PETITION TO EMERGENCY LIST
SUSAN'S PURSE-MAKING CADDISFLY
(Ochrotrichia susanae)
AS AN ENDANGERED SPECIES
UNDER THE U.S. ENDANGERED SPECIES ACT

Chubb Park in Chaffee County, Colorado, where O. susanae type locality spring is located.

Prepared by

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Submitted by

The Xerces Society for Invertebrate Conservation

July 8, 2008

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Dirk Kempthorne
Secretary of the Interior
Office of the Secretary
Department of the Interior
1849 C Street NW
Washington D.C., 20240

Dear Mr. Kempthorne:

The Xerces Society, Dr. Boris Kondratieff, Western Watersheds, the Center for Native Ecosystems and WildEarth Guardians hereby formally petition to list the Susan's purse-making caddisfly (*Ochrotrichia susanae*) as endangered pursuant to the Endangered Species Act, 16 U.S.C. §§ 1531 *et seq.* This petition is filed under 5 U.S.C. § 553(e) and 50 C.F.R. § 424.14 (1990), which grants interested parties the right to petition for issue of a rule from the Secretary of the Interior.

Petitioners also request that critical habitat be designated concurrent with the listing, as required by 16 U.S.C. § 1533(b)(6)(C) and 50 C.F.R. § 424.12, and pursuant to the Administrative Procedure Act (5 U.S.C. § 553).

Due to the threat of extinction and because of its small population size, restricted distribution, isolation, and the numerous factors threatening the species and its remaining habitat, we request an emergency listing and emergency critical habitat designation pursuant to 16 U.S.C. § 1533(b)(7) and 50 CFR 424.20. While the species is emergency listed, the U.S. Fish and Wildlife Service should finalize a standard listing rule for the Susan's purse-making caddisfly.

We are aware that this petition sets in motion a specific process placing definite response requirements on the U.S. Fish and Wildlife Service and very specific time constraints upon those responses. 16 U.S.C. § 1533(b).

Sincerely,

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The Xerces Society is an international nonprofit organization dedicated to preserving the diversity of life through the conservation of invertebrates. The Society works with scientists, land managers, and citizens to protect invertebrates and their habitats by producing information materials, presenting educational activities, implementing conservation projects, and advocacy.

The mission of **Western Watersheds Project** is to protect and restore western watersheds and wildlife through education, public policy initiatives and litigation.

The Center for Native Ecosystems is 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.

WildEarth Guardians is a non-profit environmental organization with over 4,500 members with offices in New Mexico, Colorado, and Arizona. WildEarth Guardians has an active endangered species protection campaign, geographically focused on the southern Great Plains, desert Southwest, Colorado Plateau and Rocky Mountains. As part of this campaign, WildEarth Guardians frequently petitions the Secretary of Interior to list imperiled species, including endangered insects such as the Susan's purse making caddisfly. WildEarth Guardians members frequently use and enjoy aquatic habitats such as those presently or formerly occupied by the Susan's purse making caddisfly.

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I. EXECUTIVE SUMMARY

Susan's purse-making caddisfly (*Ochrotrichia susanae*) is in imminent danger of going extinct. *O. susanae* is an endemic species that is restricted to two sites in central Colorado, one in Chaffee County and one in Park County. This species is subject to habitat loss, primarily due to the effects of livestock grazing, including: cattle trampling in spring and riparian habitats; reduction and alteration of riparian vegetation; increases in bank instability, sediment, and turbidity; and increased nutrient concentration due to livestock waste. Additional threats include: the effects of timbering projects; de-watering of spring habitats due to increased water development for livestock and increased groundwater usage by surrounding cities; habitat damage from off-road recreational vehicle use; use of the type locality spring by campers as a water source and as an unregulated hiking area; and the effects of drought and altered stream hydrology and water temperature that are likely to occur in the mountainous West as the result of global climate change.

These threats, the small number of extant populations, the species' low dispersal ability, and the natural instability of small populations lead us to conclude, unequivocally, that Susan's purse-making caddisfly is immediately threatened with extinction and must be given emergency protection under the Endangered Species Act.

II. CANDIDATE BACKGROUND, STATUS, AND LISTING HISTORY

Susan's purse-making caddisfly is a Region 2 Sensitive Species in Colorado (USDA Forest Service, 2007a). It was designated as a conservation target in a Nature Conservancy ecoregional assessment of the Southern Rocky Mountains ecoregion (The Nature Conservancy, 2001).

Susan's purse-making caddisfly has a Global Heritage Status Rank of G2. The United States National Heritage Status Rank is N2.

III. SPECIES DESCRIPTION

A. Adult

Susan's purse-making caddisfly (*O. susanae*) is a small hairy brown caddisfly (Flint & Herrmann, 1976). Adult forewings are 2 mm (0.078 inch) in length, and are dark brown with three transverse silver bands: one each at the wing base, the wing midline, and the wing apex.

B. Immature

Larvae in this family are very small (1-4 mm; 0.039-0.157 inch) and are free-living for the first four instars. The head and the dorsal surface (top) of all three thoracic segments are dark brown and sclerotized (hardened). When the larvae molt to the fifth instar, they develop enlarged abdomens, build purse-shaped cases from silk and sand, and become less active (Wiggins, 1996). Larval cases are small, flattened, bivalved, and open at each end, similar to other members of the genus *Ochrotrichia*. However, *O. susanae* larval cases are slightly shorter proportionally and are made from smaller grains of sand (Flint & Herrmann, 1976).

IV. TAXONOMY

The taxonomy of Susan's purse-making caddisfly (*O. susanae*) is uncontested. *Ochrotrichia susanae* is a small caddisfly in the family Hydroptilidae (purse-maker or micro-caddisflies). It was first described by Flint and Herrmann (1976) from specimens taken in 1974 at Trout Creek in Chaffee County, Colorado. The genus *Ochrotrichia* is widespread and fairly diverse in North America, with over 50 species described species (Wiggins, 1996). Adults can be distinguished from other species in the genus *Ochrotrichia* based on characteristics of the genitalia.

V. POPULATION DISTRIBUTION AND STATUS

A. Historic Distribution

The range and abundance of Susan's purse-making caddisfly is not known prior to 1974, when the first specimens were collected and identified as a new species. The type locality for this species is Trout Creek Spring, which is located at an elevation of about 2750 m (9020 ft). Larvae, pupae, and adults were collected at the spring outfall area and as far downstream as ~130 m (426 ft).

