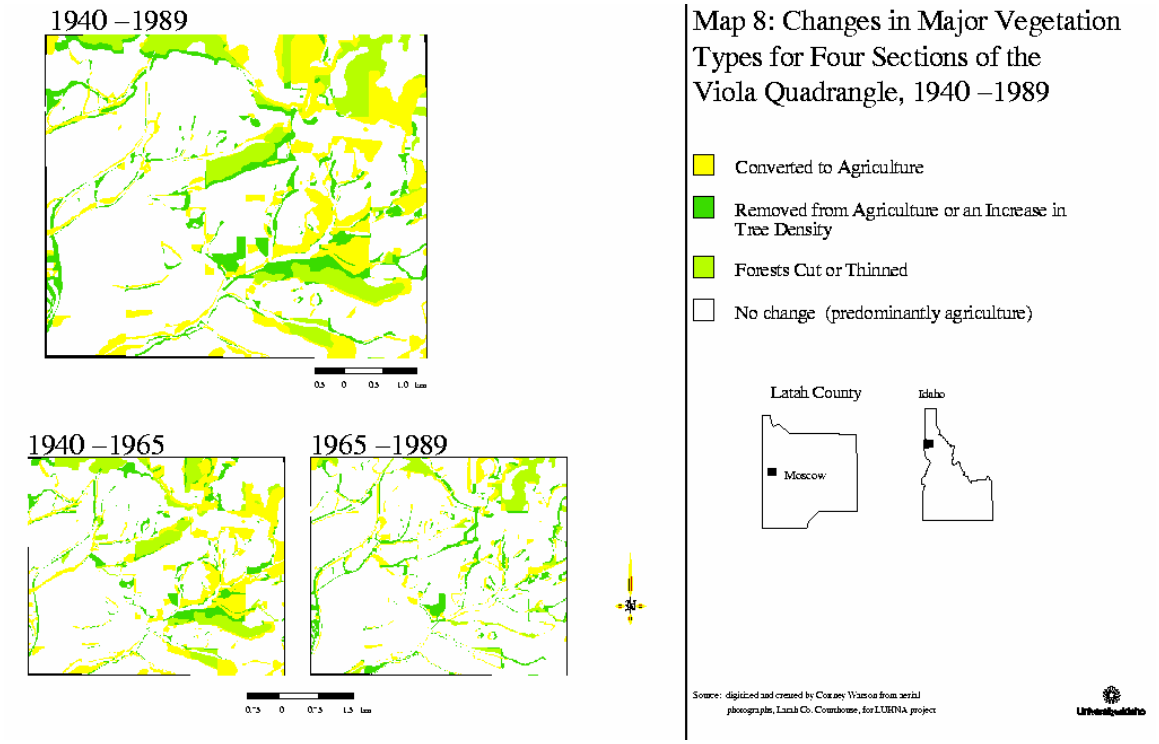

Figure 4: Viola Quadrangle Map (USGS LUHNA)

Changes in biodiversity. The remaining <1% of native Palouse prairie faces many threats, including invasive species, disease, pesticide drift, and development from agriculture or suburbanization. According to USGS LUHNA,

> Two of the native plant communities, bluebunch wheatgrass-snowberry and bluebunch wheatgrass-rose, are globally rare, and eight local plant species are threatened globally (Lichthardt and Moseley 1996). Many once-intermittent streams are now farmed; many perennial streams with large wet meadows adjacent to them are now intermittent or deeply incised, and the adjacent meadows are seeded to annual crops. Few areas of camas bloom in the spring. Clean farming practices (field burning, herbicide use, and roadbed-to-roadbed farming) leave few fences and fewer fencerows, negatively impacting even those edge species which can flourish in agricultural areas (Ratti and Scott, 1991).

Plants that are believed to have disappeared from the Palouse prairie are: transparent milkvetch (*Astragalus diaphanous*), long-tubed evening primrose (*Oenothera flava*), liverwort monkey-flower (*Mimulus jungermannioides*), and kidney-leaved violet (*Viola renifolia*) (Cook and Hufford). Similarly, Jessica's aster (*Aster jessicae*), yellow lady's-slipper (*Cypripedium parviflorum*), Wanapum locoweed (*Oxytropis campestris var. wanapum*), broadfruit mariposa (*Calochortus nitidus*), Palouse thistle (*Cirsium brevifolium*), Palouse goldenweed (*Haplopappus liatriformis*) and Thompson's clover (*Trifolium thompsonii*) are considered endangered, threatened, or rare (Cook and Hufford Online, and Palouse Prairie Foundation 2006). USGS LUHNA reports that six globally rare plant species are endemic of the Palouse region.

Animal species dependent on the Palouse grassland prairie have declined as well. In addition to the Giant Palouse Earthworm, the sharp-tailed grouse (*Tympanchus phasianellus*), white-tailed jack rabbit (*Lepus townsendii*), ferrunginous hawk (*Buteo regalis*), and spotted frog (*Rana pretiosa*) populations are seriously threatened (USGA LUHNA p.8). Johnson's hairstreak (*Callophrys johnsoni*) is a species of concern and Shepard's Parnassian (*Parnassius clodius shepardii)* is listed as a candidate species for State of Washington Species of Concern (USGA LUHNA). Both butterflies have a limited geographic range within the Palouse Basin.

