PETITION TO LIST
THE ARAPAHOE SNOWFLY
(*Capnia arapahoe,* Nelson and Kondratieff 1988)

AS AN ENDANGERED SPECIES
UNDER THE U.S. ENDANGERED SPECIES ACT

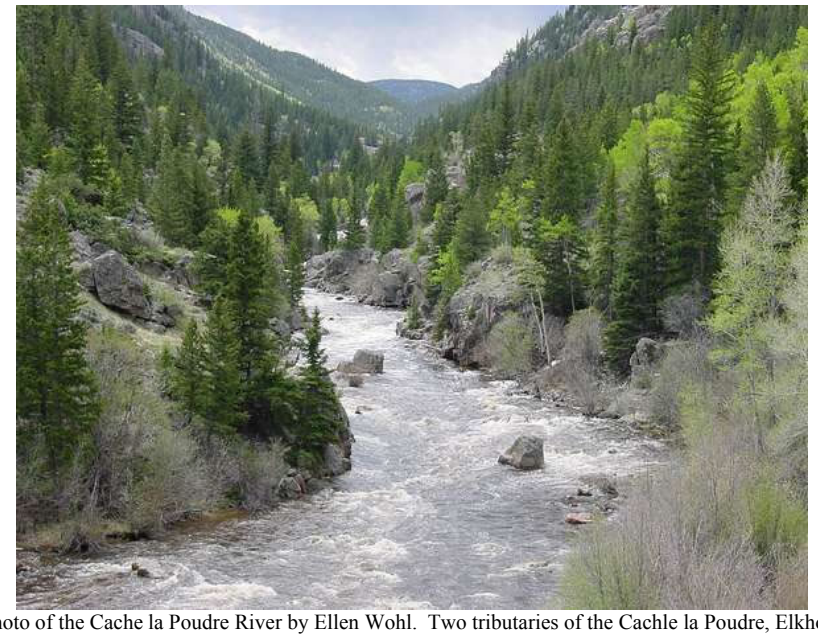

Photo of the Cache la Poudre River by Ellen Wohl. Two tributaries of the Cachle la Poudre, Elkhorn Creek and Young Gulch, constitute the entire historic and current known range of the Arapahoe snowfly.

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The Xerces Society for Invertebrate Conservation

Submitted by
The Xerces Society for Invertebrate Conservation
Dr. Boris Kondratieff
Save the Poudre: Poudre Waterkeeper
Cache la Poudre River Foundation
WildEarth Guardians
Center for Native Ecosystems

April 6, 2010

The Honorable Ken Salazar
Secretary of the Interior
Office of the Secretary
Department of the Interior
1849 C Street N.W.
Washington D.C., 20240

Dear Mr. Salazar:

The Xerces Society, Dr. Boris Kondratieff, Save the Poudre: Poudre Waterkeeper, Cache la Poudre River Foundation, WildEarth Guardians, and Center for Native Ecosystems hereby formally petition the U.S. Fish and Wildlife Service to list the Arapahoe snowfly (*Capnia arapahoe*) 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 Procedures Act (5 U.S.C. § 553).

Because the Arapahoe snowfly has an extremely limited geographic range, is experiencing deteriorating ecological conditions within its habitat and is vulnerable to extinction from a single catastrophic event, we also appeal for emergency listing pursuant to 16 U.S.C. § 1533(b)(7) and 50 CFR 424.20 in order to ensure the species' survival. While the species is emergency listed, the U.S. Fish and Wildlife Service should finalize a standard listing rule for the Arapahoe snowfly.

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). We will therefore expect a finding by the Service within 90 days, as to whether our petition contains substantial information to warrant a full status review. 16 U.S.C. § 1533(b)(3A).

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.

Dr. Boris Kondratieff is a Professor of Entomology at Colorado State University.

Save The Poudre: Poudre Waterkeeper works to Protect and Restore the Cache la Poudre River.

Cache la Poudre River Foundation is an organization founded for the protection of Wild Trout through the town of Fort Collins, Colorado.

WildEarth Guardians is a nonprofit conservation organization dedicated to protecting and restoring wildlife, wild places, and wild rivers in the American West.

Center for Native Ecosystems conserves and recovers native species and ecosystems of the Greater Southern Rockies using the best available science.

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I. EXECUTIVE SUMMARY

A rare endemic insect species, the Arapahoe snowfly (*Capnia arapahoe),* is threatened with imminent extinction. The Arapahoe snowfly is known historically only from two small tributaries of the Cache la Poudre River in the Front Range of Northern Colorado: Young Gulch and Elkhorn Creek. Repeated surveys in recent years indicate the species may be extirpated from Young Gulch and the entire known range of the snowfly may now be restricted to one small, continuous stretch of Elkhorn Creek, which is in a "Forest Service Class II, at risk" watershed, twenty miles west of Fort Collins (USDA Forest Service 2008a). The species and its restricted habitat in the Canyon Lakes Ranger District of the Roosevelt National Forest are at serious risk from several anthropogenic threats, including: intensifying recreational use in and around the species' habitat; grazing adjacent to Elkhorn Creek; timber and forest stand management practices impacting the riparian zone of Elkhorn Creek; management actions for the mountain pine beetle (*Dendroctonus ponderosae*) infestation in Roosevelt National Forest, including pesticide application close to water bodies connected to Elkhorn Creek; dewatering; sedimentation and runoff from roads and trails; and seepage from residential and destination resort septic systems. Additional threats are posed by hydrologic changes that are expected to be exacerbated by global climate change. Impaired conditions on the mainstem of the Cache la Poudre may also act as dispersal barriers. These stressors, in combination with the Arapahoe snowfly's limited range and dispersal ability, and the inherent instability of small populations, collectively threaten this rare species with imminent extinction. It should be given immediate, emergency protection under the Endangered Species Act ("ESA").

II. CANDIDATE BACKGROUND, STATUS, AND LISTING HISTORY

The Arapahoe snowfly currently receives no federal protection. It is rated as Critically Imperiled at the state (S1) and global level (G1) by NatureServe (NatureServe 2010). The species was also identified as a target species of conservation concern within a potential conservation area around the Cache la Poudre River (Colorado State University 2009), although this designation does not provide any legal protection for the Arapahoe snowfly or its habitat.

On July 24, 2007, the organization Forest Guardians (now WildEarth Guardians) formally petitioned to list *Capnia arapahoe* under the Endangered Species Act as part of a larger effort to collectively list 206 species in the western and midwestern United States, including 42 in Colorado (Rosmarino & Tuchton 2007). On February 5, 2009, the U.S. Fish and Wildlife Service ("FWS") determined that the petition did "not present substantial scientific or commercial information" to indicate that listing for the Arapahoe snowfly, along with 165 other species, was warranted under the Endangered Species Act (U.S. Fish & Wildlife Service 2009a). That decision is now the subject of litigation filed on January 8, 2010 (WildEarth Guardians 2010).

The FWS determination specifically stated that threats to the Arapahoe snowfly had not been adequately described and referenced in the Forest Guardians' petition (U.S. Fish & Wildlife Service 2009a). This petition presents substantial new scientific information demonstrating that the Arapahoe snowfly's habitat is subject to ongoing and severe threats, and that the species is in peril of imminent extinction.

III. SPECIES DESCRIPTION

The Arapahoe snowfly is a small snowfly in the family Capniidae (snowflies). Species in this genus (*Capnia*) are generally found in the Western U.S. (Stewart & Stark 2002). Like all snowflies, most *Capnia* adults are winged and generally use terrestrial habitats close to the stream for mating and sometimes feeding, while the immature form is completely aquatic.

A. Adult

Adult males of the Arapahoe snowfly belong to Decepta Group within the genus *Capnia* and have a slender epiproct (intromittent organ at the end of the abdomen) with horns on the tip; the epiproct is about 7 times as long as it is wide when viewed dorsally. Adults also have a distinct knob on tergum (dorsal or top portion) of the 7th abdominal segment (Nelson & Baumann 1989). Females of the species were recently described from a single specimen collected at the type locality on Elkhorn Creek (Heinold & Kondratieff 2010). As the common name 'snowfly' suggests, the dark-bodied *Capnia* adults are adapted to winter conditions and emerge in late winter or early spring, often when snow is still on the ground (Stark *et al.* 1998).