B. Current Distribution

Susan's purse-making caddisfly is known only from two sites in central Colorado: the type locality at Trout Creek Spring in Chaffee County, and High Creek Fen in Park County. A state-wide survey undertaken to provide distributional data for all Trichoptera in Colorado indicated that Susan's purse-making caddisfly was present only at the type locality, Trout Creek Spring (Herrmann *et al*., 1986). The only other reported collection site for this species is the High Creek Fen area, about 20 miles north of the type locality (Durfee & Polonsky, 1995). High Creek Fen is a unique groundwater-fed wetland with high ecological diversity; it is considered a rare type of habitat, and the southernmost example of this type of ecosystem in North America (Cooper, 1996; Rocchio, 2005; Legg, 2007).

The USDA Forest Service Region 2 Sensitive Species Evaluation form (USDA Forest Service, 2007a) states:

"Extensive field surveys have been conducted for the species (Herrmann et al., 1986). Over the past 30 years, even with extensive field work, only 2 populations have been found and the likelihood of major new populations is unlikely."

VI. HABITAT REQUIREMENTS

A. Overview

Physical and chemical conditions of the type locality spring were assessed when Susan's purse-making caddisfly was first collected and described (Flint & Herrmann, 1976). The results suggested that this species has a relatively narrow set of ecological requirements. Water temperatures in the spring habitat were cold and varied little (14.4–15.8^{o}C). Stream conditions included extremely high levels of dissolved oxygen (at or near 100% saturation), as well as high concentrations of dissolved Ca, Mg, and SO_4, which gave the water a higher conductance value than typically seen in most regional streams at the same elevation. Overall, larvae may be said to inhabit waters in small streams that are cold, well-oxygenated, highly buffered, and low in trace

metals. Larvae and pupae were collected primarily from the sides of rocks in both the spring outfall and the downstream locations, especially in areas directly below small waterfalls in the creek, often clustered in clumps that covered the rocks. Like most caddisflies, the adults are weak fliers, flying only about 1-2 m when disturbed, and tend to remain close to the larval habitat for mating and oviposition.

B. Diet

Larvae

Feeding behavior of *O. susanae* larvae has not been observed directly, but larvae in this genus generally feed by scraping diatoms from rocks (Wiggins, 1996). Rocks in Trout Creek Spring that were thickly covered with larval cases were also associated with heavy growths of filamentous algae and moss.

Adults

Adult Trichoptera have reduced mouthparts and lack mandibles, but can ingest liquids.

C. Life Cycle

The larvae of Hydroptilidae are unusual among the case-making families of Trichoptera in that they are free-living until the final (fifth) larval instar, and then they construct a case which can be portable or cemented to the substrate (Wiggins, 1996). The larvae eventually pupate within this case. The adult flight period was estimated to be from late June to early August by Flint & Herrmann (1976), although adults were collected from mid-April to late July in a later survey (Herrmann *et al*., 1986). Susan's purse-making caddisfly is thought to be univoltine, producing one generation per year.

D. Habitat Status

The Trout Creek Spring type locality is located at the south end of Chubb Park in Chaffee County, Colorado. Nearly 80% of Chaffee County lands are managed by the State of Colorado, the Bureau of Land Management, and the US Forest Service as public lands. Chubb Park consists of 3640 acres of Colorado State Trust Land (Colorado Division of Wildlife, 2007). State Trust Lands are open to grazing, hunting, fishing, and watchable wildlife activities; camping and motorized vehicles are also permitted in designated areas. Habitat in the Chubb Park area consists of upland grass communities, shrubs, rocky outcrops, and forested areas that are mixtures of blue spruce, ponderosa pine, Douglas fir, and aspen.

The Trout Creek area has been negatively impacted in the past by grazing, mining, and timbering, in addition to the current and proposed management activities described below. Trout Creek and tributaries on U.S. Forest Service lands are currently on the state list of 303(d) (impaired) waters, due to excess sedimentation (Teves & Stednick 2005; Colorado Department of Public Health and Environment 2006), but TMDL (total maximum daily load) values for sediment load have not yet been established. Trout Creek watershed was classified as a Class 2 Watershed Condition Class (WCC) under an Inland West Watershed Initiative (IWWI) project conducted in 1999. Class II (WCC 2) watersheds are defined as areas where there are currently management activities occurring, and that are not in a pristine condition.

The area is managed for intensive livestock grazing, with periodic heavy forage utilization. The Chubb Park allotment currently has 33 cow/calf units permitted for an annual grazing season from June through October. An additional 113 cow/calf pairs are permitted on a private land permit for the Colorado State Land Board (State) and private lands in Chubb Park. Most suitable forage is in the bottom lands and riparian areas on the State and private lands, and U.S. Forest Service lands bordering State and private lands on the east and west sides of Chubb Park provide upland forage. Portions of the grazing allotment were rested in 2002 and 2004-2006 due to poor condition and drought.

The type locality may also be impacted by road construction and vehicle traffic. Highway 285, which regularly receives heavy traffic, runs within several hundred feet of Trout Creek Spring, and Forest Road 309 is immediately above the spring.

The only other site at which this species has been collected is in High Creek Fen Preserve, in South Park (Park County), Colorado. The 1200 acre preserve is currently managed and protected by The Nature Conservancy; it is very ecologically diverse and supports several rare species of plants and invertebrates. The calcareous nature of the water may contribute to its suitability as habitat for *O. susanae*. High Creek Fen is fed by groundwater inputs, and increased groundwater usage associated with rapid population expansion in South Park since the 1990's could threaten the hydrology of this vulnerable wetland (Cooper, 1996; Legg, 2007; Miller & Ortiz, 2007).

E. Current Conservation Efforts

No conservation agreements have been developed for Susan's purse-making caddisfly. The USDA Forest Service is supposed to take sensitive species into account when developing rangeland allotment management plans, but did not consider Susan's purse-making caddisfly in either the North Trout Creek Hazardous Fuels Project Environmental Assessment (USDA Forest Service, 2007b) or the Rangeland Allotment Management Planning on the Salida-Leadville-South Park Planning Area Environmental Assessment (USDA Forest Service, 2007c).

There are no targeted efforts to preserve or restore habitat for Susan's purse-making caddisfly.

VII. CURRENT AND POTENTIAL THREATS—SUMMARY OF FACTORS FOR CONSIDERATION

A. The present or threatened destruction, modification, or curtailment of its habitat or range.

The primary threats to the survival of Susan's purse-making caddisfly are impairment and destruction of their restricted habitat due to the effects of livestock grazing and logging-related activities.