A comparison of Figure 5 with 6 (a) and (b) illustrates the effect intensive agriculture has had on vegetative biodiversity in the Palouse bioregion. Stream channelization is a significant problem in the basin and has had widespread negative impacts on the aquatic component of the native grassland ecological community.

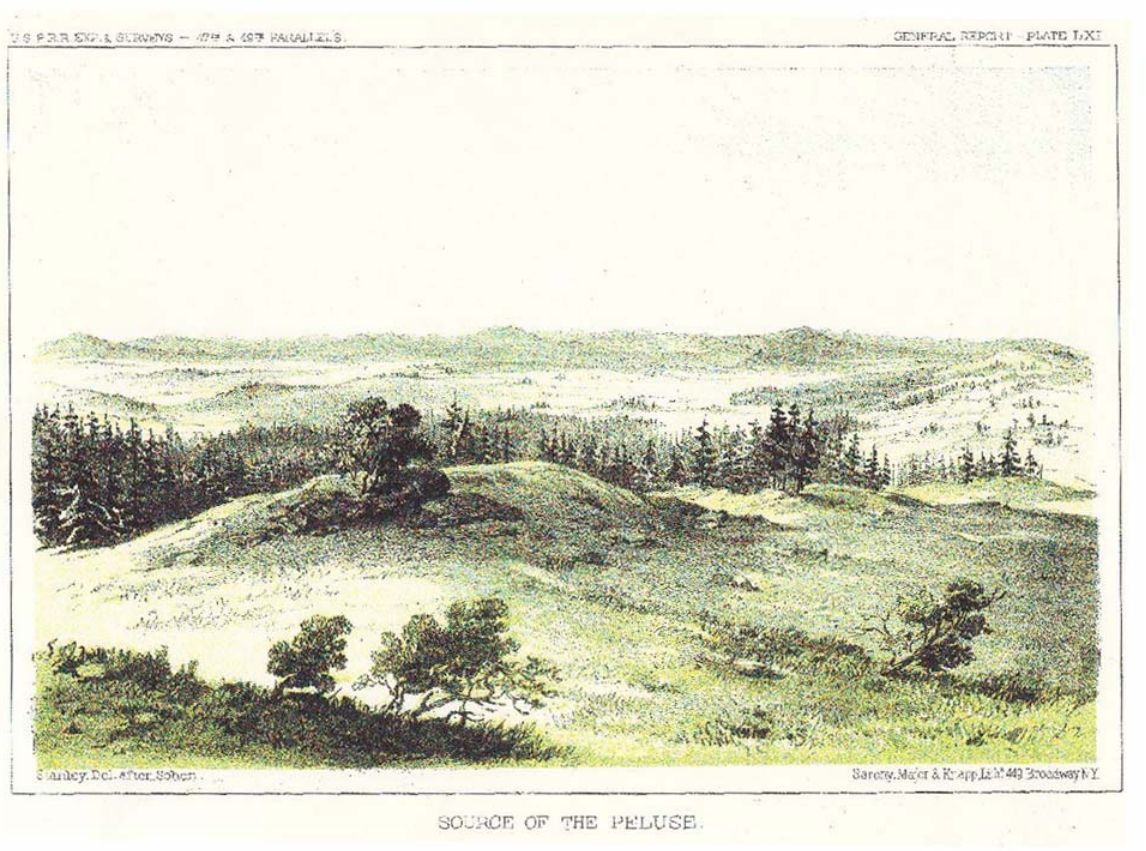

Figure 5: *Source of the Peluse*, accessed at PPF website.
Plate LXI from Stevens, I. I. 1860. Reports of explorations and surveys, to ascertain the most practicable and economical route for a railroad from the Mississippi River to the Pacific Ocean. Made under the Secretary of War in 1853-5, 36th Congress 1st Session, Senate Executive Document, Part I, General Report.

Figure 6(a): USGS LUHNA, Ch10 ad.figs. Bare cropland, stripped of native vegetation, leaves native species vulnerable.

Figure 6(b) USGS LUHNA, Ch10 ad.figs. Native Prairie riparian grassland habitat gone.

Changes in ecological resources and disturbance regimes. According to the U.S. Department of Agriculture, the Palouse bioregion has one of the highest erosion rates in the country (Fig 7). Replacement of native grasses with annual crops leaves the soil susceptible to precipitation and wind erosion. As a result, increased surface flow and decreased infiltration result in high sediment loads in streams and rivers and high peak flows followed by periods of low-flow. One result has been that once year-round streams are now intermittent and with streambed channelization a widespread problem (PSMP). The loss of rich topsoil also leaves the landscape susceptible to invasions of exotic and noxious species. As the habitat composition changes to favor exotic species, or only those native species that are highly adaptable, the job of regenerating native biodiversity becomes increasingly difficult.

