SPECIES FACT SHEET

Common Name: Green Springs Mountain Farulan Caddisfly
Scientific Name: *Farula davisi* (Denning 1958)
Phylum: Mandibulata
Class: Insecta
Order: Trichoptera
Family: Uenoidae
Subfamily: Uenoinae

Conservation Status:
Global Status (2005): GH
Rounded Global Status: GH - Possibly Extinct
National Status (United States): NH
State Status (Oregon): SH (Possibly Extirpated: species occurred historically in the state and there is some possibility that it may be rediscovered, but some amount of effort to relocate occurrences has not been successful).
IUCN Red List Category: NE - Not evaluated
(NatureServe 2008)

Technical Description:

Adult: The description of this species is based on two males collected at one location (the type series and only known specimens). The adult head and thorax are testaceous, the appendages yellowish, and the wings uniformly ferruginous. Length of males: 5 mm (0.2 in.). Details concerning wing venation, palpi, and antennae are obscure, due to poor condition of specimens. The adult genitalia are as follows: Process (probably the tenth tergite) from lateral aspect sinuate, its apex slender and acute, from dorsal aspect the apex gradually curved laterad; lateral margin about midway bearing a prominent, acute, lateral structure with distal margin darkened and heavily sclerotized. Cercus, slender and elongate. Claspers, acuminate as seen from lateral aspect; from ventral aspect slender, elongate, connected at base by a narrow to an acute, slender point, mesal margin straight. Aedeagus, emarginate apically, gradually tapering toward base, trough-like (Denning 1958). Species identification is based on the following diagnostic characters of the genitalia: Inferior appendages with basal segment comprising only one elongate sclerotized process, the lateral spiniform process lacking with a slender but clavate second segment arising from the base of the first. External branch of segment ten approximately as long as inferior branch (Wiggins et. al. 1985).

Larva: The immature stages of this species are unknown, but larvae of the genus *Farula* make extremely slender portable cases, lack abdominal gills, and their sclerotized parts are mostly uniform dark brown or black (Wiggins 1996). The smoothly textured cases, so slender they could be mistaken for pine-

needles (Wiggins 1996), are constructed of small sand grains fitted closely together and covered externally and internally with a thin silken lining (Wiggins 1996, Merritt et al. 2008). Cases can be up to 14.5 mm (0.6 in.) in length. *Farula* is further distinguished from other genera in the Uenoidae family by the following characters: pronotum broadest anteriorly in dorsal aspect, mesonotal sclerites with anterior margin rounded and single median notch between two sclerites, pronotum with anterior margin and anterolateral corner curved, darkened posterolateral corner of each mesonotal sclerite not reaching the mid-lateral point of sclerite, abdomen with filaments of lateral fringe scattered and arising over less than half of most segments, but with prominent and discrete tuft of filaments at anterior edge of segment II (Wiggins 1996).

Pupa: Cases in this genus are converted into pupal chambers by a silken sieve membrane spun across the inside posterior opening (Wiggins 1996).

Life History:
Most trichopterans in temperate latitudes are univoltine (Wiggins 1996), developing from the egg through five larval instars, pupating and emerging as adults within a single year. Larval diet of this species is unknown, but the larvae of other members of the genus are classed as collectors, scrapers, and gatherers, feeding on periphyton and organic particles on rocks (Wiggins 2004). Studies examining gut contents of *Farula* species revealed mostly fine organic particles with some filamentous algae and fine rock fragments. *Farula* larvae pupate in aggregations on the undersides of rocks and logs (Applegarth 1995, Wiggins 1996). Since the adult males were caught in a pear scylla trap in a tree, it is clear that they are capable of flight. Females are not known. The adult flight period is unclear, but the known specimens were collected in the fall. The flight periods of other Oregon *Farula* species range from April to June.

Range, Distribution, and Abundance:
Endemic to Oregon. Known only from a collection of two males in the fall of 1950 from Green Springs Mountain, Jackson Co., Oregon, 16 to 19.3 km (10 – 12 miles) east of Ashland (Anderson 1976, but note that the collection year provided in this reference (1960) is a misprint). Subsequent targeted searches at Green Springs Mountain by R. Wisseman in the 1990's did not yield specimens, nor was very suitable habitat found. *Farula* species generally require cold-water, yet all of the encountered streams heated up substantially in the summer, and many were seasonal or intermittent (Wisseman 2008, *pers. comm.*).