The Trout Creek Spring area will be impacted by a proposed rangeland allotment plan for livestock grazing (USDA Forest Service, 2007c). The plan addresses allotment areas in the Salida, Leadville, and South Park areas, and encompasses a total of 340,000 acres, about half of which has suitable and accessible forage. Trout Creek Spring is located at the south end of the Lower Chubb allotment unit. Only one portion of this allotment, the Upper Chubb unit, has been designated as a benchmark area for meeting desired conditions. Current assessment of this

benchmark area indicates that it is "moving towards" desired conditions, but has poor vegetation cover, composition, and structure in stream riparian areas on State-owned land in the allotment, large areas of bare ground and poor vegetation cover in grasslands and uplands of State- and federal-owned lands, reduced vigor in upland grasses, and willow die-off in riparian areas. A soil survey of the project area conducted in 1995 indicated that 20% of the Chubb allotment is considered to have severe or moderate erosion hazard potential.

The area is also subject to a new project called the North Trout Creek Hazardous Fuels Project (USDA Forest Service, 2007b), which will treat approximately 8,700 acres with salvage logging, thinning, and prescribed fire to reduce hazardous fuel loads.

Although both of these projects occur in the area surrounding the Trout Creek Spring type locality, and Susan's purse-making caddisfly is listed as a Forest Service Region 2 Sensitive Species, the potential impacts of these activities on Susan's purse-making caddisfly were not considered in either of the project environmental assessments and no surveys were conducted.

1. Livestock grazing

Livestock grazing can negatively impact natural ecosystems through trampling, vegetation loss, reduction in water quality, and increased erosion. Excessive livestock grazing results in loss of biodiversity, population decreases in a variety of taxa, disruption of biological communities, and dramatic alteration of terrestrial and aquatic communities (Fleischner, 1994; Agouridis *et al*., 2005). The negative effects of livestock grazing are frequently magnified in riparian ecosystems, as cattle tend to congregate in these areas for the abundant forage, shade, and water (Kennedy, 1977; Roath & Krueger, 1982; Gillen *et al*., 1984; Chaney *et al*., 1993; Belsky *et al*., 1999). The tendency of livestock to be attracted to riparian zones is considered to be higher during the summer and fall (Clary & Webster, 1989; Leonard *et al*., 1997); the annual grazing season on the Chubb Park allotment is June through October, which may be considered prime seasons for riparian zone use by cattle. Deleterious impacts to stream, spring, and wetland areas from livestock grazing include:

- Reduction and alteration of riparian vegetation due to grazing and trampling in spring and riparian habitats.
- Increases in temperature, sediment and turbidity.
- Increased nutrient levels due to introduction of livestock waste material into waters and riparian areas.
- De-watering of springs and streams to concentrate and pipe flow for livestock drinking water.

The combined impacts of vegetation loss, soil compaction, streambank destabilization, and increased sedimentation associated with intensive livestock grazing can have a profound effect on aquatic macroinvertebrates. A four-year study conducted in a mountain stream in northeastern Oregon found a dramatic decline in macroinvertebrate abundance when ten cow-calf pairs were allowed to graze in units along the stream from July through September (McIver & McInnis, 2007), including significant reductions in species richness and total abundance of the sensitive Ephemeroptera, Plecoptera, and Trichoptera taxa (mayflies, stoneflies, and caddisflies) in grazed units versus ungrazed controls. A variety of aquatic macroinvertebrate community

attributes relating to taxa diversity, community balance, trophic status, and pollution tolerance were strongly negatively impacted by moderate or heavy grazing in small mountain streams in Virginia, compared to lightly grazed or ungrazed controls (Braccia & Voshell, 2007). Livestock grazing in the area around the type locality spring of Susan's purse-making caddisfly has the potential to result in habitat degradation and destruction due to the impacts stated above.

Most of the accessible forage in the Chubb allotment, which encompasses the Trout Creek Spring region, is in riparian areas. Livestock grazing has been shown to remove riparian zone vegetation, especially willow, and disrupt riparian plant communities (Kennedy, 1977; Kovalchik & Elmore, 1992; Fleishner, 1994). The habitat around Trout Creek Spring is currently subject to reduced riparian vegetation. Continued grazing around Trout Creek Spring will further remove riparian vegetation, reducing the shading canopy and leading to rising water temperatures and lower dissolved oxygen levels. Susan's purse-making caddisfly requires cold, fast-running, well-oxygenated water (Flint & Herrmann, 1976), and this species is likely to be negatively impacted by decreased riparian vegetation, streambank destabilization, and increases in water temperature.

Livestock grazing creates greater erosion potential due to removal of riparian and upland vegetation, removal of soil litter, increased soil compaction via trampling, and increased area of bare ground (Schultz & Leininger, 1990; Fleishner, 1994). Upland areas in the allotment are indicated as having more bare ground than expected (USDA Forest Service 2007b & c), and continued grazing pressure will likely increase the severity of this problem. Bare compacted soils allow less water infiltration, which generates more surface runoff and can contribute to erosion as well as flooding and streambank alterations (Abdel-Magid *et al*., 1987; Orodho *et al*., 1990; Chaney *et al*., 1993). Increased erosion leads to higher sediment loads in nearby waters, degrading habitat and increasing water turbidity. These problems will be exacerbated by the livestock removal of riparian vegetation, as a riparian buffer helps filter overland runoff, slow flooding, and stabilize streambanks. Areas of bare ground can also facilitate the colonization and spread of invasive species, further reducing riparian vegetation quality. Seeds and propagules of such weeds and noxious species can be carried in by livestock via their fur, hooves, or dung. Like many Trichoptera, Susan's purse-making caddisfly inhabits streams that are fast-flowing, well-oxygenated, highly buffered, and low in trace metals (Flint & Herrmann, 1976), and increased siltation and altered stream hydrology are likely to have a negative impact on this species.

The preference of livestock to loiter near streams also results in increased defecation and urination in or near the water source, which can degrade water quality and alter nutrient levels and the trophic status of streams (Strand & Merritt, 1999). Nitrogen, phosphorus, and potassium levels have been shown to increase in close proximity to livestock forage and watering sites (Mathews *et al*., 1994). Decreases in water quality associated with livestock waste are likely to have a deleterious effect on Susan's purse-making caddisfly.