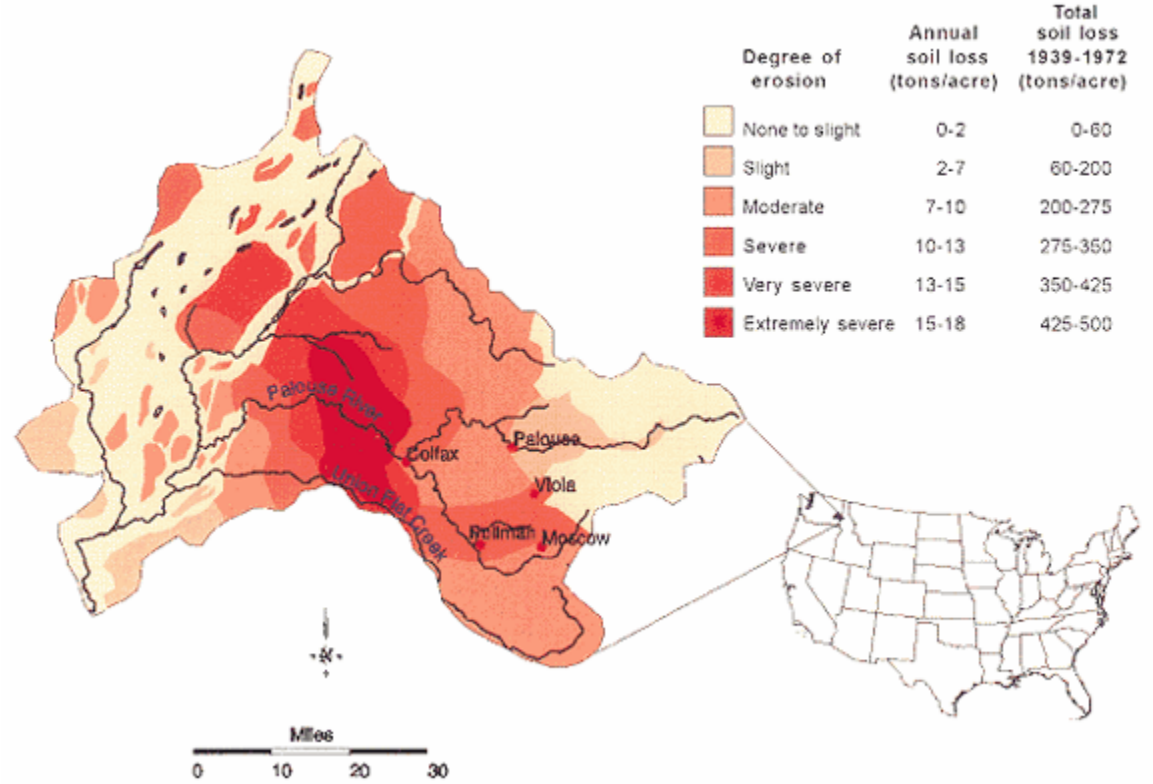

Figure 7: Erosion rates of Palouse Bioregion **(**USGS LUHNA**)**

Population

The Giant Palouse Earthworm was first described by Frank Smith in 1897 after his discovery of the earthworm near Pullman, WA: ". . .this species is very abundant in that region of the country and that their burrows are sometime seen extending to a depth of over 15 feet." Although only a few specimens have been collected, early descriptions and collection locations indicate that the Giant Palouse Earthworm is an endemic that utilizes the rich, deep soil and native vegetation of the endangered grassland habitat of the Palouse bioregion (James 1995, Niwa et al. 2001, p.40). Three collection sites had been identified as of 1990 (Fender and McKey-Fender 1990).

Sightings of the Giant Palouse Earthworm have been extremely infrequent. University of Idaho graduate student Yaniria Sanchez-de Leon was the first person in nearly two decades to report a sighting of this earthworm (University of Idaho 2006). She was conducting her graduate research at a site near Pullman, Washington on May 27, 2005, when she accidentally killed and collected a specimen of this species. Since that time, her preserved specimen has been confirmed to be of the species *Driloleirus americanus* by two professional entities. Independent confirmation of the specimen was made by northwest earthworm expert William M. Fender-Westwind and by earthworm experts gathered for a workshop in Puerto Rico in November, 2005 (Mullins 2006).

One of the few previously recorded sightings of *Driloleirus americanus*, prior to Sanchez-de Leon's sighting, was made in 1988 by J. B. Johnson and P. Johnson. J.B. Johnson is a University of Idaho Plant, Soil and Entomological Sciences Department head. P. Johnson was a graduate student. They found several of these worms in a forest clearing near Moscow, Idaho while studying pill beetles. The two specimens that they collected and sent to Fender-Westwind were positively confirmed to be *Driloleirus americanus* (Mullins 2006).

Prior to the Johnson and Johnson recorded sighting, the Giant Palouse Earthworm was collected by Fender in 1978 near Pullman, WA (Fender 1995).

An indication of this species' rarity is documented by the research done by Fauci and Bezdicek (2002). These researchers surveyed earthworms at 46 Palouse sights without one collection of the Giant Palouse Earthworm.

Due to critical loss of habitat and restricted geographic range the Giant Palouse Earthworm was listed as vulnerable in 1996 by the International Union for Conservation of Nature and Natural Resources on the IUCN Red List of Threatened Species (World Conservation Monitoring Centre 1996).This listing is described as the following:

> Population is characterized by an acute restriction in its area of occupancy (typically less than 100 square kilometers) or in the number of locations (typically less than five). Such a taxon would thus be prone to the effects of human activities (or stochastic events whose impact is increased by human activities) within a very short period of time in an unforeseeable future, and

> is thus capable of becoming Critically Endangered or even Extinct in a very short period.