Federal Land: The only known documented occurrence is from the Medford District, BLM.

Habitat Associations:

The habitat requirements for this species are not accurately known. Adult males were collected from traps in a tree near a small stream across the road from a marshy area. The aquatic habitat could therefore be either marsh or stream, although most species of *Farula* species inhabit small, cold-water, forested streams or seeps of higher gradient. They are found most commonly on exposed bedrock with a thin stream of water passing over it (Wisseman 2008, *pers. comm.*).

Threats:
Most trichopteran species have highly specific preferences with regard to water temperature, velocity, dissolved-oxygen levels, and substrate characteristics, and are therefore sensitive to a wide array of habitat alterations. Increased sedimentation, eutrophication, and chemical pollution by grazing, development, and agriculture in the watershed could harm this species. The loss of trees through timber harvest poses additional threats, since this species occupies forested habitats, and trees provide shade that maintains appropriate water levels and temperatures for larval and pupal development.

Continued global climate change may further threaten the long-term survival of this cold-water species. Projected changes due to this factor include increased frequency and severity of seasonal droughts and flooding, reduced snowpack to feed river flow, increased siltation, and increased air and water temperatures (Field *et al.* 2007), all of which could impact this species and its habitat unfavorably. Recent surveys at the type locality found only unsuitable habitat for this species: all of the encountered streams heated up substantially in the summer, and many were seasonal or intermittent (Wisseman 2008, *pers. comm.*).

Conservation Considerations:
Inventory: Conduct further surveys at and around the type locality to help establish the current status of this rare species. Explore similar mountainous areas in the region for suitable habitat, and survey for this species.

Management: Protect all new sites and their associated watersheds from timber harvest and other practices that would adversely affect any aspect of this species' life cycle. Undisturbed buffers of coniferous forest around stream habitat may be critical for the survival of species within the *Farula* genus (Applegarth 1995). Riparian habitat protection, including maintenance of water quality, substrate conditions, and canopy cover, would likely benefit and help maintain this species.

Version 2:
Prepared by: Sarah Foltz
Xerces Society for Invertebrate Conservation
Date: December 2008

Edited by: Celeste Mazzacano, Sarina Jepsen
Xerces Society for Invertebrate Conservation
Date: December 2008

Version 1:
Prepared by: Eric Scheuering
Date: December 2005

ATTACHMENTS:

(1) References
(2) List of pertinent or knowledgeable contacts
(3) Trichoptera Survey Protocol, including specifics for this species

ATTACHMENT 1: References:

Anderson, N.H. 1976. The distribution and biology of the Oregon Trichoptera. Oregon Agricultural Experiment Station Technical Bulletin, 134:1-152.

Applegarth, J.S. 1995. Invertebrates of special status or special concern in the Eugene district. U.S. Department of the Interior, Bureau of Land Management. Eugene, OR. 126 pp.

Denning, D.G. 1958. The genus *Farula* (Trichoptera: Limnephilidae). Annals of the Entomological Society of America 51: 531-535.

Field, C.B., Mortsch, L.D., Brklacich, M., Forbes, D.L., Kovacs, P., Patz, J.A., Running, S.W. and M.J. Scott. 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.

Merritt, R.W., Cummins, K.W., and M.B. Berg. 2008. An introduction to the aquatic insects of North America. Fourth Edition. Kendall/Hunt Publishing Co., Dubuque, Iowa. 1158pp.

NatureServe. 2008. "*Farula davisi*." *NatureServe Explorer: An online encyclopedia of life [web application]*. Feb. 2008. Version 7.0. NatureServe, Arlington, Virginia. 21 Oct. 2008 <http://www.natureserve.org/explorer/>

Wiggins, G.B., J.S. Weaver III, and J.D. Unzicker. 1985. Revision of the caddisfly family Uenoidae (Trichoptera). Canadian Entomologist 117: 763-800.

Wiggens, G.B. 1996. Larvae of the North American Caddisfly Genera (Trichoptera). Second Edition. Toronto and Buffalo: University of Toronto Press, 457pp.

