SPECIES FACT SHEET

Scientific Name: *Lepidostoma (Nosopus) astanea* Denning, 1954
Common Name: Goeden's lepidostoman caddisfly; astaneous lepidostoman caddisfly
Phylum: Mandibulata
Class: Insecta
Order: Trichoptera

Conservation Status:

Global Status: G2 - Imperiled (last reviewed 14 Jun 2005)
National Status: United States – N2, Imperiled (last reviewed 08 Mar 2005)
State Status (Oregon): S2?, Imperiled/Uncertain
(NatureServe 2015)
IUCN Red List Category: NE – Not evaluated

Taxonomic note:

Lepidostoma astanea was originally described by Denning (1954) and it is the currently accepted taxonomic name for this species (Weaver 2002; NatureServe 2015; Morse 2016). *Lepidostoma astanea* can be found in the literature under two synonyms, *L. astaneum* (Weaver 1988; ORBIC 2013; ITIS 2016) and *L. goedeni* Denning, 1971. Morse (2016, pers. comm.) suggests "*L. astaneum* is considered the species epithet to be an adjective, with varying gender, despite lack of evidence that it is an adjective". The Trichoptera World Checklist recognizes *L. goedeni* Denning, 1971 as a synonym to *Lepidostoma astanea* Denning, 1954 (Morse 2016). Additionally, ITIS (2016) suggests *L. goedeni* is invalid as it is a junior synonym to *Lepidostoma astanea*.

Technical Description:

Lepidostoma astanea is a member of the Lepidostomatidae family, sometimes referred to as "bizarre caddisflies" (NPS 2003; BugGuide 2016) a diverse group of case-makers that utilize various materials to construct their cases (Wiggins 2004; Merritt et al. 2008). The genus *Lepidostoma* is derived from the Greek words '*Lepidos'* (meaning scale) and '*stoma'* (meaning mouth), in reference to specialized scales on the head and mouthparts of males in this genus (Wiggins 2004). A microscope is required and consultation with a Trichoptera expert is recommended to identify *L. astanea*. Diagnostic characteristics are based on male genitalia (Denning 1954; Denning 1971; Weaver 1988). Caddisfly adults are generally small, grey to brown moth-like insects with two pairs of wings. Genitalia morphological characters are used to distinguish species in the order Trichoptera as other morphological characteristics such as wing pattern may

be nondescript and variable. *Lepidostoma astanea* (i.e. *L. goedeni*) is known only from male specimens.

Adult: Adults in the family Lepidostomatidae lack ocelli (primitive eyes; Wiggins 2004) and ventral abdominal glands are not apparent (Merritt et al. 2008). Adult antennae in the family Lepidostomatidae are about 1.5 times longer than their forewing (Merritt et al. 2008). The maxillary palpi (sensory appendages) in lepidostomatid females have five sections (Wiggins 2004); whereas, in males the maxillary palpi and basal segments of the antennae may be enlarged and distorted (Wiggins 2004; Merritt et al. 2008). Small posterior setose (hair covered) warts are present on the head of lepidostomatid adults (Merritt et al. 2008); additionally, a pair of setose warts are present on the mesoscutum and a second pair on the mesoscutellum, which may be fused or separate (Wiggins 2004; Merritt et al. 2008). The family Lepidostomatidae is also described as having:

> Frequent bizarre specializations in males on the antennae, maxillary palps, and wings. These structures seem to be products of sexual selection, perhaps in part associated with the dissemination of pheromones (Wiggins 2004).

Weaver (2002) described the genus *Lepidostoma* as having four large species groups or branches based on male forewings and genitalia. *Lepidostoma astanea* is described as being in the *L. podagrum* branch of this genus; the remaining three branches are *L. verndale, L. hirtum,* and *L. ferox*. Identifying features for adults in the *L. podagrum* branch, which contains *L. astanea,* are described as follows:

> Male forewing with Cu_2 atrophied and the configuration of anal and cubital veins is altered, being quite different from that of the female which retains the typical configuration. This type of forewing is exhibited by a majority of North American species previously placed in the subgenus *Nosopus* McLachlan (Weaver 2002).

Species specific characteristics are available for adult male *L. astanea* only. Males are 6-7 mm long (Denning 1954; Denning 1971). General color of wings and appendages are luteus (i.e. brown to yellow). Costal cell on the leading edge of the forewings is lined with long slender brown scales (Denning 1971). Anterior wing is 6.3 mm long (Weaver 1988). Maxillary palpi (sensory appendages) are one-segmented, short (0.6 mm long) and covered with flattened black scales (Denning 1971, Weaver 1988). This species' first antennal segment is long. It has large tibial spurs in 2-4-4 arrangement (Denning 1971).

The holotype male description includes the following account:

> The **tenth tergite** with its prominent dorsal spine and **elongated ventral lobe**. First antennal segment long and slender, otherwise not modified. Maxillary palpi apparently two segmented, directed dorsad to near margin of head, mesal surface bearing a dense brush of blackish scales and setae. About three-quarters of the costal cell of the front wing (Denning 1954).