Due to the temperate climate in the Palouse Bioregion, earthworms are mainly active in the autumn and spring. During the winter they burrow deeper in the soil, where they are protected from cold winter temperatures. During the dry summer they also burrow deep into the soil to find moisture (Edwards 2004). Additionally, according to Fender (1995, p. 58), *Driloleirus* generally form permanent burrows at least 4.5 meters deep and can move very rapidly to escape a shovel. This may account for the fact that, in the absence of any formal studies of native earthworms in the bioregion, there have been only a few recorded sightings of *Driloleirus americanus* in the past 107 years. The best indicator for the location of populations of the Giant Palouse Earthworm is its critical habitat, Palouse prairie grassland and associated habitats.

Summary of Factors for Consideration

The Giant Palouse Earthworm meets all five criteria under the Endangered Species Act for consideration as an endangered species: 16 U.S.C. §1533 (a)(1)(A,B,C,D,E) (Section 4).

A: present or threatened destruction, modification, or curtailment of its habitat or range;

The Giant Palouse Earthworm is threatened by the extensive conversion of native Palouse prairie grassland habitat to non-native annual crop production. Current trends in agriculture show that the intensity of farming in the bioregion continues to increase in terms of production, numbers of acres farmed, and the use of fertilizer and pesticide sprays (USGS LUHNA, and USDA). In addition, grazing and rural and suburban development pose a threat to remnant grassland prairie habitat upon which the Giant Palouse Earthworm depends.

The Giant Palouse Earthworm is threatened by the extensive conversion of its native habitat to suburban human development. The Palouse region is currently undergoing a surge in high density housing construction and its associated infrastructure. In addition to the footprint of suburban housing development and apartment complexes with huge parking lots, access roads fragment existing habitat for this species. County roads are being constantly upgraded and widened to handle the increase in motorized traffic. State and federal highways are being re-constructed and re-located to expedite motorized traffic, frequently utilizing previously undeveloped landscapes with little or no regard for wildlife habitat requirements. Maintaining these motorized traffic by-ways is often toxic to humans, animals, insects and invertebrates. The pollution of runoff from the roads associated with motorized traffic is toxic to this species and others. The rare Giant Palouse Earthworm is especially susceptible to unregulated human developments for these and other reasons.

As a native endemic species, it is particularly vulnerable to habitat loss due to its narrow geographic range (James 2000, and Fender and McKey-Fender 1990). Of the three native species of earthworms occurring in the Columbia Basin, only Driloleirus americanus is known to be associated with a special habitat type, the native grasslands of the Palouse prairie of the Palouse bioregion (James 1995, p.3). During the past 125 years, the Palouse prairie has experienced a dramatic conversion of native vegetation and habitat to non-native, due primarily to agricultural development (Fig's.2,3,and4). The intensity of farming in the basin continues to rise, as bushels per acre produced continues to rise, as illustrated in Figure 8.

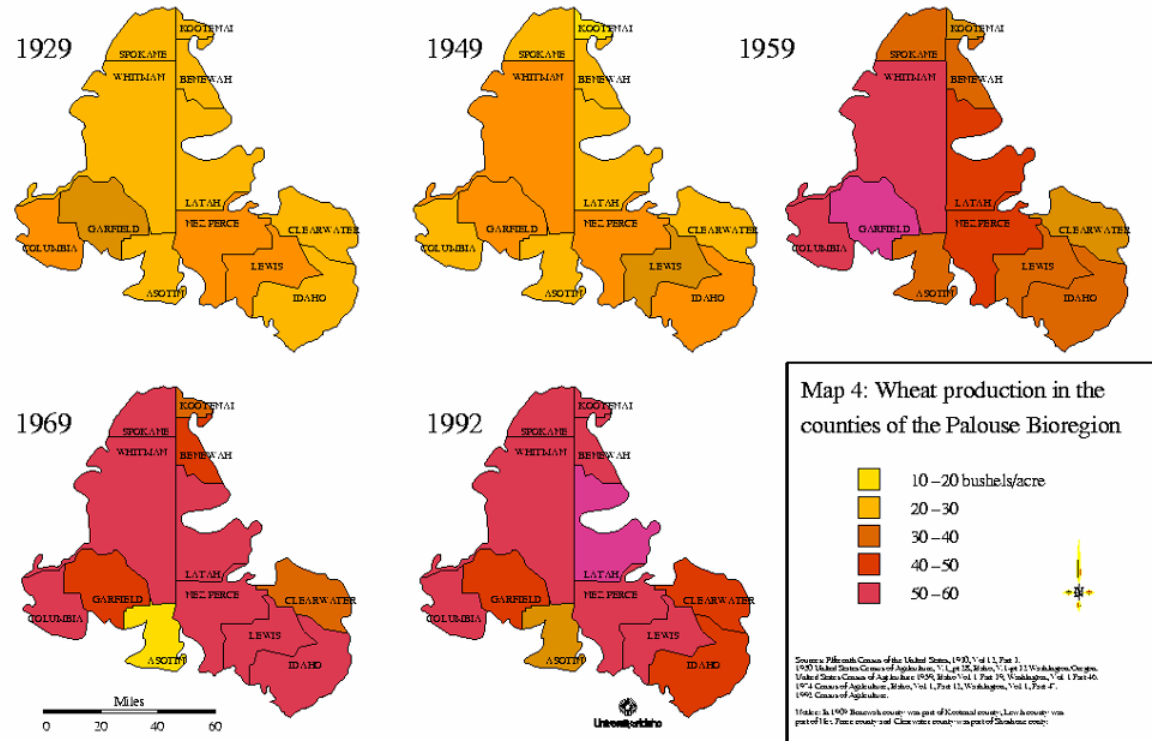

Figure 8: Changes in bushels-per-acre over time (USGS LUHNA).