Wisseman, Robert W. 2008. Personal communication with Sarah Foltz.

ATTACHMENT 2: List of pertinent, knowledgeable contacts:

Robert Wisseman, Aquatic Biology Associates, Inc. Corvallis, OR.

ATTACHMENT 3: Trichoptera Survey Protocol, including specifics for this species:

Survey Protocol

Taxonomic group:
Trichoptera

Species:
Agapetus denningi
Farula constricta
Farula davisi
Namamyia plutonis
Rhyacophila colonus

Where:
Trichopterans utilize a diversity of fresh water aquatic habitats, including headwater springs, streams, rivers, lakes, marshes, seepage areas, ponds, hot springs, and temporary pools. Most species have highly specific preferences with regard to water temperature, velocity, dissolved-oxygen levels, and substrate characteristics. Since the case-making larvae generally specialize in certain types of building material, the size and composition of available organic and inorganic materials can largely limit species' distributions. Construction materials include sand, pebbles, small rocks, mollusk shells, algae, duck-weed, plant stems, pine-needles, bark, grasses, and dead leaves. Some species are more selective than others and a few even exhibit life-stage-specific specialization, changing the case material and design partway through their aquatic life. Additionally, trichopteran larvae are often highly specialized in their dietary preferences and in the manner and location in which food is obtained. For species-specific construction material, feeding behavior, and habitat information, see the section at the end of this protocol.

When:
Adults are surveyed in the spring, summer, and fall, within the window of the species' documented flight period. In temperate climates, adults of various species can be collected from ice-break until the first days of heavy frost (Canton and Ward 1980). Larvae and pupae are most conveniently surveyed at the same time as adults.

Adults:
Adult trichopterans are predominantly encountered in the vicinity of water, close to their emergence or oviposition site. Dispersal from the emergence site appears to be negatively correlated with vegetation density along the dispersal corridor; adults disperse farther (up to around 200 m (656 ft.) in sparsely vegetated areas (Collier and Smith 1998). In general, searches will be most productive within 30 m (98 ft.) of the water edge (Collier and Smith 2004).

Adults are frequently collected from riparian vegetation with an aerial sweep net; they can also be hand-picked from the undersides of bridges and culverts, and from the sides and upper-surfaces of partly-submerged logs. Additionally, adults can often be collected in large numbers in soapy-water pan traps placed under a light (e.g. a vehicle headlight) and left overnight. Specimens can also be collected at night directly from lights or an illuminated sheet using an aspirator or finger dipped in alcohol. An aspirator is especially useful for capturing small species. Some species (such as members of the *Rhyacophila*) are attracted to ultraviolet light. Emergence traps placed over habitat where the larvae are known or suspected to occur are another good method for obtaining adults (Wisseman 2005, *pers. comm.*). For emergence trap designs and sampling information, see Davies (1984). Additionally, sticky traps constructed from 5-gallon buckets lined with non-drying glue are effective at capturing adults of some species (Applegarth 1995).

Adults should be killed and preserved in 80% alcohol, or killed in cyanide and transferred to alcohol. Cyanide-killed adults may also be pinned, particularly to preserve color patterns, but pinning often damages critical aspects of the thorax and dried specimens are very difficult to identify to species (Triplehorn and Johnson 2005).

Since trichopteran identification often involves close investigation of adult male genitalia, photographs and sight records will not provide sufficient evidence of species occurrences. However, such observations may be valuable in directing further study to an area.

Larvae and pupae:

The aquatic larvae and pupae are found underwater, often creeping slowly along the substrate, or attached to rocks. In streams and springs, it is best to search for larvae and pupae on the undersurface of large rocks and in the smaller substrate underneath the rocks. Since some species pupate in clusters, it may be necessary to turn over many rocks before finding a cluster. Grazing larvae frequently occur in mosses and liverworts growing on the tops of rocks, and in the thin layers of water running over rocks. In seepage areas at the head of springs, particular attention should be given to washing and searching samples of water-saturated organic muck (Wiggins 1996). In the heavily vegetated areas of lake shores, ponds, and marshes, larvae can be found in the substrate and crawling on aquatic plants. In deeper parts of lakes, larvae occur in surface mat plants, such as *Ceratophyllum*, and in soft bottom materials (Wiggins 1996).