Figure 1. Photograph of Arapahoe snowfly adult by Boris Kondratieff.

B. Immature

The immature (nymph) of the Arapahoe snowfly has not yet been described. The *Capnia* genus contains 56 species in North America (Stark *et al.* 2009.); nymphs have been described for only four of these species, due to the difficulties inherent in sampling for nymphs under ice in winter, and difficulties in distinguishing between *Capnia* nymphs of different species. Nymphs in the family Capniidae have elongated bodies with no visible external gills; the hind legs do not extend past the tip of the abdomen, the midline of the wingpads is almost parallel to the body axis, and the 2nd tarsal segment of the leg is much shorter than the 1st tarsal segment (Stewart & Stark 2002, Merritt *et al*. 2008). *Capnia* nymphs are generally 5-8 mm (0.2-0.3 in.) long, and light to medium brown in color. They differ from other genera in the family Capniidae by the presence of a shallow notch halfway along the inner margins of the hind wingpads; a silky fringe on the outer edge of the foretibia and tarsus; and a whorl of bristles at the apex of the abdominal cerci ("tails") (Stewart & Stark 2002).

IV. TAXONOMY

The taxonomy of the Arapahoe snowfly (*Capnia arapahoe*) is uncontested (Nelson & Baumann 1989). *Capnia arapahoe* is a winter snowfly in the family Capniidae. It was first described from specimens collected at Young Gulch on March 22, 1986 (paratype) and Elkhorn Creek on April, 3 1987 (holotype), above the Cache la Poudre on the Roosevelt National Forest (Nelson & Kondratieff 1988, Heinold & Kondratieff 2010).

V. POPULATION DISTRIBUTION AND STATUS

A. Historic Distribution

The range and abundance of the Arapahoe snowfly is not known prior to 1986, when the first specimen was collected. The holotype locality for this species is on the lower reaches of Elkhorn Creek, 22 miles west of Fort Collins, at an elevation of 2012 m (6600 ft). A paratype was collected at Young Gulch above the Ansel Watrous Campground in the Poudre Park area at an elevation of 1768 m (5800 ft) (Nelson & Kondratieff 1988). Both streams are tributaries of the Cache la Poudre, Colorado's only Federally-designated Wild and Scenic river. The Cache la Poudre River rises in the Front Range of Rocky Mountain National Park and runs downstream through the Roosevelt National Forest, then through Bellvue, LaPorte, Fort Collins, Timnath, Windsor and Greeley before joining the South Platte River just downstream of Greeley.

B. Current Distribution

Successive searches for the species were conducted recently by B. Kondratieff and B. Heinold, from 2007 to 2009, on the mainstem of the Cache la Poudre River, Young Gulch, Elkhorn Creek, and other nearby suitable tributaries close to Young Gulch and Elkhorn Creek. They sampled about 6 sites. No systematic adult survey of the area for this species has been done, and additional surveys during the appropriate time of year should be accomplished. However, only one or two other streams in this area are likely to support *C. arapahoe* because of their ecological similarity to Elkhorn Creek. Even if new populations of *C. arapahoe* were found in those few additional streams, the species would likely still face a high risk of extinction. (B. Kondratieff pers. comm., March 2010). Additional specimens from the immediate vicinity of the initial holotype have been collected at Elkhorn Creek, confirming that the species is extant at this location (Heinold & Kondratieff 2010). No additional specimens from Young Gulch were found during the 2007-2009 surveys, suggesting that the Arapahoe snowfly may be extirpated from this site, possibly due to intensifying recreational use at Young Gulch and severe drought conditions over the past decade (B. Heinold pers. comm., Jan. 2010). During routine survey work on Elkhorn Creek from 2007-2009, only five of the 500 *Capnia* stoneflies collected were identified the Arapahoe snowfly, demonstrating that this species is markedly rare within its known range (B. Heinold pers. comm., Jan. 2010).

VI. HABITAT REQUIREMENTS

A. Overview

Insects in the genus *Capnia* are stoneflies (Order: Plecoptera). Stoneflies in general require cold, clean, well-oxygenated streams (Baumann 1979, Stewart & Stark 2002). Although a few genera in the family Capniidae may occur in warmer habitats, *Capnia* species are usually found in

small, cold, streams, often at high elevations (Baumann 1979, Baumann *et al*. 1977, Ward & Kondratieff 1992, Merritt *et al*. 2008). Stoneflies are one of the most sensitive biotic indicators of water quality and are frequently used as sentinel organisms in biomonitoring, as they are among the first macroinvertebrates to disappear from systems impacted by thermal or chemical pollution and physical habitat degradation (Gaufin 1973, Rosenberg & Resh 1993, Barbour *et al*. 1999). Stonefly nymphs have narrow temperature, substrate and stream size ranges within which they can persist (Baumann 1979, Williams & Feltmate 1992), making them especially vulnerable to anthropogenic impacts on water quality.

The two small streams from which this species has been collected are both in the Front Range of the Rocky Mountains of Colorado and are tributaries of the Cache la Poudre River. The upper stream reaches have steep slopes with sparse riparian vegetation, including ponderosa pine. The lower reaches where Arapahoe snowfly specimens have been collected have a pebble, cobble, and bedrock substrate, with a riparian buffer of cottonwood, willow, and box elder (Nelson & Kondratieff 1988). Most adult specimens of the Arapahoe snowfly collected from Elkhorn Creek were obtained from exposed bank grasses and willows, suggesting that adults are closely associated with native riparian plants for mating and feeding (B. Heinold pers. comm., Jan. 2010). Annual precipitation patterns affect both Elkhorn Creek and Young Gulch, and anthropogenic withdrawals restrict flows in Elkhorn Creek (M. Easter pers. comm., Dec. 2009), and in summer and fall sections of both become intermittent (Nelson & Kondratieff 1988).

B. Diet

Specific feeding behavior of Arapahoe snowfly nymphs has not been observed, but most species in this family feed by shredding detritus, and active nymphs are generally found in leaf packs or woody debris (Stewart & Stark 2002). Adult feeding behavior of the Arapahoe snowfly has not been documented, but capniid adults are known to feed on epiphytic algae or the buds and pollen of riparian vegetation (Stewart & Stark 2002).

C. Life Cycle

Species in the family Capniidae, including the Arapahoe snowfly, require cool temperatures for development and have a univoltine fast life cycle, producing only one generation per year (Lillehammer *et al.* 1989, Stewart & Stark 2002, Merritt *et al.* 2008). Females lay eggs after mating in the late winter, eggs hatch soon after laying and the nymphs enter the hyporheic zone (a zone of loose rocky substrate below the streambed saturated with water) and undergo diapause, becoming inactive until the water cools in late fall and winter, during which the nymphs enter the stream benthos, developing rapidly to maturity, feeding as shredders of conditioned leaf material. Adult Arapahoe snowflies apparently emerge and are active from late March to early April (Nelson & Kondratieff 1988, Heinold & Kondratieff 2010).