It should be noted that damage done to riparian ecosystems due to grazing can be remediated when livestock grazing pressure is reduced or eliminated, but full riparian recovery may require several years. Moderate-intensity summertime grazing experiments conducted across a four-year period in an Oregon mountain stream demonstrated that although some recovery in streambank

conditions and riparian vegetation occurred during the fall and winter, each year saw progressively greater lengths of streambank classified as lower condition (McIver & McInnis, 2007). Other Oregon studies indicated that the number of different species in a previously grazed riparian area increased more than threefold within nine years after livestock were removed (Winegar, 1977), and livestock removal from a grazed riparian zone in Colorado resulted in an eight-fold increase in willow canopy coverage and a more than five-fold increase in shrub canopy coverage (Schultz & Leininger, 1990). Grazing exclusion from a montane riparian system resulted in an increase in willow canopy cover, height growth, and stem density during eleven years of study (Holland *et al*., 2005). Streams in grazing allotments on federal lands in Idaho and Oregon subjected to livestock exclusion had significantly greater hydric vegetation and bank stability as well as smaller width-to-depth ratios in previously grazed areas compared to adjacent grazed areas (Coles-Ritchie *et al*., 2007). The restricted distribution and narrow habitat requirements of the endemic Susan's purse-making caddisfly makes protection, conservation, and restoration of existing habitat areas imperative for the survival of this species.

2. Logging-related activities

The area around Trout Creek Spring is subject to the North Trout Creek Hazardous Fuels Project (USDA Forest Service, 2007b), which will treat approximately 8,700 acres with salvage logging, thinning, and prescribed fire to reduce hazardous fuel loads. The Salida Ranger district has recently instituted a new federal business opportunity (FBO) program adjacent to the North Trout Creek project area, Ranch of the Rockies (http://www2.fbo.gov/spg/USDA/FS/82X9/AG-82X9-S-07-2059/SynopsisP.html), which involves 86 acres in the Trout Creek pass area. This is a timber sale project that involves skidding and yarding live and dead trees and piling and burning the resulting slash (branches and other debris created by logging activities).

Forestry operations are frequently associated with increased sediment delivery to streams. A variety of forestry-associated activities contribute to this increased sedimentation, including yarding (hauling felled timber to a temporary storage site prior to offsite transport), skidding (a yarding process that involves dragging timber across the ground), site preparation for replanting, and the construction, use, and maintenance of permanent or temporary roads (Waters, 1995). Timber harvesting activities have been shown to have a negative impact on stream-dwelling insects and other aquatic macroinvertebrates. When benthic macroinvertebrates were used as a measure of aquatic biointegrity to assess seven stream sites in the Blackfoot River watershed in Montana, sites in areas where silviculture activities occurred showed increased soil erosion and sediment delivery as well as decreased aquatic biointegrity when compared with a reference-quality restored wilderness site (Rothrock *et al*., 1998).

a) Roads

It is difficult to separate the effects of logging from the effects of logging-associated roads on aquatic habitats; disturbance associated with logging road construction and operation is thought to have the greatest influence on increasing sediment load (Cederholm *et al*,. 1981; Furniss *et al*,. 1991; Waters, 1995). Similar to the effects of livestock grazing on aquatic habitats, roads increase erosion and sedimentation, increase the amount and pattern of surface runoff, and facilitate the spread of invasive plant species (Anderson, 1996; Forman & Alexander, 1998;

Trombulak & Frissell, 2000; Gucinski *et al*., 2001; Angermeier *et al*., 2004). The cumulative effects on streams include:

- increases in siltation
- increases in nonpoint source pollution
- increases in water temperatures
- decreased dissolved oxygen levels

The presence of roads can cause erosion rates and turbidity levels three orders of magnitude greater than in undisturbed forest areas (Grace, 2002), and unpaved roads are considered a primary source of sediment in forested watersheds (Megahan & Kidd, 1972; Sugden & Woods, 2007). Studies conducted in Montana found that sediment yields increased almost eight-fold in the year following road construction, and two-fold following logging activities in the second year (Anderson & Potts, 1987). Roads associated with a logging unit in the Payette National Forest in Idaho resulted in a 750-fold increase in sediment production over the natural rate for six years following their construction (Megahan & Kidd, 1972). The newly-signed North Trout Creek Hazardous Fuels Project (USDA Forest Service, 2007b) does not propose to create new permanent roads, but would create about 6 miles of new temporary roads and re-open 10 miles of existing closed roads. The sediment yield from construction of temporary roads and re-opening of closed roads associated with the North Trout Creek Hazardous Fuels Project is estimated to be 41.2 tons/year (USDA Forest Service, 2007b).

By increasing the amount of compacted and/or impervious surface, reducing water infiltration, and removing surface vegetation, roads result in increased runoff of surface water to streams, which can increase flooding, alter the stream channel, and deliver contaminants to streams, including heavy metals and organic pollutants (Anderson, 1996; Forman & Alexander, 1998; Jones *et al*., 1999; Trombulak & Frissell, 2000; Gucinski *et al*., 2001; Grace, 2002). Even the use of temporary roads can have a long-term effect on soil compaction, as studies conducted in California indicated that soil in logging skid trails that had not been used in forty years remained 20% more compacted than soil in nearby areas that were not used as skid trails (Vora, 1988).

b) Prescribed fire

In addition to logging activities, the North Trout Creek Hazardous Fuels Project involves prescribed burns, and the Ranch of the Rockies timber sale project involves burning piles of slash (branches and other debris created by logging activities). Regular burns conducted around the area of Trout Creek Spring could have a negative impact on stream quality, as burning has been shown to affect aquatic habitats and watersheds in a variety of ways (Neary *et al*., 2005), including:

- Mechanical site preparation and road construction needed to conduct prescribed burns can lead to increased erosion and sediment production, especially on steep terrain.
- Removal of leaf litter from the soil surface through burning can lead to reduced water infiltration into the soil, increasing the amount of surface runoff into streams.
- Ash depositions following a fire can affect the pH of water.

Negative impacts may be exacerbated by burning slash piles, since the fire intensity is greater when the fuel is piled in a small area and can have a stronger impact on the underlying soil.

Susan's purse-making caddisfly has narrow habitat requirements that include fast-flowing, cold, well-oxygenated water that is well-buffered and lacking in trace metals. It is known only from two restricted populations, and the weak flight capacity and low dispersal ability of this species make colonization of new habitats unlikely. The cumulative effects of increased erosion, increased sedimentation, nonpoint source pollution, and increased water temperature, combined with the changes in stream hydrology and decreased water quality associated with logging activities in the area around the habitat for Susan's purse-making caddisfly are likely to have a serious deleterious effect on this species.