When surveying for larvae, care must be used to avoid disrupting stream banks, shorelines, vegetation, and habitat. Depending on the habitat, a variety of nets can be useful. D-frame nets with mesh size fine enough to retain small larvae (0.5 mm, 0.02 in.) are the most versatile, as they can be used in both

lotic and lentic habitats. In stream systems, the standard kick-net technique can be applied. The net is held vertically with the opening facing upstream and the flat side pressed tightly against the bottom substrate, so that water flows neither under nor over the net. Large rocks and wood immediately upstream of the net are gently scrubbed by hand or with a soft brush and the bottom substrate is disturbed with the hands, feet, or a stick while the current carries the uncovered and dislodged insects and material into the net. The stream bottom is disturbed to a depth of 4 – 6 cm (1.2 – 2 in.) for about three minutes, following which the net is removed from the water for specimen retrieval. When lifting the net, the bottom of the frame is swept forward in a scooping motion to prevent insects from escaping. Net contents are then flipped or rinsed into shallow white trays to search for larvae more easily, as they are often quite cryptic and can be difficult to see if they are not moving. In addition to nets and shallow trays, the following equipment is also useful: fine-mesh strainers/sieves for washing mud and silt from samples, squirt bottles for rinsing the net, five-gallon buckets for holding rinsing water, and white ice-cube trays, forceps, and a hand lens for sorting insects.

Larvae and pupae should be preserved on-site in 80% alcohol, unless collection for rearing is an objective. Since most trichopteran species have not been described in their larval stage, rearing can be critical in both (1) enabling species identification and (2) providing novel associations of larvae with adults. Wiggins (1996, pages 37-38) provides a summary of the accepted methods for immature-adult associations in caddisflies. Generally, in order to maximize the amount of information that can be gained from collected specimens, as many life stages as possible should be collected and a portion of both the larval and pupal series reared to adulthood. While pupae can be reared in small, refrigerated containers containing damp moss, larvae require an aerated aquarium with isolated cages for individuals. An oxygen bubbler generally provides sufficient oxygen and current, although some species (e.g. members of the Hydropsychidae) may require unidirectional current. Detailed techniques for rearing stream-dwelling organisms in the laboratory, including transportation, aeration, current production, temperature control, food, and toxic substances, are provided by Craig (1966), and available online at http://www.nzetc.org/tm/scholarly/tei-Bio14Tuat02-t1-body-d1.html (last accessed 19 November 2008).

Although quantitative collecting of trichopterans is difficult, population-size data is important in evaluating a species' stability at a given locality and in assessing its conservation needs. Relative abundances of immature trichopterans can be estimated by using a uniform collecting effort over a given sample period at comparable habitats (Wiggins 1996). The area or volume of substrate samples can also be standardized, although the aggregated spatial distributions of many species (e.g. Schmera 2004) can complicate this approach.

While researchers are visiting sites and collecting specimens, detailed habitat data should also be acquired, including substrate type(s), water temperature, water source, water velocity, water depth, stream width, canopy cover, streamside vegetation density, and degree of human impact. Algal or cyanobacterial blooms and other signs of eutrophication should be watched for and noted.

Species-specific Survey Details:
Farula davisi

This species is known from a single collection in 1950 at the type locality (Green Springs Mountain, Jackson Co., Oregon). Subsequent targeted searches at Green Springs Mountain by R. Wisseman in the 1990's did not yield specimens, nor was very suitable habitat found. While *Farula* species generally require cold water, all of the encountered streams heated up substantially in the summer, and many were seasonal or intermittent (Wisseman 2008, *pers. comm.*). Further surveys at and around the type locality are needed to help establish the current status of this rare species. Similar mountainous areas in the region should also be explored for suitable habitat, and surveyed for this species.