VII. HABITAT STATUS AND CONDITION

A. Geographic, Ecological and Hydrological Characteristics

Specimen localities for *Capnia arapahoe* are on the lower reaches of Young Gulch and Elkhorn Creek, near their confluences with the mainstem of the Cache la Poudre River in the Front Range of the Rocky Mountains (Nelson & Kondratieff 1988). Though portions of the Poudre are now designated as a Wild and Scenic River, its water has been diverted extensively for irrigation

making the Poudre valley one of the first and most intensively irrigated areas of Colorado (Poudre River Trust 2008). There have also been significant anthropogenic diversions of Elkhorn Creek. For example, in the 1960's and 1970's, Currie Ranch near present day Red Feather Lakes was divided into six subdivisions, requiring water decrees in the Elkhorn Creek drainage (Red Feather Historical Society 2004). The mainstem of the Cache la Poudre has also been affected by dewatering; in the past, the river typically flowed during Winter and early Spring at approximately 30-50 cubic feet per second (CFS) (City of Fort Collins, 2003), but ongoing ditch diversions and upstream reservoir diversions reduce flows by 67-80% to roughly 10 CFS in areas around the Young Gulch and Elkhorn Creek confluences during the Winter. Whereas flows during the Spring snowmelt and summer remain at levels similar to historic flows, they are highly variable due to trans-basin diversions into the Cache la Poudre watershed from the Colorado, Laramie, Michigan, and North Platte river watersheds. (City of Fort Collins 2003, Colorado Division of Water Resources 2004).

Young Gulch and Elkhorn Creek are cool, high elevation mountain streams that become intermittent by late Summer and early Fall, and are largely dependant on precipitation, snowmelt and groundwater for flow (Nelson & Kondratieff 1988). Elkhorn Creek rises from its headwaters near treeline on South Bald Mountain in the Laramie Mountains and runs to the north bank of the Poudre approximately 20 miles west of Fort Collins. Elkhorn Creek is considered to be in an at-risk Class II watershed by the Forest Service, meaning it is at risk of being unable to support beneficial uses (USDA Forest Service 2008a). The flow rate of Elkhorn Creek has been drastically diminished from historical flow by large artificial lake impoundments in the upper Elkhorn Area (USDA Forest Service 2008a) and water withdrawal for residential use by developments at Glacier View Meadows and Crystal Lakes (Red Feather Society 2004). The Colorado Water Conservation Bureau declares instream flow rights to ensure a minimum flow that will preserve the natural environment "to a reasonable degree", but the flow rate declared for Elkhorn Creek is extremely low, at only 2 CFS (Colorado Water Conservation Board 2007).

Young Gulch is fed from several minor tributaries rising from spring-fed seeps in Mummy Range foothills. Young Gulch enters the Poudre from the south approximately six miles west of the Canyon Lakes Ranger District eastern boundary. The confluence of Young Gulch and the Poudre is separated from the confluence of Elkhorn Creek and the Poudre by approximately five miles. In recent years, the stream at Young Gulch has flowed at a very slow late summer rate of less than 1 CFS (M. Easter pers. comm., Dec. 2009).

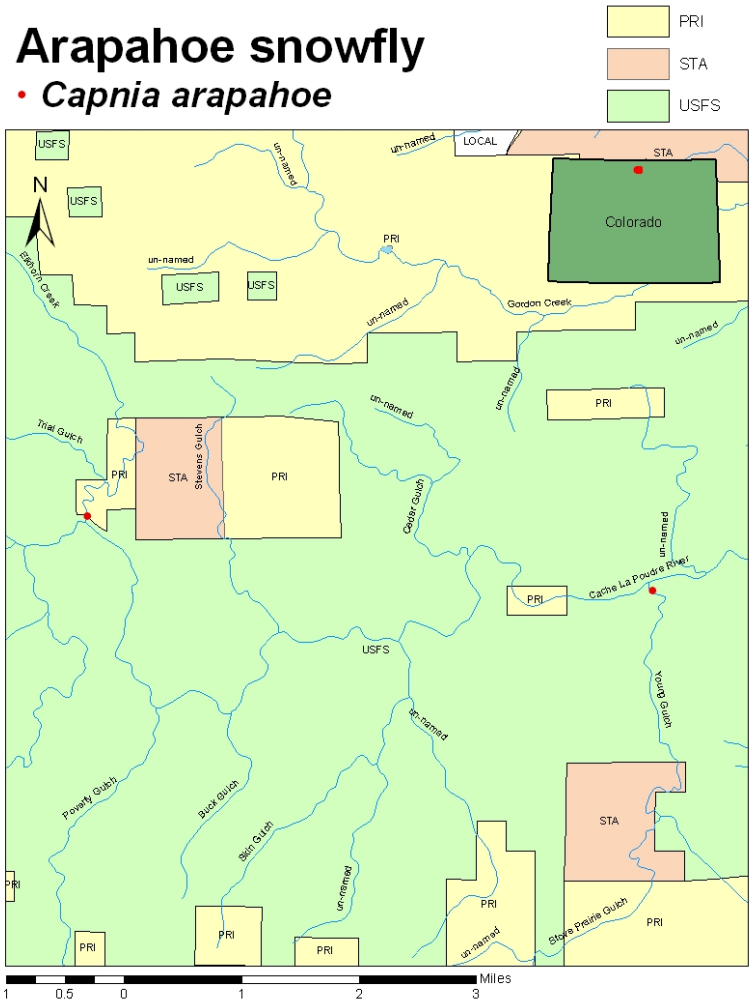
B. Land Ownership and Water Rights

Both specimen localities are in the Poudre Canyon area of the Canyon Lakes Ranger District in the Roosevelt National Forest on U.S. Forest Service lands (see Figure 2). Property ownership in the immediate surrounding area alternates between the Forest Service and a variety of private holdings, including some with significant recreational and residential developments, as well as private agricultural operations.

Private land development around the upper Elkhorn Creek drainage is extensive relative to the creek's lower reaches and other portions of the Roosevelt National Forest. The community of Red Feather Lakes and developments at Glacier View Meadows and Crystal Lakes are surrounded by Roosevelt National Forest Land and divert a significant portion of water from the

Elkhorn Creek system (Red Feather Society 2004). A number of recreational and resort facilities influence flow and water quality in the creek via withdrawals, discharges and recreational activities that directly impact the stream (discussed below). Destination facilities include a popular Buddhist Retreat Center (Shambhala Mountain Center) and a very active Ben Delatour Boy Scout Camp that maintains an impoundment of Elkhorn Creek at Weaver Lake (USDA Forest Service 2008a). A variety of other significant water rights are held on the "Manhattan Ditch", a diversion on Manhattan Creek which empties a small quantity of return flows to Elkhorn Creek (USDA Forest Service 2008a). The Colorado Water Conservation Board holds a nominal instream flow right of 2 CFS on the river (Colorado Water Conservation Board 2007). Additional developments that require diverting more water from the Elkhorn system are periodically proposed (Colorado Water Conservation Board 2009). As recently as 2009, a 50-residence development plan was pending before the state water conservation board requesting a permit to withdraw 15 acre-feet of water annually from the Elkhorn system (Colorado Water Conservation Board 2009). Though the application was opposed by the board, decisions affecting the diversion of water from the Elkhorn System are currently made on an *ad hoc* basis and there is ongoing demand for new water diversions (Colorado Water Conservation Board 2009).

Figure 2. Distribution of the Arapahoe snowfly.



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

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

The primary threats that jeopardize the Arapahoe snowfly are degradation of water quality and habitat integrity caused by heavy recreational use, grazing, forest management practices, and development.

1. Recreation

Young Gulch is one of the most popular hiking destinations in the Cache la Poudre River Canyon. Intense recreational use of the Young Gulch area by tens of thousands of hikers, dogs, mountain bikers, horseback riders and campers annually threaten water quality and habitat conditions. While recreation is not yet as pronounced in the lower Elkhorn Creek area, a greatly expanded recreational network has been approved and the Forest Service is currently accepting bids to begin construction on new forest trails and infrastructure in the Elkhorn Creek area (USDA Forest Service 2009). Recreational activities at Young Gulch and Elkhorn Creek adversely affect Arapahoe snowfly habitat via runoff of pollutants from roads and trails, the introduction of bacteria and excess nutrients from dog, horse and human waste, trampling of streamside riparian habitat, increased sedimentation from erosion caused by foot and bike traffic, and the construction and maintenance of stream crossings and culverts which can interrupt streamflow and generate additional sedimentation and siltation of waterways (see Appendix B for site photographs illustrating some of the habitat impacts).