3. De-watering of spring habitats

Trout Creek Spring is not currently proposed for livestock water development, but several other water developments exist and are being pursued in the Chubb Park area. Also, water from a well at the north end of Chubb Park will be piped to several new tanks in the southwestern portion of Chubb Park within about one-half mile of the type locality, potentially bringing livestock closer to Trout Creek Spring. The development of numerous springs in the area could affect the hydrology of remaining springs and streams, in addition to reducing potential new habitat for *O. susanae* colonization. Reduction of stream flow due to increased groundwater use and water diversion can have a dramatic impact on stream habitat and associated macroinvertebrate communities. A range of studies examined in a review of the subject by Dewson *et al*. (2007) indicated that artificial flow reductions frequently lead to changes such as decreased water depth and increased sedimentation, as well as altered water temperature and water chemistry. The restricted distribution and narrow habitat requirements of Susan's purse-making caddisfly makes it likely that human-induced alterations in stream hydrology and water chemistry will have a negative impact on this species.

High Creek Fen is part of a 1200-acre preserve owned and managed by The Nature Conservancy. Park County, where the preserve is located, has experienced significant population increases since the 1990's, and is currently considered one of the fastest-growing counties in Colorado (Miller & Ortiz, 2007). Population growth in this area is accompanied by an increased demand for fresh drinking water. The total daily withdrawal of fresh water to meet these demands is about 0.28 million gallons per day, 61% of which is taken from groundwater sources (Miller & Ortiz, 2007). The area surrounding High Creek Fen is currently being protected, but the fen itself is fed by groundwater sources; sustained or increasing groundwater removal to support increased human development is likely to have a deleterious effect on the hydrology of this vulnerable habitat and the unique plant and invertebrate species it supports, including Susan's purse-making caddisfly.

Spring habitat is particularly critical in arid regions, and the vulnerability of endemic spring-dependent species to habitat alterations cannot be overstated. Investigations by Sada & Vinyard (2002) revealed that the majority of endemic macroinvertebrate species in the Great Basin region are restricted to springs, and that such species are acutely vulnerable to extirpation from human-related activities. Of the 135 distinctive aquatic taxa they reviewed, 50% had lost at least one major population during the past 140 years, 58% overall had experienced a major decline, and 12% became extinct. Water flow diversion and groundwater pumping were among the most

important factors contributing to the decline and/or extinction of endemic aquatic species in this region.

4. Roads

The probable effects of temporary road construction and re-opening of existing roads associated with timber-related projects are described above (see Section VII. A, 2a). The type locality spring for *O. susanae* is also impacted by other existing roads, such as Highway 285 and Forest Road 309.

Highway 285, which regularly receives heavy traffic, runs within several hundred feet of Trout Creek Spring. Roads accumulate a variety of contaminants including brake dust, heavy metals, and organic pollutants, which are carried directly into streams by overland runoff (Forman & Alexander, 1998; Jones *et al*., 1999; Trombulak & Frissell, 2000). Forest Road 309, which is immediately above the spring, receives periodic maintenance, including grading, which can increase the rate of erosion and deliver increased silt loads to the type locality spring and stream (Gucinski *et a*l., 2001; Grace, 2002).

5. Recreation

Population growth in and around the project area has led to increased numbers of recreational users. The pressure of recreational users is likely to remain high, as the population growth this area has experienced in recent years is expected to continue. The population of Chaffee County increased 28.1% from 1990 to 2000, with much of the growth occurring in unincorporated areas, and the population of Colorado is expected to increase by 50% within the next 20-25 years (Chaffee County Comprehensive Plan, 2000).

a) Camping/hiking

The Chubb Park area is a popular site for outdoor enthusiasts, and is a year-round destination for hunting, mountain biking, scenic drives, bird watching, hiking, and camping. Population increases in the region have also increased the numbers of regular local users, and recreational use is likely to continue to intensify, based on national trends. A study of outdoor recreation trends in the U. S. (Cordell *et al*., 1996) found increases in participation in most of the activities surveyed, including a growth in bicycling from 12 million in 1960 to 63 million in 1995, and an increase of 350% in camping during the same time span. From 1983-1995, increases of anywhere from 155% to 34% were seen in the numbers of people who reported engaging in birdwatching, hiking, backpacking, primitive or developed area camping, and snowmobiling. Participation in these outdoor activities is anticipated to heighten from 1995 to 2050 (Bowker *et al*., 1996).

Intensified human activities in and around natural areas will have unavoidable negative impacts on habitat. For example, State Trust Land usage rules require that hiking be done only along designated trails. However, unauthorized trails have been created by hikers along streams in the area around Trout Creek Spring. In addition, hikers may intentionally or through negligence leave gates open that are intended to restrict livestock from riparian areas or from grazed pastures that are being rested. There is also the potential for direct damage to Trout Creek Spring, as it is a desirable water source for campers. Increased human passage to the spring to obtain water could damage the riparian zone and disturb habitat; in addition, if campers use the

spring to wash themselves or their cookware, the water quality of the spring could be negatively impacted by detergents. Overall, the activities of large numbers of recreational users could damage the integrity of the habitat of Susan's purse-making caddisfly through trampling and removal of riparian vegetation, soil compaction, creation of ruts and bare ground across portions of upland and riparian zones, and lowering water quality.

b) ORV use in non-designated areas

Unauthorized off-road vehicle (ORV) and motorcycle usage has been documented in the Trout Creek watershed and around the Trout Creek Spring type locality (Teves & Stednick, 2005; USDA Forest Service, 2007a). On the national level, ORV usage has risen substantially; the number of people who reported engaging in ORV activities rose by 8 million individuals between 1982 and 1995, and an increase of 16% nationally is anticipated during the next 50 years (Bowker *et al.*, 1999; Garber-Yonts, 2005). ORV use in the Trout Creek watershed is extensive, and as much as 80% of the trails have been created illegally in some areas (Teves & Stednick, 2005). Illegal ORV use can negatively impact conditions in riparian areas through damage to riparian vegetation and stream banks, leading to increased sedimentation.

B. Overutilization for commercial, recreational, scientific, or educational purposes.

In general, because of the high fecundity of individual insects, the collection of insects poses little threats to their populations. However, in the case of some endangered species, such as the Susan's purse-making caddisfly, the collection of individuals for scientific or educational purposes could significantly reduce production of offspring. Because this species is so rare, collection is a potential threat.

C. Disease or predation.

This does not appear to be a threat to Susan's purse-making caddisfly at this time. However, little is known about the life history and ecology of this species, and threats from disease or predation have never been assessed. The small size of the only two known populations of Susan's purse-making caddisfly makes this species more vulnerable to extinction as a result of normal population fluctuations due to predation or disease.