Initial surveys for this species should be conducted in spring at small, cold streams in the vicinity of the type locality. The collection date of the type series was in the fall, but larvae, pupae, and adults of *Farula constricta* have been collected March through May (Wisseman 2008, *pers. comm.*), and the flight periods of other Oregon *Farula* species range from April to June. Sweep-netting of streamside vegetation and handpicking of adults from streams where *Farula* larvae are found are the most direct survey procedures for this species (Wisseman 2005 *pers. comm.*). Adults do not appear to respond to ultraviolet light. If adults are not found, pupae can be collected and reared to adulthood, or emergence traps can be placed over known larval habitats to obtain adults (Wisseman 2005 *pers. comm.*). Pupae in this genus are found attached to the undersides of rocks and logs (Applegarth 1995).

Adults of this species have yellow-brown heads and thoraxes, yellowish appendages, and uniformly rusty-colored wings. Males are 5 mm (0.2 in.) in

length. The smoothly textured larval cases are constructed of small sand grains fitted closely together, and are so slender they could be mistaken for pine-needles. Since the immature stages of this species are undescribed, species identification of collected larvae or pupae will require rearing to adulthood. Males, in particular, are needed for positive species confirmation.

Prepared by: Sarah Foltz
Xerces Society for Invertebrate Conservation
Date: December 2008

Edited by: Celeste Mazzacano, Sarina Jepsen
Xerces Society for Invertebrate Conservation
Date: December 2008

References (survey protocol only):

Anderson, N.H. 1976. Distribution and Ecology of Oregon Trichoptera. Technical Bulletin #134. Agricultural Experiment Station, Oregon State University, Corvallis, Oregon, 152 pp.

Applegarth, J. S. 1995. Invertebrates of special status or special concern in the Eugene district. U.S. Department of the Interior, Bureau of Land Management. Eugene, OR. 126 pp.

Borgias, D. and Wisseman R.W. 1999. Report on the 1998 and 1999 survey for *Rhyacophila colonus*, in forested torrents near O'Brien, Oregon. The Nature Conservancy of Oregon. Prepared for Diane Perez, Siskiyou National Forest.

Burdick, Donald J. 1999. Trichoptera of California. Listing of records in the Donald G. Denning collection of Trichoptera at the California Academy of Sciences, San Francisco, California. Posted at a web site in 1999. Department of Biology, California State University, Fresno, California. *Reference obtained via pers. comm. with R. Wisseman, 2008.*

Canton, S.P. and J.V. Ward. 1980. The aquatic insects, with emphasis on Trichoptera, of a Colorado stream affected by coal mine drainage. Southwestern Naturalist 25: 453-460.

Collier, K.J. and B.J. Smith. 1998. Dispersal of adult caddisflies (Trichoptera) in forests alongside three New Zealand streams. Hydrobiologia 361: 53–65.

Collier, K., Shankar, U., and P. Smith. 2004. Measuring stream network connectivity: how close is close enough? Water & Atmosphere 12(1): 14–15.

Craig, D.A. 1966. Techniques for rearing stream-dwelling organisms in the laboratory. Tuatara 14(2). Available online at http://www.nzetc.org/tm/scholarly/tei-Bio14Tuat02-t1-body-d1.html (last accessed 19 November 2008).

Schmera, D. 2004. Spatial Distribution and Coexistence Patterns of Caddisfly Larvae (Trichoptera) in a Hungarian Stream. International Review of Hydrobiology 89(1): 51-57.

Schmid, F. 1968. Quelques Trichopteres nearctiques nouveaux ou peu connus. Naturaliste Canadien 95 (3): 673-98.

Schmid, F. 1970. Le genre Rhyacophila et la famille Rhyacophilidae (Trichoptera). Memoirs of the Society of Entomology of Canada. 66:1-230.

Thut, R.N. 1969. Feeding habits of larvae of seven *Rhyacophila* (Trichoptera: Rhyacophilidae) species with notes on other life history features. Annals of the Entomological Society of America 62: 894–898.

Triplehorn, C. and N. Johnson. 2005. Introduction to the Study of Insects. Thomson Brooks/Cole, Belmont, CA. 864pp.

Wiggins, G.B. 1996. Larvae of the North American Caddisfly Genera. 2nd ed. University of Toronto Press, Toronto. 457pp.

Wiggins, G.B. 2004. Caddisflies: the Underwater Architects. University of Toronto Press, Toronto. 292pp.

Wisseman, R. 2005. Personal communication with Eric Scheuering.

Wisseman, R. 2008. Personal communication with Sarah Foltz.