The Forest Service National Visitor Use Monitoring Program indicates that National Forest lands are increasingly popular destinations (USDA Forest Service 2008d). Thousands of visitors recreate annually in the Poudre Canyon Area of the Roosevelt National Forest (M. Easter pers. comm., Dec. 2009). Elkhorn Creek and Young Gulch provide opportunities for a host of outdoor activities, including hiking, biking, horseback riding and camping. Data from the national visitor use monitoring program indicate that almost 50% of the visitors to any single national forest live within 50 miles (USDA Forest Service 2008d). Many visitors to the Roosevelt National Forest and Poudre Canyon come from Fort Collins, which is roughly 20 miles away and has a growing population of approximately 137,200 residents (City of Fort Collins 2010), as well as from Denver and Boulder, which are only a few hours away. The population of the state of Colorado is expected to increase by up to 100% by 2050; as one of the fastest-growing cities in the state, Fort Collins will likely match this pace of population growth (City of Fort Collins 2010). As population continues to grow in Fort Collins and the Front Range, the likelihood for a sustained increase in visitation to premier outdoor destinations such as Poudre Canyon is high.

From 1995 to 2006, significant increases in non-motorized outdoor recreation were seen in bicycling, horseback riding, and day hiking in Colorado (USDA Forest Service 2008a). These statistics reflect recreation patterns on the Roosevelt National Forest, including the Elkhorn Creek and Young Gulch areas (Nelson & Kondratieff 1988). The Mount Margaret trail is in close proximity to Elkhorn Creek and representative of recreational trends in the wider Canyon Lakes Ranger District. Mountain biking increased almost 20-fold on the Mount Margaret trail from 2004 to 2008, and the level of horseback riding activity doubled. Currently, mountain

biking and horseback riding comprise an average of 10% and 12% of the trail system's use, respectively (USDA Forest Service 2008a).

i. Young Gulch

Young Gulch is widely recognized as a premier and heavily used destination for mountain biking, hiking with dogs, back country camping and day use (Miller 2009, Singletracks.com 2010, TrailCentral.com 2010). An online biking blog lauds Young Gulch's challenging "technical features" and notes "this is a popular trail for bikers, hikers, and dogs so come prepared to have company" (TrailCentral.com 2010). The Fort Collins REI outdoor equipment store displays information on the recreational features of Young Gulch, highlighting it as one of the more popular venues for diverse pursuits on the Roosevelt National Forest (R. Moore pers. comm., Jan. 2010).

Dog-friendly policies in the area are a primary attraction for dog-owners. Dogs are allowed off-leash (Canyon-Lakes Ranger District pers. comm., March 2010, Localhikes.com 2010), and have easy access to the creek bed. One regular visitor to Young Gulch recommended that "if one does not like dogs, then this is not the trail for you" (Localhikes.com 2010). Another visitor observed "lots of dogs off leash…Due to the spring runoff we crossed the stream 58 times" (Localhikes.com 2010). Heavy human and pet traffic along with repeated stream crossings result in increased trampling, destruction of riparian vegetation, disruption of the stream substrate, and introduction of animal wastes, impairing the stream's physical habitat and water chemistry and degrading conditions for the Arapahoe snowfly.

Animal waste impairs waterways by increasing nutrient concentrations, especially nitrogen and phosphorus, as well as fecal coliform bacteria (U. S. Environmental Protection Agency 2005). As organic matter such as feces decompose, oxygen is consumed, thereby depleting the level of dissolved oxygen available to aquatic organisms. The decomposition process may also release ammonia, further altering the water quality. The increased nutrient levels associated with pet waste can lead to algal blooms, further altering the stream plant community and habitat. Increased algal growth can also cause dissolved oxygen levels to plummet at night, when the plants turn to aerobic respiration for energy, potentially harming aquatic life. These effects will be augmented in the summer; as water level falls to summer lows, nutrient and bacteria concentrations will be increased, and the water will become warmer and much lower in dissolved oxygen, creating conditions antithetical to the snowfly's survival. Finally, dogs as well as people trample streamside vegetation and damage the riparian buffer, creating patches of bare ground that can lead to increased erosion and sedimentation

Camping is another popular form of recreation in the area, and the Ansel Watrous campground immediately adjacent to Young Gulch receives large numbers of visitors each season (Trailcentral.com 2010). Ansel Watrous has 17 campsites, including several that accommodate RVs and motor homes (USDA Forest Service 2009). Hikers exploring Young Gulch from Ansel Watrous or those using the stream as a water source while backcountry camping have the potential to trample riparian areas when crossing the stream, which could harm the Arapahoe snowfly by destabilizing banks and disturbing the stream substrate. The water quality could also be negatively impacted if campers are using the stream for washing.

The extreme popularity of the Young Gulch area with mountain bikers also poses a serious threat to the Arapahoe snowfly. Successive use of stream crossings by cyclists disturbs riparian plants, destabilizes stream banks, and facilitates sedimentation of the creek (summarized in Marion & Wimpey 2007). Mountain biking is likely to damage the soil, as the bike tires are designed to bite into the substrate for greater traction (Goeft & Alder 2001). Continuing heavy cycling pressure can accelerate soil compaction, and create ruts and bare ground across portions of the upland and riparian zones. The trail stays within the riparian corridor for nearly its entire reach, crossing Young Gulch more than 45 times (R. Moore, pers. comm., March 2010), and the threats to water quality posed by mountain biking are high.

Overall, the large numbers of recreational users at Young Gulch are likely damaging the integrity of the Arapahoe snowfly's habitat through the removal of riparian vegetation, soil compaction, increased erosion and sedimentation, and lowered water quality due to eutrophication and decreased dissolved oxygen levels.

ii. Elkhorn Creek

The Arapahoe snowfly population at Elkhorn Creek is threatened by the same types of hiking, biking and camping activities that occur at Young Gulch. The levels of recreational use are currently lower at this site, but this may be changing as the trail system is expanded (see below). Because the Elkhorn Creek drainage is considerably hotter than Young Gulch in summer and is less accessible in its lower reaches, it tends to be less visited (M. Easter pers. comm., Dec. 2009). However, trails around Elkhorn Creek still receive traffic from hikers, cyclists, and livestock in the summer (USDA Forest Service 2008a). Motorized recreation was allowed in the past, but has been halted due to illegal encroachment of vehicles into non-approved areas that resulted in habitat destruction (USDA Forest Service 2009). In the summer, residents from nearby Red Feather Lakes and participants at the Boy Scout Camp often visit the area, and guests and residents of the Shambala Buddhist Center visit the area year round. Most use is day use, although there is some overnight camping around Elkhorn Creek, and unauthorized hiking trails have been created in the area (USDA Forest Service 2009). Many back country campers also stay in the area around Elkhorn Creek, often in large groups (S. Black, personal observation, July 2009).

Currently there is only a primitive trail network on the lower and middle reaches of Elkhorn Creek. In early 2009, the Forest Service approved an expansion of the existing trail system and construction of a parking area to accommodate more hikers, bikers and equestrians near and around Elkhorn Creek (the Margaret-Molly-Moon Dispersed Recreation Management Project; USDA Forest Service 2009). The Forest Service is currently accepting contractor bids to initiate the construction process (Onvia 2010). A key component of the project is to construct a 12-car, seven-trailer parking facility at the currently unsigned Elkhorn Creek trailhead, which will allow riders, bikers and hikers easier access to Elkhorn Creek (USDA Forest Service 2008a). The project also involves construction of additional trails, including miles of new trail along the middle and lower reaches of Elkhorn Creek (USDA Forest Service 2008a). Construction of the new parking lot and trails will increase soil erosion and sedimentation, and the resulting increase in compacted and impervious surfaces will generate greater runoff of pollutants into the stream. The specific threat posed by roads around Elkhorn Creek is discussed in greater detail below.