D. The inadequacy of existing regulatory mechanisms.

Susan's purse-making caddisfly receives no federal or state protection. It is listed as USDA Forest Service Region 2 sensitive species (USDA Forest Service, 2007a), but the potential impacts on *O. susanae* from the North Trout Creek Hazardous Fuels Project, the Rangeland Allotment Management Planning on the Salida-Leadville-South Park Planning Area, or the Ranch of the Rockies timber sale project were not addressed. Multiple on-going grazing and fuel reduction projects in and around the areas where *O. susanae* is found will continue to impair existing and potential spring habitat for this restricted species.

E. Other natural or manmade factors affecting its continued existence.

1. Small population size and stochastic events

Small populations are generally at greater risk of extirpation from normal population fluctuations due to predation, disease, and changing food supply, as well as from natural disasters such as floods or droughts. They may also experience a loss of genetic variability and reduced fitness

due to the unavoidable inbreeding that occurs in such small populations, particularly as the limited dispersal ability of this species is unlikely to permit breeding between the only two known extant populations.

2. Global climate change

The effects of global warming are being assessed in North America and throughout the world, and changes in precipitation patterns, stream hydrology, and bloom time have already been noted. Overall, annual mean air temperature increased in North America from 1955-2005, and streamflows decreased by about 2% per decade across the last century in the central Rocky Mountain region (Rood *et al*., 2005).

In the coming years, the effects of global climate change are anticipated to include warming in the western mountains, causing snowpack and ice to melt earlier in the season (Field *et al.,* 2007). This could lead to both increased flooding early in the spring, and drier summer conditions, particularly in the arid western areas which rely on snowmelt to sustain stream flows. Spring and summer snow cover has already been documented as decreasing in the western United States, and drought has become more frequent and intense (Intergovernmental Panel on Climate Change, 2007). Major hydrologic events such as floods and droughts are projected to increase in frequency and intensity. Erosion is also projected to increase as the result of a combination of factors such as decreased soil stability from higher temperatures and reduced soil moisture, and increases in winds and high intensity storms.

The projected cumulative effects of continuing global climate change including increased frequency and severity of seasonal flooding and droughts, reduced snowpack to feed stream flow, increased siltation, and increasing air and water temperatures would seriously impair *O. susanae* habitat and negatively impact the survival of this species.

VIII. CONCLUSION

Carefully targeted management of Western springs is essential to maintain their biological integrity and sustain the diverse endemic species they support (Sada *et al*., 2001). The importance of high-elevation springs to small populations of endemic species such as Susan's purse-making caddisfly has been stated by N. A. Erman (2002):

"In mountainous areas, springs and small headwater streams are isolated and are often habitats for rare and endemic species... These habitats contribute significantly to the diversity of several groups of aquatic invertebrates. The importance of this diversity is not always recognized by those making management decisions that affect springs and spring streams. Management of these waters too often has a single species focus primarily directed to whether or not the habitat supports fish or provides water to livestock."

The Salida Rangeland Allotment Environmental Assessment states "There are no formally recognized ecologically critical areas within the Analysis Area." (USDA Forest Service, 2007c). We contend that Trout Creek Spring and the surrounding area is critical to the continued survival of the imperiled Susan's purse-making caddisfly, and that the impacts of the current livestock

grazing, fuel reduction, and timber harvest plans have the potential to have a serious negative impact on the type locality of this species that could render it extinct in a short time.

For the above reasons, Susan's purse-making caddisfly meets four 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) The present or threatened destruction, modification, or curtailment of its habitat or range.
(C) Disease or predation.
(D) The inadequacy of existing regulatory mechanisms.
(E) Other natural or manmade factors affecting its continued existence.

Due to the threat of extinction and because of its small population size, restricted distribution, isolation, and the numerous factors threatening the species and its remaining habitat, the Xerces Society for Invertebrate Conservation formally petitions for emergency listing of Susan's purse-making caddisfly (*Ochrotrichia susanae*) as an endangered species. While the species is emergency listed, the Fish and Wildlife Service should finalize a standard listing rule for this species. Furthermore, we strongly request the Service to use their authority to establish Critical Habitat based on the facts presented to prevent further decline of this extremely vulnerable caddisfly species.

IX. REFERENCES

Abdel-Magid, A. H, Trlica, M. J., and Hart, R. H. 1987. Soil and vegetation responses to simulated trampling. Journal of Range Management 40: 303-306.

Agouridis, C. T., Workman, S. R., Warner, R. C., and Jennings, G. D. 2005. Livestock grazing management impacts on stream water quality: a review. Journal of the American Water Resources Association. 41 (3): 591-606.

Anderson, P. G. 1996. Sediment generation from forestry operations and associated effects on aquatic ecosystems. Proceedings of the Forest-Fish Conference: Land Management Practices Affecting Aquatic Ecosystems, Calgary, Alberta.

Anderson, B. and Potts, D. F. 1987. Suspended sediment and turbidity following road construction and logging in western Montana. Journal of the American Water Resources Association 23 (4): 681–690.

Angermeier P. L., Wheeler, A. P., and Rosenberger, A. E. 2004. A conceptual framework for assessing impacts of roads on aquatic biota. Fisheries 29 (12): 19-29.

Belsky A. J., Matzke, A., and Uselman, S. 1999. Survey of livestock influences on stream and riparian ecosystems in the western United States. Journal of Soil and Water Conservation 54 (1): 419-431.

Bowker, J.M., English, D.B.K., and Cordell, H.K. 1999. Projections of outdoor recreation participation to 2050. *In*: Outdoor recreation in American life: a national assessment of demand and supply trends (Cordell, H.K., Betz, C.J., Bowker, C.J., eds.). Sagamore Publishing, Champaign, IL. 449 pp. Available at: http://www.srs.fs.usda.gov/pubs/ja/ja_bowker005.pdf .

Braccia, A. and Voshell Jr., J. R. 2007. Benthic macroinvertebrate responses to increasing levels of cattle grazing in Blue Ridge Mountain streams, Virginia, USA. Environmental Monitoring and Assessment 131:185–200.

Cederholm, C.J., L.M. Reid, and E.O. Salo. 1981. Cumulative effects of logging road sediment on salmonid populations in the Clearwater River, Jefferson County, Washington. *In:* Washington Water Research Council. Proceedings from the conference on salmon-spawning gravel: a renewable resource in the Pacific Northwest. Washington State University, Washington Water Research Centre, Report 39, Pullman.

Chaffee County Comprehensive Plan. 2000. Consensus Planning Inc., 99 pp. Available at: http://gigshowcase.com/EndUserFiles/421.pdf

Chaney, E., Elmore, W., and Platts, W. S. 1993. Managing change: livestock grazing on western riparian areas. Produced for U. S. Environmental Protection Agency by the

Northwest Resource Information Center, Inc., Eagle, Idaho. 31 pp.