In general, earthworms are influenced by four environmental factors: moisture, temperature, soil pH, and food resource quality and quantity (James 2000, 1995). It is also true that, "in general, agricultural practices replace earthworm functional roles with mechanical and chemical inputs, and tend to reduce earthworm populations." (James 1995, p.12) It has been determined that the Giant Palouse earthworm is likely less tolerant of disturbances due to agriculture than its native and non-native earthworm counterparts within the bioregion (James 2000, 1995, Niwa et al. 2001, p. 40). Because temperature and moisture patterns tend to be more extreme for grassland habitat types, than forested or shrub land habitat types for example, it is possible that earthworms that are limited to grassland habitat types are more vulnerable to site-specific degradation (James 2000). Therefore, agricultural practices that have long periods of bare soil can intensify the effect of weather on earthworms, such as flooding and drought conditions (James 2000).

Soil compaction occurs from the use of agricultural machinery, development, and grazing. Soil compaction affects the soil food web, soil composition, and functional groups that live within the soil ecosystem (Niwa et al. 2001, p.13). Soil pore size is reduced (Niwa 2001, p.13), thus favoring exotic earthworm species that are more tolerant of course soils than natives species (Fender and McKey-Fender1990, p. 363-364, Edwards et al. 1995 p.200-201).

According to James (2000) and others, soil pH is often a limiting factor on earthworm distribution based on studies of the best known European varieties. It is widely known that the high application rates of ammonium-based nitrogen fertilizer over the past 40 years have increased soil pH and lost soil productivity (USDA) (Fig. 9).

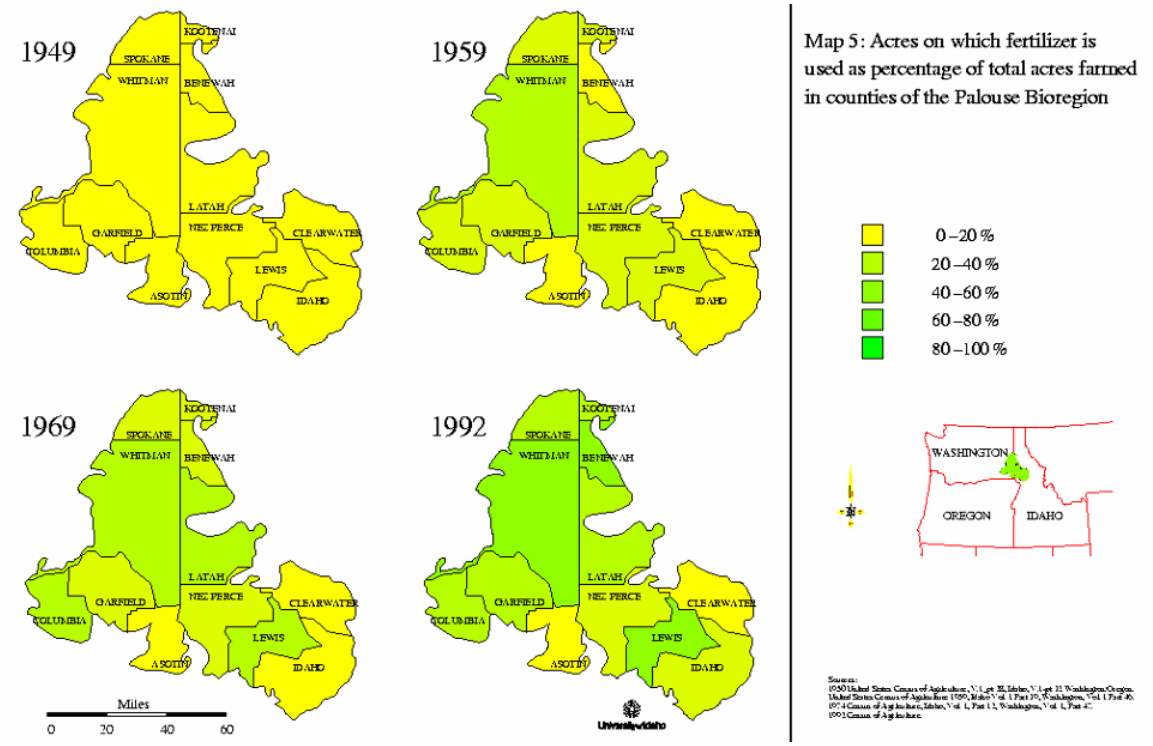

Figure 9: Application rates of ammonium-based nitrogen fertilizer over the past 40 years (USGS LUHNA).

According to Edwards et al. (1995 p. 202) earthworms are very sensitive to ammonia-based fertilizers. Similarly, there have been studies that show that earthworms are susceptible to mortality from chemical exposure, including pesticides. An overview can be found in Edwards and Bohlen 1996 (p.283-299). Several herbicides, fungicides and insecticides in particular are extremely toxic to earthworms. Earthworms are particularly vulnerable to herbicides that change or destroy the vegetation upon which the species depends. Also, in general, there is little known about the long-term toxicity of pesticides on earthworms.

The Giant Palouse Earthworm is an endemic of the Palouse prairie and its associated habitats. Its habitat is bordered on the western edge by arid desert in eastern Washington and by the western front of the Rocky Mountains in the east. Therefore, ongoing destruction and modification of habitat is assumed to have further limited its range to prairie remnants and associated peripheral habitats.