Increased equestrian activities pose an additional threat, primarily from the introduction of additional animal waste in the stream and the physical damage to stream habitat from repeated trampling and churning of the soil at stream crossings. The Elkhorn Creek trailhead will soon accommodate up to seven horse trailers to facilitate for greater equestrian recreation (USDA Forest Service 2008a). Increased levels of horse manure in Elkhorn Creek or Young Gulch would have effects similar to those described above for pet wastes—increased nutrients, fecal coliform bacteria, eutrophication, and algal blooms—but on an even larger scale. In addition, frequent stream crossings by horses or riding along the edge of the creek promote bank destabilization, increase sedimentation, and damage the riparian buffer.

2. Grazing

There are currently no active grazing allotments around Young Gulch, although this area has been grazed in the past. The Elkhorn Creek drainage contains four grazing allotments, three active (Elkhorn/Ladymoon, Lone Pine, and Dowdy Lake) and one inactive (Seven Mile). The Elkhorn/Ladymoon allotment boundaries are several miles upstream from known snowfly habitat in Elkhorn Creek (USDA Forest Service 2008b), and grazing-related impairment of water quality may impact the downstream habitat.

The current term of the Elkhorn/Ladymoon allotment began in 2006 when it was approved concurrent with the other allotments, and extends through 2016 (USDA Forest Service 2008b). The allotment is active annually from late Spring through early Fall (June 11 – September 30), with 75 cow/calf pairs on five rotational units, and a total of 365 AUMs impacting approximately 11,700 acres (USDA Forest Service 2008b). While some fencing to protect riparian areas is planned, there have been no cattle exclusion structures on the Elkhorn Creek allotment during the past four grazing seasons (USDA Forest Service 2008b), and cattle use existing trail and road crossings to gain direct access to the creek bed (USDA Forest Service 2008a).

Livestock grazing can degrade water quality and negatively impact aquatic macroinvertebrate communities in several ways: trampling riparian vegetation; consuming streamside vegetation and downcutting the riparian buffer; defecating and urinating on stream banks or in the channel; and increased sedimentation due to removal of riparian vegetation and direct damage to banks and channel from trampling and wallowing. Since cattle are not excluded from the stream bed in Elkhorn Creek, eutrophication and erosion are especially significant threats. Intensive livestock grazing has been shown to result in loss of biodiversity, 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 preference of livestock to loiter near streams results in increased defecation and urination in or near the water source, which can degrade water quality and alter both 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). 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), which overlaps with the annual grazing season on the Elkhorn allotment (USDA Forest Service 2008b).

Decreases in water quality associated with livestock waste are likely to have a serious, adverse effect on the Arapahoe snowfly.

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 (Schulz & Leininger 1990, Fleishner 1994). Increased erosion leads to higher sediment loads in nearby waters, degrading habitat and increasing water turbidity. These problems will be exacerbated by livestock removal of riparian vegetation, as a riparian buffer helps filter overland runoff, slow flooding, and stabilize stream banks. Because riparian zones within the Elkhorn allotment areas are unfenced, the combined impacts of the above factors could have a profound negative effect on water quality and the Arapahoe snowfly's survival in Elkhorn Creek. A four-year study of a western mountain stream found a dramatic decline in macroinvertebrate abundance when just 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 has been shown to remove riparian zone vegetation and disrupt riparian plant communities (Kennedy 1977, Kovalchik & Elmore 1992, Fleishner 1994). Continued grazing in riparian areas of the Elkhorn system by 75 cow-calf pairs will remove riparian vegetation, reducing the shading canopy and leading to rising water temperatures and lower dissolved oxygen levels, further imperiling the Arapahoe snowfly.

Damage done to riparian ecosystems due to grazing can be remediated when livestock grazing pressure is reduced or eliminated (Winegar 1977, Schulz & Leininger 1990, Holland *et al*. 2005, Coles-Ritchie *et al*. 2007). Thus, alteration of grazing activity in the areas around the snowfly habitat is likely to have a beneficial effect. However, such changes must be kept in place over the long term for full riparian recovery to occur, and recovery is not guaranteed. Moderate-intensity summertime grazing experiments conducted across a four-year period in a 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). Although the Forest Service plans to protect riparian areas concurrent with its pending Red Feathers Fuels Reduction Project (discussed below), the legacy of grazing in the Elkhorn allotment is likely to have continued harmful ramifications for the snowfly and its habitat well into the future, even with more conscientious management practices.

3. Timber and Forest Management Practices

Past and present forest management practices in the Canyon Lakes Ranger district may impair the Arapahoe snowfly's habitat. The two major impacts involve pesticide applications to control mountain pine beetle infestations and the Red Feathers Fuel Reduction project.

i. Carbaryl Application in the Canyon Lakes Ranger District

Carbaryl (1-naphthyl N-methylcarbamate; Sevin) spraying was conducted to control mountain pine beetle infestation in more than 11,000 trees in April and May of 2009 (USDA Forest Service news release April 2009), with about 2,500 affected trees being sprayed in the vicinity of the campgrounds at West and Bellaire Lakes. Both of these lakes are near Elkhorn Creek, raising the possibility that carbaryl could enter the creek via drift or groundwater contamination. Aerial carbaryl application was shown to affect aquatic macroinvertebrates downstream, even when a 152-meter no-spray buffer was maintained around the waterway (Beyers *et al*. 1995, reviewed in Hastings *et al*. 2001). Carbaryl is highly toxic to aquatic invertebrates, and data indicate that the major carbaryl breakdown product, 1-naphthol, ranges in toxicity from moderately to highly toxic to aquatic organisms (US EPA 2004). In an EPA re-registration study (US EPA 2004), carbaryl was rated as "very highly toxic" against a stonefly test species (*Chloroperla*), and it was further concluded that carbaryl use represents a chronic risk for threatened aquatic invertebrates. Continuing carbaryl applications around campgrounds in the Elkhorn Creek area, especially during spring months when this intermittent stream is still running, are likely to impair the survival of sensitive aquatic invertebrates such as the Arapahoe snowfly.

ii. The Red Feather Fuel Reduction Project

The recently implemented Red Feather Fuel Reduction Project may negatively impact Elkhorn Creek. This project involves cutting to thin stands and conducting controlled burns. The Environmental Assessment for the Red Feather Project (USDA Forest Service 2008b) acknowledged that under its plan the riparian corridor at Elkhorn Creek could be impacted by timber and fuel removal along with prescribed burn activities. The finding of "no significant impact" was based on the absence of any "unique characteristics within the project area that would be significantly affected by treatment activities" (USDA Forest Service 2008c), although they acknowledged that Elkhorn Creek is impacted by roads and grazing. The only aquatic invertebrate considered was the Hudsonian emerald dragonfly (*Somatochlora hudsonica*), which does not have any habitat within the project area. In a separate Forest Service planning document for the Molly Moon recreation project, the agency concluded that the fuel reduction project would impact soil compaction and erosion, both of which can affect stream quality via increased runoff and sedimentation (USDA Forest Service 2008a).

(a) <u>Timbering and "Fuel Treatment" in the Red Feathers Project</u>

The Red Feathers Fuel Treatment project includes more than 1,000 acres in the Elkhorn drainage and near Elkhorn Creek (USDA Forest Service 2008b), and involves cutting, chipping, and burning selected trees. In some areas the project approaches the riparian corridor, although crews are required to maintain a 100-150 foot (30-45 meter) riparian buffer if sensitive or listed species are present (USDA Forest Service 2008c). Critical Habitat for the Preble's jumping mouse, a Federally Threatened species, covers 394-459 feet (120-140 meters) on each side of Elkhorn Creek. Logging activities require consideration of the effects of logging-associated roads on aquatic habitats, as disturbance associated with logging road construction and operation is thought to have the greatest influence on increasing sediment load in streams (Cederholm *et al.* 1980, Furniss *et al.* 1991). Roads increase erosion and sedimentation, increase the amount and pattern of surface runoff, and may also facilitate the spread of invasive plant species (Anderson 1996, Forman & Alexander 1998, Trombulak & Frissell 2000, Gucinski *et al*. 2001, Angermeier

et al. 2004). 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*. 2000, Trombulak & Frissell 2000, Gucinski *et al*. 2001, Grace 2002).