Clary, W. P. and Webster, B. F. 1989. Managing grazing of riparian areas in the intermountain region. General Technical Report INT-263. United States Department of Agriculture, Forest Service, Intermountain Research Station, Ogden UT. 15 pp.

Coles-Ritchie M. C., Roberts, D. W., Kershner, J. L., and Henderson, R. C. 2007. Use of a wetland index to evaluate changes in riparian vegetation after livestock exclusion. Journal of the American Water Resources Association 43 (3): 731-743.

Colorado Department of Public Health and Environment. 2006. Status of Water Quality in Colorado – 2006: The Update to the 2002 and 2004 305(b) Reports, Appendix D: 2006 303(d) List and Monitoring and Evaluation List. Colorado Department of Public Health and Environment, Water Quality Control Division. Available at: www.cdphe.state.co.us/op/wqcc/waterstatus_305_b/2006_305_b__Appdx_D.pdf .

Colorado Division of Wildlife. 2007. Colorado State Trust Lands. Colorado Division of Wildlife, Denver CO.

Cooper D. J. 1996. Water and soil chemistry, floristics, and phytosociology of the extreme rich High Creek fen, in South Park, Colorado, U.S.A. Canadian Journal of Botany 74 (11): 1801-1811.

Cordell, H. K., McDonald, B. L., Teasley, R. J., Bergstrom, J. C., Martin, J., Bason, J., and Leeworthy, V. R. 1996. Outdoor recreation participation trends. *In*: Outdoor recreation in American life: a national assessment of demand and supply trends (Cordell, H.K., Betz, C.J., Bowker, C.J., eds.). Sagamore Publishing, Champaign, IL. 449 pp. Available at: http://www.srs.fs.usda.gov/pubs/ja/ja_cordell010.pdf .

Dewson, Z. S., James, A. B. W., and Death, R. G. 2007. A review of the consequences of decreased flow for instream habitat and macroinvertebrates. Journal of the North American Benthological Society 26 (3):401–415.

Durfee, R.S. and A.P. Polonsky. 1995. Inventory of aquatic and semiaquatic macroinvertebrates of High Creek Fen Preserve, Park County, Colorado: refugium for northern disjunct species. Unpublished report to The Nature Conservancy, Boulder, Colorado.

Erman, N. A. 2002. Lessons from a long-term study of springs and spring invertebrates (Sierra Nevada, California, U.S.A.) and implications for conservation and management. Conference Proceedings. Spring-Fed Wetlands: Important Scientific and Cultural Resources of the Intermountain Region, 2002. Available at: http://www.wetlands.dri.edu.

Field, C.B., Mortsch, L.D., Brklacich, M., Forbes, D.L., Kovacs, P., Patz, J.A., Running, S.W. and Scott, M.J. 2007. Chapter 14: North America. *In:* Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (Parry, M.L., Canziani, O.F., Palutikof, J.P., van der Linden, P.J. and Hanson, C.E., eds.). Cambridge University Press,

Cambridge, UK. Available at: www.ipcc.ch/pdf/assessment-report/ar4/wg2/ar4-wg2-chapter14.pdf

Fleischner, T. L. 1994. Ecological costs of livestock grazing in western North America. Conservation Biology 8 (3): 629-644.

Flint, O. S., and Herrmann, S. J. 1976. The description of, and environmental characterization for, a new species of *Ochrotrichia* from Colorado. Annals of the Entomological Society of America 69 (5): 894-898.

Forman, R. T. T. and Alexander, L. E. 1998. Roads and their major ecological effects. Annual Review of Ecology and Systematics 29: 207-231.

Furniss, M.J., Roelofs, T.D. and Yee, C.S. 1991. Road construction and maintenance. *In:* Meehan, W.R. (ed.) Influences of forest and rangeland management on salmonid fishes and their habitats. American Fisheries Society Special Publication 19.

Garber-Yonts, B. E. 2005. Conceptualizing and measuring demand for recreation on national forests: a review and synthesis. General Technical Report PNW-GTR-645. U.S. Department of Agriculture Forest Service, Pacific Northwest Research Station, Portland, OR. 40 pp. Available at http://www.fs.fed.us/pnw/pubs/pnw_gtr645.pdf .

Gillen, R. L., Krueger, W. C., and Miller, R. F. 1984. Cattle distribution on a mountain rangeland in northeastern Oregon. Journal of Range Management 37: 549-553.

Grace, J. M., III. 2002. Sediment movement from forest road systems-roads: a major contributor to erosion and stream sedimentation. American Society of Agricultural Engineers, December 2002, pp. 13-14.

Gucinski, H., Furniss,M. J., Ziemer, R. R. and Brookes, M. H. 2001. Forest roads: a synthesis of scientific information. General Technical Report PNW-GTR-509, United States Department of Agriculture, Forest Service, Pacific Northwest Research Station, Portland Oregon. Available at: http://www.fs.fed.us/pnw/pubs/gtr509.pdf .

Herrmann, S. J., Ruiter, D. E., and Unzicker, J. D. 1986. Distribution and records of Colorado Trichoptera. The Southwestern Naturalist 31 (4): 421-457.

Holland, K. A., Leininger, W. A., and Trlica, M. J. 2005. Grazing history affects willow communities in a montane riparian ecosystem. Rangeland Ecology & Management 58 (2): 148-154.

Intergovernmental Panel on Climate Change. 2007. Summary for Policymakers. *In:* Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (Parry, M.L., Canziani, O.F., Palutikof, J.P., van der Linden, P.J. and Hanson, C.E., eds.). Cambridge University Press, Cambridge, UK. Available at: http://www.ipcc.ch/pdf/assessment-report/ar4/wg2/ar4-wg2-spm.pdf .

Jones, J. A., Swanson, F. J., Wemple, B. C., and Snyder, K. U. 1999. Effects of roads on hydrology, geomorphology, and disturbance patches in stream networks. Conservation Biology 14 (1): 76-85.

Kennedy, C. 1977. Wildlife conflicts in riparian management: water. *In:* Symposium on importance, preservation, and management of riparian habitat. U.S. Forest Service General Technical Report RM-43, Ft. Collins, CO.

Kovalchik, B.L. and W. Elmore. 1992. Effects of cattle grazing systems on willow dominated plant associations in central Oregon, *In :* Proceedings of a symposium on ecology and management of riparian shrub communities (Clary, W.P., McArthur, E.D., Bedunah, D. and Wambolt, C.L., eds.). USDA Forest Service General Technical Report INT-289. Ogden, UT.