The Rose Creek Preserve, maintained by The Nature Conservancy; Kamiak Butte County park and nearby private land; Steptoe Butte, north of Colfax, WA; Farr Cemetery, Pullman; Wawawai County Park, Snake River; Klemgard Park, a Whitman County park; Washington State University's Roundtop Area, adjacent to the newly expanding Palouse Ridge golf course; and Magpie Forest, a hawthorn prairie remnant on the outskirts of Pullman are a few examples of the small patches of grassland communities that are still wholly or partially intact (Cook and Hufford Online).

B Over utilization for commercial, recreational, scientific, or educational purposes;

Three of the last few reported individuals of this species have been inadvertently killed in the academic process of reporting the rarity of its existence.

C Disease or predation;

The removal of native plants and the agriculture practice of leaving cropland bare for long periods of time, leaves native species, such as the Giant Palouse Earthworm **susceptible to predation** (James 2000,1995). Additionally, these conditions leave the door open for exotic predators. Although the extent of predation and its threat to the Giant Palouse Earthworm is unknown, it certainly is a factor that must be considered.

Pathogens are known to have been transmitted by exotic earthworms either as passive carriers or as intermediate hosts (Lee 1985, Edwards and Bohlen 1996, Jameison 2000, in Hendrix and Bohlen, 2002). More information is needed to determine the extent of this threat to the Giant Palouse Earthworm. Certainly, the lack of regulation of the importation of earthworms poses an increased risk.

D Inadequacy of existing regulatory mechanisms;

There are currently no federal, state, or local regulations that can be applied to directly protect the Giant Palouse Earthworm or its habitat.

Noss (1995) writes that prairies, grasslands and savannas are some of the most endangered habitats throughout the United States. The reason for this lies in the fact that the soil is fertile and accessible for agriculture. Remnant native grasslands are obvious priorities for protection. Protection need not be restricted to pristine or near pristine sites. Therefore, protection of both critical habitat and degraded habitat, in addition to grassland restoration, are key components to the existence and recovery of this species and is not currently regulated.

The Palouse Subbasin Management Plan (PSMP) was developed as part of the Northwest Power and Conservation Council (NWPCC) review process for each of the 62 subbasins in the Columbia River Basin (Palouse Subbasin Management Plan 2004). The PSMP was designed to meet the requirements of the 2000 Federal Columbia River Power System Biological Opinion for NWPCC, Bonneville Power Administration (BPA), and the US Fish and Wildlife Service (USFWS). It was also intended to provide a resource for use by USFWS as part of threatened and endangered species recovery planning.

Three objectives and strategies in the PSMP are relevant to the Giant Palouse Earthworm and its habitat: objectives 7, 8, and 15. Private lands followed by state, federal, county, and city ownership dominate land ownership. There are two cities with populations over 10,000 (Moscow, Idaho and Pullman, Washington), one city with a population over 3,000 (Colfax), 10 towns with populations over 200, and more than a dozen smaller communities (Palouse Subbasin Management Plan). The following objectives and strategies—outlined below with comments—were designed for the mixed ownership and jurisdiction in the basin:

Palouse Subbasin Management Plan Objective 7. Protect native grassland habitat within the Palouse subbasin.

Strategy A. Identify location and quantity of existing native grassland habitat.
Strategy B. Evaluate grassland habitat condition and rank protection needs.
Strategy C. Design a protection plan for all identified native grassland habitat.
Strategy D. Implement the protection plan for identified native grassland habitat.

There is no indication that Objective 7 will be regulatory rather than voluntary in nature and does not provide specific protection for Giant Palouse Earthworm habitat. Further, such management processes can take decades to implement during which time the remaining habitat may be lost. Several key Prairie grassland tracts are currently threatened from development options ranging from golf course expansion to new subdivision construction. Because only 0.1% of native prairie remains, every acre counts and immediate protection is warranted.

Palouse Subbasin Management Plan Objective 8. Restore lost or degraded grassland habitat 17 within the Palouse subbasin.

Strategy A. Identify potential for restoration of lost or degraded grassland habitat with practical and feasible opportunities for restoration (see limiting factors in Assessment 1.5.1 Agricultural Conversion, 1.5.2 Exotic Vegetation Encroachment, 1.5.4 Fire Suppression, 1.5.5 Urban Development).
Strategy B. Rank grassland habitat restoration potential.
Strategy C. Design a grassland habitat restoration plan.
Strategy D. Implement the grassland habitat restoration plan.

Restoring and rehabilitating native prairie grassland habitat is essential for the long-term survival of the Giant Palouse Earthworm. However, the restoration objective does not define “practical and feasible opportunities” beyond a voluntary or default approach. This provides no regulatory protection for the Giant Palouse Earthworm.

Palouse Subbasin Management Plan Objective 15. Increase wildlife habitat value on agricultural land for focal species support.

Strategy A. Identify potential for conversion of marginal cropland to native habitat.

Strategy B. Convert marginal cropland areas to appropriate native grassland or shrub/steppe habitat.

Strategy C. Support short-term conversion from an annual cropping sequence to perennial vegetation establishment (utilizing programs such as CRP and CCRP; see Assessment 1.5.1.1 Agricultural Practices, 2.1.1.1 Conservation Districts, and 2.1.3.1 United States Department of Agriculture Farm Services Agency and Natural Resources Conservation Service).