The Red Feathers Fuel treatment project requires creating several miles of new temporary roads and using existing but inactive logging roads in the Elkhorn drainage (USDA Forest Service 2008c). The construction, use, and maintenance of either permanent or temporary roads facilitates accelerated runoff into streams (Waters 1995). The presence of logging road networks 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 extractive 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). Even the use of temporary roads can have a long-term effect, and the temporary roads required for the Red Feather project could have a long-term negative impact on the Arapahoe snowfly's habitat in Elkhorn Creek.

(b) Prescribed burns

More than 1,000 acres in the Elkhorn Creek drainage were burned under the prescribed burn component of the Red Feather Fuel Reduction Plan (USDA Forest Service 2008b). These controlled burns could adversely impact the Arapahoe snowfly's habitat in several ways. The use of prescribed burns as a fuel management strategy has been shown to have deleterious effects on water quality generally and on macroinvertebrates in particular (Neary *et al.* 2005). As with fuel removal and timbering operations, mechanical site preparation and road construction needed to conduct prescribed burns may lead to increased erosion and sediment production, especially on the steep terrain in the Elkhorn drainage. Removal of leaf litter from the soil surface through burning near the riparian corridor can lead to reduced water infiltration into the soil, increasing the amount of surface runoff into streams.

However, an intense, stand-replacing fire in the Elkhorn Creek drainage that may be more likely to occur without prescribed burning treatments would likely be catastrophic for the survival of the Arapahoe snowfly.

4. Development

Red Feather Lakes is a village of about 600 residents with several lodges, resorts and recreational venues. It is surrounded by a more dispersed network of rural agricultural lands and aging homesteads. At its closest point, Elkhorn Creek comes within ~2.5 miles of Red Feather Lakes. The proximity of the community and its associated tourist facilities to Elkhorn Creek pose distinct threats to creek integrity and to the Arapahoe snowfly's survival, including: planned increases in recreational use; a road network that crosses or approaches Elkhorn Creek in several places; reduced flow in Elkhorn Creek as a result of surface and subterranean water withdrawal; and potential waste seepage from septic systems into the Elkhorn Creek system.

The Environmental Assessment for the Margaret Molly Moon Dispersed Recreation Management Project (described above in A.1.ii.) discussed the current impaired condition of Elkhorn Creek, and stated that the creek exhibits only moderate integrity relative to its potential condition (USDA Forest Service 2008a), due to the presence of roads, recreation, development, and vegetation management. The cumulative impact of surrounding land uses have resulted in the Elkhorn Creek watershed being classified by the Forest Service as "At-risk, Class II" (USDA Forest Service 2008a). The only site at which the Arapahoe snowfly has been collected recently is Elkhorn Creek; the degraded condition and continuing threats to this stream place the survival of the snowfly at extreme risk.

i. Roads

Roads contribute substantially to sedimentation in aquatic systems; the increase in impervious surface area contributes to large quantities of overland flow, and both traffic and road maintenance activities generate large amounts of sediment (Anderson 1996, Forman & Alexander 1998, Jones *et al*. 2000, Trombulak & Frissell 2000, Gucinski *et al*. 2001, Ziegler *et al*. 2001, Grace 2002). 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*. 2000, Trombulak & Frissell 2000). Forest roads and smaller access roads often must receive periodic maintenance, including grading, which can increase the rate of erosion and deliver increased silt loads to streams (Gucinski *et a*l. 2001, Ziegler *et al*. 2001, Grace 2002). Road networks can also create a barrier to dispersal, especially for insects such as adult stoneflies, which are weak fliers and rely on an intact stream corridor for movement (Peterson *et al.* 1999, 2004; MacNeale *et al*. 2005).

The Forest Service classifies the Elkhorn Creek watershed as 'Class II - At Risk', largely as a result of erosion, sedimentation, and runoff. The Molly Moon EA cites roads crossing the creek as primary causes for the creek's deteriorated condition (USDA Forest Service 2008a). Major roads that cross the creek include Manhattan Road, Road 267, and Forest Road 68, along with a variety of other smaller roads and trails. The southern segment of Road 267 near the creek is steep and severely eroded in several places (USDA Forest Service 2008a), and is a major, ongoing source of sedimentation. The sedimentation of Elkhorn Creek caused by surrounding roads degrades water quality and increases turbidity in the sole location where the Arapahoe snowfly currently exists, and destroys habitat and refugia for the snowfly by filling in the interstitial spaces in the substrate (see photo documentation in Appendix B), jeopardizing the species' continued existence.

De-icing agents can cause increased mortality of aquatic organisms. Road salts are used as a de-icer throughout Colorado and on roads in the Elkhorn Creek drainage. Magnesium chloride ($MgCl_2$) is the primary component in the liquid de-icers used by the Colorado Department of Transportation (CDOT), which can also include additional chemicals such as dyes, corrosion inhibitors, and trace metals. Although there is little research on the impact of $MgCl_2$ on aquatic organisms, there is substantial evidence that other road salts such as NaCl negatively impact aquatic life (Hart *et al*. 1991, Forman & Alexander 1998, Kaushal *et al*. 2005, Karraker *et al*. 2008, Silver *et al*. 2009). Chloride-based deicers have the potential to increase the salinity of rivers, streams, and lakes. Increased salinity has been reported in groundwater at a distance of

more than 300 feet from roadways, and damage to vegetation from deicing salts has been reported at a distance of up to 100-650 feet (Center for Environmental Excellence 2009). A study conducted for the Colorado Department of Transportation showed that the aquatic invertebrate cladoceran *Ceriodaphnia* exhibited mortality and reduced reproductive capacity when the concentration of $MgCl_2$ deicer was approximately 0.1% (Lewis 1999); this concentration is considered to be close to the expected median concentration of deicer runoff from highways. Some studies have shown that magnesium-based deicing salts have higher invertebrate toxicity than sodium or calcium-based salts (Environment Canada 1999). Chloride-based deicers can increase the salinity of nearby streams, and may also contribute to mobilizing trace metals from the soil into groundwater and surface water (Fischel 2001). In addition, rust inhibitors included in deicer composition to offset the corrosive effects of the salts can cause stream eutrophication (Fischel 2001).

ii. Dewatering for Development

Numerous private parties hold water rights to both the surface and subjacent waters of Elkhorn Creek and the surrounding hydrological system (Red Feather Historical Society 2004). These withdrawals and diversions reduce the amount of creek flow available to the Arapahoe snowfly and impair key habitat factors such as temperature and dissolved oxygen levels. Groundwater extraction can also increase the influx of surface water contaminants into the hyporheic zone (Hancock 2002), which is exploited by snowfly nymphs as a refuge from increased summer temperatures (Stewart & Stark 2002).

A variety of regional developments and surface impoundments have reduced the flow of Elkhorn Creek below historic levels. The Elkhorn Creek drainage is a significant water source for development around Glacier View Meadows, Crystal Lakes, and Red Feathers. Several ditches divert flow from the creek for agricultural and domestic purposes at different reaches. Subterranean extractions also provide a significant water source for surrounding development (Red Feather Historical Society 2004). On the creek's lower reaches, closer to the Arapahoe snowfly's holotype locality, a diversion dewaters the stream channel completely during low flow periods for approximately a 200-yard stretch, at which point a failure in the ditch allows water to return to the creek (USDA Forest Service 2008a). While many of the water rights held on the creek are historic and well-established, new developments are periodically proposed with Elkhorn Creek as a primary water source, creating the possibility of additional future water withdrawals that will impair the stream even further.