Legg, T. M. 2007. Methods for identifying groundwater sources to High Creek Fen, South Park, Colorado. Geological Society of America, Annual Meeting, October 28-31 2007. Geological Society of America Abstracts with Programs, 39 (6): 475.

Leonard, S. G., Elsbernd, V., Borman, M., Swanson S., and Kinch, G. 1997. Grazing management for riparian-wetland areas. Bureau of Land Management Technical Report 1737-14. U. S. Department of the Interior, Bureau of Land Management, National Applied Resource Sciences Center. 63 pp.

Mathews, B. W., Sollenberger, L. E., Nair, V. D., and Staples, C. R. 1994. Impact of grazing management on soil nitrogen, phosphorus, potassium, and sulfur distribution. Journal of Environmental Quality 23 (5): 1006-1013.

McIver, J. D. and McInnis, M. L. 2007. Cattle grazing effects on macroinvertebrates in an Oregon mountain stream. Rangeland Ecology and Management 60: 293–303.

Megahan, W.F. and Kidd, W.J. 1972. Effects of logging roads on sediment production rates in the Idaho Batholith. U.S. Forest Service Research Paper INT-123.

Merritt, R. W., K. W. Cummins, and M. B. Berg (eds). 2008. An introduction to the aquatic insects of North America. 4th edition. Kendall/Hunt Publishing Company, Dubuque, Iowa.1158 pp.

Miller, L.D., and Ortiz, R.F. 2007. Ground-water quality and potential effects of individual sewage disposal system effluent on ground-water quality in Park County, Colorado, 2001–2004. U.S. Geological Survey Scientific Investigations Report 2007–5220, 48 p.

The Nature Conservancy. 2001. Southern Rocky Mountains: an ecoregional assessment and conservation blueprint. Available at: http://www.mountainstudies.org/research/TNC_SRM_Assessment.pdf.

Neary, D. G., Ryan, K. C., DeBano, L. F. (eds). 2005. Wildland fire in ecosystems: effects of fire on soils and water. General Technical Report RMRS-GTR-42-vol.4. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Ogden UT.

Orodho, A. B., Trlica, M. J., and Bonham, C. D. 1990. Long-term heavy-grazing effects on soil and vegetation in the Four Corners region. Southwestern Naturalist 35: 9-14.
Roath, L. R. and Krueger, W. C. 1982. Cattle grazing influence on a mountain riparian zone. Journal of Range Management 35: 100-103.

Rocchio, J. 2005. Rocky Mountain subalpine-montane fen ecological system. Ecological Integrity Assessment, Colorado Natural Heritage Program, Colorado State University, Fort Collins, CO.

Rood, S.B., Samuelson, G.M., Weber, J.K., and Wywrot, K.A. 2005. Twentieth-century decline in streamflows from the hydrographic apex of North America. *Journal of Hydrology*, 306: 215-233.

Rothrock, J. A., Barten P. K., and Ingman, G. L. 1998. Land use and aquatic biointegrity in the Blackfoot River watershed, Montana. Journal of the American Water Resources Association 34 (3): 565-581.

Sada, D. W., Williams, J. E., Silvey, J. C., Ramakka, J., Summers, P., and Lewis, L. 2001. Riparian area management: a guide to managing, restoring, and conserving springs in the Western United States. Technical Reference 1737-17, Bureau of Land Management, Denver, CO. 70 pp.

Sada, D. W. and Vinyard, G. L. 2002. Anthropogenic changes in biogeography of Great Basin aquatic biota. Smithsonian Contributions to the Earth Sciences, Volume 33: 277-293.

Schultz, T. T. and Leininger, W. C. 1990. Differences in riparian vegetation structure between grazed areas and enclosures. Journal of Range Management 43: 295-299.

Strand, M., and Merritt, R. W. 1999. Impacts of livestock grazing activities on stream insect communities and the riverine environment. American Entomologist 45: 13–29.

Sugden, B. D. and Woods, S. W. 2007. Sediment production from forest roads in western Montana. Journal of the American Water Resources Association 43(1): 193-206.

Teves, N. B. and Stednick, J. D. 2005. Effectiveness of forestry related best management practices in the Trout Creek watershed, Colorado. Colorado Water Resources Research Institute, Completion Report No. 202, 121 pp.

Trombulak, S. C. and Frissell, C. A. 2000. Review of ecological effects of roads on terrestrial and aquatic communities. Conservation Biology 14: 18-30.

USDA Forest Service. 2007a. Region 2 sensitive species evaluation form, *Ochrotrichia susanae*. Available at: http://www.fs.fed.us/r2/projects/scp/evalrationale/evaluations/insects/caddisfly.pdf

USDA Forest Service. 2007b. Environmental assessment, North Trout Creek Forest Health and Hazardous Fuel Reduction Project, Salida Ranger District, San Isabel National Forest, Chaffee County, Colorado. Available at: http://www.fs.fed.us/r2/psicc/publications/environmental_assessments/ea_n_trout/index.shtml

USDA Forest Service. 2007c. Environmental assessment, rangeland allotment management planning on the Salida-Leadville-South Park planning area. Available at: http://www.fs.fed.us/r2/psicc/publications/environmental_assessments/sal_ldv_ramp/

Vora, R. S. 1988. Potential soil compaction forty years after logging in northeastern California. Great Basin Naturalist 48: 117-120.

Waters, T.F. 1995. Sediment in streams: sources, biological effects and control. American Fisheries Society Monograph 7. Bethesda, Maryland.

Wiggins, G. B. 1996. Larvae of the North American caddisfly genera (Trichoptera). 2nd edition. University of Toronto Press, Toronto, Canada. 457 pp.

Winegar, H. H. 1977. Camp Creek channel fencing—plant, wildlife, soil, and water responses. Rangeman's Journal 4: 10-12.

APPENDIX I. LOCATIONS OF RECORDED POPULATIONS OF SUSAN'S PURSE-MAKING CADDISFLY

Location	**Current Status**	**Date**	**Number of caddisflies observed, observer, notes**
type locality, Trout Creek Spring, south end of Chubb Park, Chaffee County, CO (Zone 13S 414403E 4301636N)	Extant	1975	100+ (Flint & Herrmann); larvae, pupae, and adults
		1986	Numbers not noted (Herrmann *et al*.)
		2005	Numbers not noted, but assumed stable (Herrmann, pers. comm., 2007)
High Creek Fen, Nature Conservancy site, ~8 miles south of Fairplay in South Park, Park County, CO (at or near Zone 13S 414895E 4328674N)	Extant	1995	Numbers not noted (Durfee & Polonsky)