Strategy D. Continue to promote research and development to assist producers in agronomically acceptable ways to maximize crop residue (stubble from previous crop) on annually cropped land for focal species support.

These are commendable objectives, but there is no indication that Objective 15 will be regulatory rather than voluntary in nature and does not provide specific protection for Giant Palouse Earthworm habitat. If implemented, Objective 15 would not provide regulatory protection for the Giant Palouse Earthworm.

Interior Columbia Basin Ecosystem Management Project was initiated by the USDA Forest Service and the USDI Bureau of Land Management. The Interior Columbia Basin Ecosystem Management Project (ICBEMP) charter was to develop an ecosystem-based management strategy for managing lands of the Interior Columbia River Basin owned by the USFS and BLM. Earthworms in particular are not mentioned in the Environmental Impact Statement and proposed decision (ICBEMP 2003).

The Columbia Basin report states, "An overview of the Palouse subbasin wouldn't be complete unless the Palouse giant earthworm was mentioned." (ICBEMP 2003, p. 1.31) Yet a list of focal species for the grassland habitat type does not include the Giant Palouse Earthworm or any key indicator species for the grassland soil ecosystem. Spalding's catchfly, grasshopper sparrow, sharp-tailed grouse, loggerhead shrike, and Lazuli bunting are listed (p. 1.52, p. 1.58-59). Neither the Giant Palouse Earthworm nor any other native earthworm species is listed as a priority species in Washington, even though grassland habitat is considered a priority habitat in this bioregion (WDFW).

A technical document, *Earthworms (Annelida: Oligochaeta) of the Columbia River Basin Assessment Area* (James 2000), was prepared in order to assess the status of native earthworms in the Columbia Basin Ecosystem, which includes the Palouse basin. James suggests that "This should begin with those species potentially threatened both in the basin assessment area and globally, such as *Driloleirus americanus*." Inventory and research priorities highlighted by James (2000) are important; however, the research and monitoring priorities discussed therein do not provide regulatory protection for the Giant Palouse Earthworm and their habitat.

Currently, the regulation of earthworms imported into the United States is based on the **Federal Plant Pest Act** (FPPA) (7 U.S.C. § 150aa-150jj, May 23, 1957, as amended 1968, 1981, 1983, 1988 and 1994), under which the Animal and Plant Health Inspection Service (APHIS) controls imports containing soil that might carry pathogens. Hendrix and Bohlen (2002) observe, "In the absence of pathogens, it appears that any earthworm species may be imported, that is, there is no specific consideration of earthworms as invasive organisms" (p. 809). They go on to suggest that without regulatory reform invasions by new and already known species will continue to occur (p. 809). The introduction of new invasive species of earthworms carries the risk of the introductions of pathogens (see summary of factor C above) carried by exotics from infected areas.

Hendrix and Bohlen summarize the history of the importation of exotic earthworms in North America as follows:

> Much of our knowledge of the earthworm fauna of North America is based on the work of Gordon E. Gates who, over a 60-year career, collected, described, and cataloged many of the currently recognized taxa, both native and exotic. Beginning in 1949, Gates collaborated with the US Department of Agriculture (USDA), Bureau of Plant Quarantine (now Animal and Plant Health Inspection Service, or APHIS) to intercept oligochaetes found in "plant-associated materials" (mostly soil) being imported into the United States. Over a 32-year period (1950—1982), Gates (1976, 1982) acquired thousands of specimens and was able to determine that earthworms from all over the world were continually being imported. There is no reason to expect that this situation has changed since 1982. Indeed, as with exotic plants, fungi, and insects (Ruesink et al. 1995, Campbell 2001, Mack and Lonsdale 2001), growing global commerce may be increasing the likelihood that exotic earthworms will be introduced, both inadvertently with the importation of soil-containing materials (e.g., agricultural and horticultural products; Gates 1976, 1982, Boag and Yeates 2001, Ehrenfeld and Scott 2001) and intentionally for use in commercial applications (e.g., waste management and land bioremediation; Lee 1995, Edwards 1998). Because previous invasions by exotic earthworms have had significant impacts on soil processes and plant communities in native ecosystems (e.g., Alban and Berry 1994, Groffman and Bohlen 1999, Hale et al. 2000), there may be reason for concern over continued unrestricted importation of earthworms.
>
> (2002, p.1)

Regulation has not been effective in reducing the importation of exotic earthworm species to the United States from other parts of the world, which poses a direct threat to the existence of the Giant Palouse earthworm and other native earthworm species in the United States.

E Other natural or manmade factors affecting its continued existence.

In general, native species earthworms are vulnerable to habitat disturbance and invasion by exotic species (James 1995, p.5). Invasion of exotic species is a twofold threat to the Giant Palouse Earthworm. First, exotic plants and animals pose a threat to

the native Palouse grassland habitat upon which the Giant Palouse Earthworm depends. Second, native earthworm species are susceptible to the invasion of exotic earthworm species that are better able to adapt to a degraded environment.

Non-native Plants and animals have been both intentionally and accidentally introduced into the Palouse bioregion ecosystem (USDA LUHNA). Invasion of Kentucky bluegrass is common on deep soil sites (Palouse Subbasin Management Plan 2004). Throughout much of the subbasin, native interior grasslands have been replaced by agricultural crops or severely reduced as a result of competitors, such as cheatgrass. On the shallower soils and drier parts of the Palouse basin, cheatgrass is the likely dominant. Similarly, annual, yellow starthistle, has been replacing cheatgrass as the dominant species in disturbed areas (Palouse Subbasin Management Plan 2004).