Historically, Currie Ranch held title to several thousand acres bordering National Forest Land, and several thousand additional acres of grazing rights on the upper reaches of Elkhorn Creek. Over the course of the 20th century, the original ranch was subdivided for residential housing. In the late 1970's, the Colorado Water Court granted a water decree of underground water (Water Augmentation Plan) from the Cache la Poudre River in the Elkhorn and Gordon Creek drainages through the Mountain and Plains Irrigation Company, a landmark decision for developers in Larimer County (Red Feather Historical Society 2004). This initial allocation and consequent development resulting from the allocation continue to reduce surface and subterranean water flow in the Elkhorn system, imperiling the Arapahoe snowfly and its habitat.

iii. Septic Systems

Most developed sites throughout the Red Feathers area and the Elkhorn Drainage, particularly private, residential and commercial development, rely on individual sewage disposal systems (George Weber Inc. Environmental 2007). These septic systems pose a significant risk to the water quality of Elkhorn Creek, through the potential introduction of excess nutrients and bacteria. The septic disposal system for the Shambhala Mountain Center exemplifies the threats posed to the snowfly by human waste disposal in the Elkhorn Drainage.

The Shambhala Mountain Center's wastewater treatment facility is located on property in the Red Feathers Lakes area owned by the Shambhala Mountain Center, LLC. All human waste and sewer water from this popular destination center drains into Elkhorn Creek via leach fields. Waste flows from the Shambhala Mountain Center to Elkhorn Creek at a rate of between 35,000 and 100,000 gallons per day. The Center's actual waste has exceeded the capacity of their treatment plant, and it was placed under a Compliance Advisory by the Colorado Department of Public Health and Environment (Wright Water Engineers Inc. 2009).

The Arapahoe snowfly is particularly vulnerable to threats posed by septic drainage into Elkhorn Creek because of its dependence on clean, clear, well oxygenated water, and the use of the hyporheic zone by nymphs as a refuge from summer high temperatures (Stewart & Stark 2002). Discharge of septic material into waterbodies results in nutrient loading and eutrophication (Peterson *et al.* 2003). Macroinvertebrates that spend portions of their life cycle in the hyporheic zone can be especially vulnerable to the impacts of septic disposal in waterways, as effluents and coliform bacteria can concentrate in that zone (Hancock 2002). Septic infiltration from the Shambhala Center and other residential developments may significantly impair water quality in Elkhorn Creek and further endanger the Arapahoe snowfly.

5. Barriers to dispersal

Adult *Capnia* are weak fliers with limited airborne dispersal ranges, and rely primarily on water course connections for nymphs to colonize new habitats (Hynes 1976, Stewart & Stark 2002). The fact that the Arapahoe snowfly is a species restricted to small streams will limit dispersal via the mainstem of the Cache la Poudre River. Historic variability of conditions on the Cache La Poudre River and its historic depth, flow and substrate composition provided for a high diversity of species, habitats, and food chain interactions in the watershed (City of Fort Collins 2008). Current conditions on the Poudre River have been radically altered. While flow levels still rise each year in the late spring, the magnitude has fallen significantly as a result of dam releases and water withdrawal for agricultural irrigation and municipal uses (City of Fort Collins 2003, 2008).

Habitat conditions in the Cache La Poudre River are impaired; the river exhibits increased growth of filamentous algae (which is often associated with excess nutrient and chemical inputs), poor habitat quality, rapid changes in water levels due to river management and water withdrawals, and reduced water quality due to urban and agricultural inputs. A Poudre Technical Advisory Group concluded that the current impaired flow regime has decreased the number of aquatic insects in the Poudre by up to 75% in more urban areas (City of Fort Collins 2008). Impaired habitat conditions on the mainstem may limit the capacity of the snowfly to use the Poudre as a vehicle to colonize other apparently suitable tributaries flowing to the Poudre (B.

Heinold pers. comm., Jan. 2010). The Arapahoe snowfly may thus be entirely confined to a single creek that is becoming increasingly impaired.

B. Overutilization for Commercial Purposes
The Arapahoe snowfly is not used commercially and is not at risk of over-collection.

C. Disease or Predation
Neither disease nor predation is known to threaten the Arapahoe snowfly at this time. However, little is known about the life history and ecology of the species, and threats from disease or predation have never been assessed. As discussed below, the rarity of the species and its confined range makes the Arapahoe snowfly more vulnerable to extinction as a result of normal population fluctuations resulting from predation or disease.

D. The Inadequacy of Existing Regulatory Mechanisms
The Arapahoe snowfly receives no recognition or protection under federal or state law. The Arapahoe snowfly is recognized as Critically Imperiled by Colorado's Natural Heritage Program, but this designation does not provide any protection for the Arapahoe snowfly or its habitat. The Arapahoe snowfly is not listed as a Forest Service Sensitive Species, so it is not taken into consideration in the development of rangeland allotment management plans or in the assessment of the environmental impacts of management actions. The Elkhorn Creek watershed is considered by the Forest Service to be Class II 'at-risk' (USDA Forest Service 2008a), although this classification has not provided any meaningful protection or recovery for the Arapahoe snowfly. The Arapahoe snowfly and its habitat in Elkhorn Creek and Young Gulch are mentioned in a Level 4 Potential Conservation Area report by Colorado Natural Heritage Program (Colorado State University 2009), although this Potential Conservation Area does not provide for any actual conservation measures for the Arapahoe snowfly or its habitat (J. Sovell pers. comm., Feb. 2010).

Sections of both Young Gulch and Elkhorn Creek fall within a 2003 Critical Habitat Designation for Preble's Jumping Mouse (*Zapus hudsonius preblei*) (N. Rosmarino pers. comm., Dec. 2009). However, this designation recognizes only the stream banks as critical habitat for the mouse and does not affect any upstream activities, including grazing or diversions affecting the creeks' flows (US Fish & Wildlife Service 2003). Further, site investigations have revealed that neither the Young Gulch nor the Elkhorn Creek portions of the critical habitat receive any physical protection from recreation. There is no signage in the habitat areas to indicate the presence of the mouse or sensitive species of any kind to hikers in the area (N. Rosemarino pers. comm., Dec. 2009; R. Moore pers. comm., Jan. 2010). As a result of the above listed factors, the Arapahoe snowfly derives no protection from the critical habitat designation of Preble's jumping mouse.

E. Other natural or manmade factors affecting its continued existence
1. <u>Small population size and stochastic events</u>
Small and fragmented populations are generally at greater risk of extinction from normal population fluctuations due to predation, disease, and changing food supply, as well as from natural disasters such as floods or droughts (*reviewed in* Shaffer, 1981). Small populations are also threatened with extinction from a loss of genetic variability and reduced fitness due to the

unavoidable inbreeding that occurs in such small populations (*reviewed in* Shaffer, 1981). The Arapahoe snowfly is known from only two locations that are separated by a distance of five miles. Adult stoneflies are weak fliers and usually unable to disperse more than a few hundred yards from where they emerged (Macneale *et al.* 2005, Stewart & Stark 2002). Even if the population at Young Gulch is still extant, genetic mixing between the Elkhorn Creek and Young Gulch populations is unlikely.

2. Global Climate Change

Global climate change could threaten the Arapahoe snowfly's survival. Assessment of climate change trends in North America has already revealed changes in precipitation patterns, stream hydrology, and plant bloom time. Overall, annual mean air temperature increased in North America from 1955-2005, and total annual flow has decreased in many streams in the central Rocky Mountain region throughout the past century at an average rate of 0.2% per year (Rood *et al.* 2005). The effects of global climate change are projected to include warming in the western mountains, causing snowpack and ice to melt earlier in the season (Field *et al.* 2007), which will have a serious impact on mountain stream hydrology.

It has been calculated that up to 60% of the climate-related trends of river flow, winter air temperature and snow pack from 1950 to 1999 are human-induced, and threaten an approaching crisis in water supply for the western United States (Barnett *et al.* 2008). Climatologists have agreed that growing aridity in the West will be most severe in the Rocky Mountain West (Saunders *et al.* 2008). These changing conditions may lead to increased flooding early in the spring and drier summer conditions, particularly in arid western areas where snowmelt sustains 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, Saunders *et al*. 2008). Floods and droughts are projected to increase in frequency and intensity; erosion is also projected to increase due to decreased soil stability from higher temperatures and reduced soil moisture, and increases in winds and high intensity storms. Because the Arapahoe snowfly requires cool temperatures for development, its survival is likely to be severely threatened by climate change induced habitat impairments.

Finally, recent warming trends have led to proliferation of mountain pine beetles in the West (Intergovernmental Panel on Climate Change 2007), including in the Poudre Canyon region of the Roosevelt National Forest. Because they kill their host trees to reproduce, mountain pine beetles have significant ecological impacts on terrestrial systems. Drought and forest stress have generated a mountain pine outbreak of epidemic proportions (Black *et al.* 2010), with a total of up to 1.5 million acres of infestation since the first indication of an outbreak in 1996. The infestation does not itself pose a direct threat to the Arapahoe snowfly or its habitat, but management actions undertaken by the Forest Service in response to the infestation such as logging, controlled burns, and the application of pesticides, can all negatively impact the Arapahoe snowfly.

IX. CRITICAL HABITAT

Petitioners request the designation of critical habitat for the Arapahoe snowfly concurrent with its listing. Critical habitat should include areas of Elkhorn Creek and Young Gulch where this species recently and/or historically occurred.

X. CONCLUSION

For the above reasons, the Arapahoe snowfly meets three criteria under the Endangered Species Act for consideration as an endangered species: 16 U.S.C. § 1533 (a)(1)(A,D,E) (Section 4) including: (A) The present or threatened destruction, modification, or curtailment of its habitat or range; (D) The inadequacy of existing regulatory mechanisms and (E) Other natural or manmade factors affecting its continued existence.

Due to the multiple different threats faced by the species, its small population size, restricted distribution, and isolation, and the imminent likelihood that it will be driven to extinction, the Xerces Society for Invertebrate Conservation, Dr. Boris Kondratieff, Save The Poudre: Poudre Waterkeeper, Cache la Poudre River Foundation, WildEarth Guardians, and Center for Native Ecosystems formally petition the U.S. Fish and Wildlife Service to list the Arapahoe snowfly (*Capnia arapahoe*) as an endangered species under the U.S. Endangered Species Act. Because the Arapahoe snowfly has an extremely limited geographic range, is experiencing deteriorating ecological conditions within its habitat and is vulnerable to extinction from a single catastrophic event, we also appeal for emergency listing. While the species is emergency listed, the U.S. Fish and Wildlife Service should finalize a standard listing rule for the Arapahoe snowfly. Furthermore, we request the Service use its authority to establish Critical Habitat based on the facts presented to prevent the extinction of this rare and vulnerable snowfly.

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XII. PERSONAL COMMUNICATION

Canyon Lakes Ranger District
City of Fort Collins Utility Department
Dr. Mark Easter, Colorado State University
Brian Heinold, Colorado State University, Fort Collins
Dr. Boris Kondratieff, Colorado State University, Fort Collins
Rico Moore, Cache la Poudre River Foundation
Dr. Nicole Rosmarino, WildEarth Guardians
John Sovell, Zoologist/Invertebrate Zoologist, Colorado Natural Heritage Program

APPENDIX A. Locations of recorded populations of the Arapahoe snowfly (Nelson & Kondratieff, 1988, Heinold & Kondratieff, 2010).

Location	**Current Status**	**Date**	**# *C. arapahoe* observed**
Elkhorn Creek, near its confluence with the Poudre River 40.698, -105.44	Extant	April, 1987 March, 2009	1 11
Young Gulch, Near its confluence with the Poudre River 40.6892, 105.349	Possibly Extirpated	March, 1986	1

APPENDIX B. Current condition of *C. arapahoe* habitat at Elkhorn Creek and Young Gulch. Unless otherwise noted, all photographs were taken by Scott Hoffman Black, The Xerces Society, on July 28, 2009, around recorded collection localities for the Arapahoe snowfly and within 1-1.5 miles upstream.

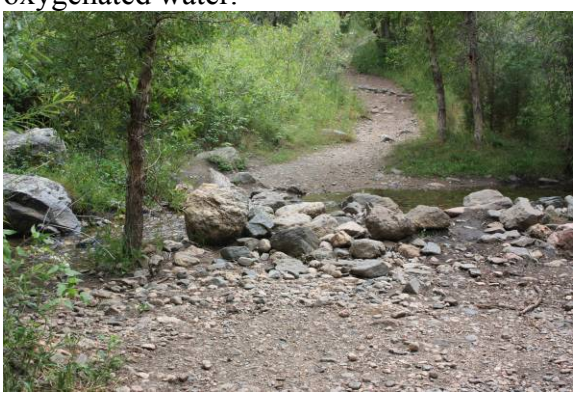
I. Young Gulch

a) Shallow small stream with cobble substrate, indicative of the type of habitat utilized by the Arapahoe snowfly.

b) Parking lot adjacent to stream (behind tree buffer at left). Bare ground with high erosive potential. Runoff can carry sediment and vehicle related contaminants into the stream. Contaminants and sedimentation are harmful to the Arapahoe snowfly.

c) Heavy siltation in stream is leading to increased sedimentation between the cobbles. Snowfly habitat is degraded when interstitial spaces are filled by sediment. Snowflies require clean, clear water for survival.

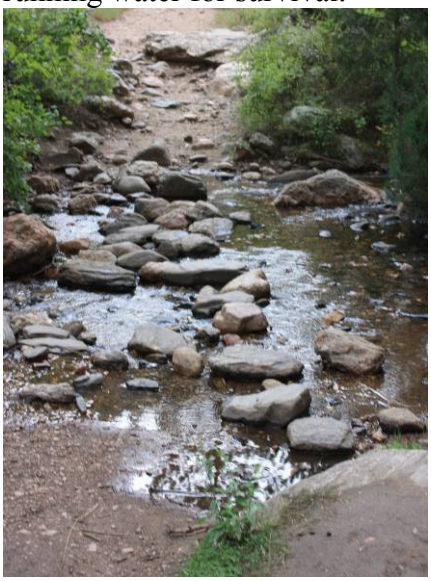
d) Bare trampled ground at stream crossing. Removal of streamside shading vegetation increases water temperature, reduces dissolved oxygen, and allows more sediment to enter the stream. Snowflies require cold, clean, well-oxygenated water.



e) Horse manure on trail by creek. Animal waste pollutes streams with bacteria and additional nutrients, degrading snowfly habitat.

f) The mountain bike tire ruts pictured below illustrate the heavy recreational use of Young Gulch. Bike tires disturb soil and increase sedimentation of the waterway.

g) The stream has widened in this area as a result of heavy mountain bike traffic. Changes in bank width and impediments to stream flow, such as the rocks pictured below, can alter stream hydrology and increase water temperatures. Snowflies require cold, clear, running water for survival.



h) A muddy, trampled, bare horse crossing is pictured below. Removal of streamside vegetation and heavy soil disturbance can increase siltation and water temperature, and can decrease dissolved oxygen levels. All of these factors impair snowfly habitat.

II. Elkhorn Creek

a) Shallow creek with gravel and cobble substrate, indicative of the type of habitat utilized by the Arapahoe snowfly.

b) Cowpie on the trail next to Elkhorn Creek. Cattle grazing removes streamside vegetation, wallowing in the water disturbs the substrate, and animal waste pollutes streams with bacteria and additional nutrients, all of which degrade snowfly habitat.

c) The large fire ring adjacent to Elkhorn Creek illustrates heavy recreational use. Campers may choose to use areas that are not designated for camping. Streamside activities, such as dishwashing, may degrade snowfly habitat.

d) Heavy siltation in stream is leading to increased sedimentation between the cobbles. Snowfly habitat is degraded when interstitial spaces are filled by sediment. Snowflies require clean, clear water for survival.

e) Elkhorn Creek has year round recreational use. The photo below shows evidence of wintertime streamcrossing by hikers. Photograph by Rico Moore.