There are two major concerns regarding exotic earthworms described by Bohlen and Hendrix, as the, "potential for certain species to invade new habitats and, once established, the effects they may have on other organisms and soil processes within those habitats." Not only are the native species threatened, but the ecosystem is threatened with the loss of the important beneficial functions that the native species provides within the soil ecosystem (see **Species Description**). Exotics often perform very different functional roles in the soil ecosystem than the earthworms they displace. Currently many exotic species occur in the Palouse Basin (see Fig. 10). The clusters of species found in one area reflects the limited number of collection sites and the diversity of earthworm species found in an area. Not all species were collected at the same time, however.

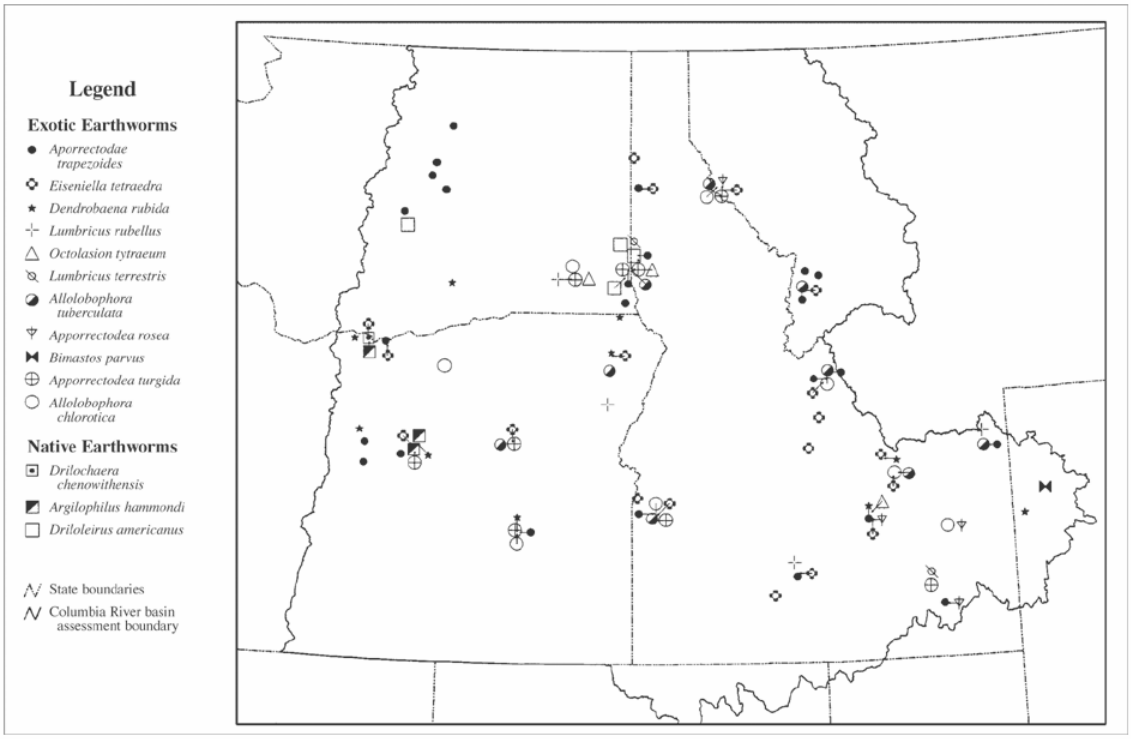

Figure 10:
Collection points for native and exotic earthworms in the Columbia River Basin (James 2000, p. 4).

Agricultural practices and development have caused the giant Palouse Earthworm to become increasingly vulnerability to weather conditions, erosion, and flooding occurrences. According to James, "Grassland temperature and moisture regimes are generally more extreme and will accentuate the effects of slope, soil type, etc. If the agricultural cycle includes long periods of bare ground, this can further magnify the impact of weather on worms." (1995, p.8)

Conclusion

The Giant Palouse Earthworm (*Driloleirus americanus*) needs to be given emergency protection under the federal Endangered Species Act. The native habitat of this species is threatened by agriculture (the conversion of grassland prairie to annual crops, grazing), development, and the invasion of exotic species. Additionally, there are no regulatory mechanisms to protect them or their habitat. Habitat degradation has also increased the vulnerability of this species to disturbance regimes and weather, such as flooding, drought, and erosion.

Due to the threat of extinction and because the Giant Palouse Earthworm is endemic, has a small population size, and the numerous factors threatening the species and its remaining habitat, the petitioners formally petition for emergency listing as an endangered species. Furthermore, the petitioners petition that Critical Habitat be established in order to protect and restore the native habitat upon which the Giant Palouse Earthworm depends.

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On page 12, under “Changes in biodiversity,” LUHNA Chapter 10 is quoted as saying “Two of the native plant communities, bluebunch wheatgrass-snowberry and bluebunch wheatgrass-rose, are globally rare, ...(Lichthardt and Moseley 1996).” However, Lichthardt and Moseley refer to *Festuca idahoensis-Symphoricarpos albus* (Idaho fescue-common snowberry) and *Festuca idahoensis-Rosa nutkana* (Idaho fescue-Nootka rose).

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