The male genitalia was described again in 1971 with more detail under the synonym *L. goedeni* and includes the following description:

> **Tenth tergite**, lateral aspect, with ventral corner produced caudad as elongate, **narrow**, distally **truncate lobe**, and acute apex directed dorsad; distal margin of dorsal portion straight, several short spines present along dorsal margin. Tenth tergum, dorsal aspect, with short, mesal incision, resultant dorsal lobes short, spinous; apices of ventral lobe project caudad beyond remainder, apex truncate. Clasper, lateral aspect, with apex subacute, curved dorsad, basodorsal lobe short and digistate, lateral lobe slender and acute. **Clasper** from ventral aspect, with an inconspicuous, mesal lobe, short, **flattened**, lightly sclerotized, does not reach apex. Aedeagus short, arcuate, no ornamentation (Denning 1971).

<u>Larvae:</u> Larvae of this species are unknown; however, larvae can be keyed out to family. Different groups within the family Lepidostomatidae often select different materials and construct unique cases which can be recognizable at the family level (Wiggins 2004; Merritt et al. 2008). In North America, larvae in the family Lepidostomatidae are described as being intermediate in size (ranging up to about 12 mm in length) (Wiggins 2004). *Lepidostoma astanea* larvae may build cases entirely of sand grains, similar to closely related *L. recinum* larvae (Wisseman 2016, pers. comm.). Distinguishing larval characteristics include the close location of the antennae to the eye (Wiggins 2004; Merritt et al. 2008; BugGuide 2016), the absence of a median dorsal hump (i.e. retractile protuberance) from abdominal segment I (Wiggins 2004; Merritt et al. 2008), and the absence of abdominal chloride epithelia (patches on the abdomen that serve as ion uptake sites) (Wiggins 2004). Lepidostomatid larvae gills, spines, and head are described as follows:

> Gills, if present, are single filaments arranged only in dorsal and ventral series without lateral gills. A patch of comb shaped spines occurs at the distal end of the hind coxae. The head is usually evenly rounded in lepidostomatid larvae, although flattened dorsally in a very few species (Wiggins 2004).

Specifically, the final instar stage in the *Lepidostoma* genus is described as follows:

> Ventral apotome of head as long as, or longer than, median ecdysial line; case usually 4-sided , or quadrate pieces of leaves or bark, but pieces may be arranged irregularly, transversely, or spirally, or case may be of sand grains (Merritt et al. 2008).

Pupae: Pupae of this species are unknown; however, Merritt et al. (2008) described the pupae in the family Lepidostomatidae with the following description: "Anal processes angulate apically; head of pupa without prominent frontal projection."

Life History:

Adults: Most adult caddisflies are small, moth-like creatures that are usually active at night (Wiggins 2004). Species in the *Lepidostoma* genus are univoltine, one generation per year, and are found in lotic habitats (i.e. creeks, streams, rivers, and springs) (Merritt et al. 2008). Adult *L. astanea* have been collected between June and August (Denning 1971; Weaver 1988) and are likely found at mid-elevation sites (Applegarth 1995). Adult *L. astanea* (i.e. *L. nr. goedeni*) have been collected on vegetation in riparian areas next to streams (Parsons et al. 1991; Wisseman 2016, pers. comm.).

Larvae: Larvae of the species is unknown, however other species in the Lepidostomatidae family are primarily shredders, and this type of functional feeding group is dominant in upper forested watersheds where vegetative material is abundant providing energy and nutrients (Wiggins 2004). Case-making larvae, suborder Integripalpia, actively search for food and have longer legs than other groups (Wiggins 2004). The genus *Lepidostoma* are found in lotic habitats and are described as exhibiting climbing, sprawling, or clinging behavior (Merritt et al. 2008). The larvae of *L. astanea* may also be scavengers and be present all year (NatureServe 2015) since larvae in the Lepidostomatid family feed on detritus (Merritt et al. 2008; BugGuide 2016). *Lepidostoma* larvae are likely found in springs, ponds, small lakes, or cool streams (e.g. backwaters, pools or near shore) (Anderson 1976; Wiggins 2004). They can construct three types of cases (i.e. chimney-type, log-cabin type, and sand-grain type) made up of leaves, twigs, needles, or sand grains (Anderson 1976), the most common being the chimney-type, four-sided and made of leaves and bark (Wiggins 2004). It is likely that *L. astanea* larvae build cases entirely of sand grains, this association is probable due to the close relation and similarity to *L. recinum* larvae, as both are placed in the Astaneum Group (Wisseman 2016, pers. comm.). Immature *L. astanea* (i.e. *L. nr. goedeni*) have been associated with aquatic sites in streams adjacent to adult collection (Parsons et

al. 1991) and are obligate shredder – detritivores (e.g. chew coarse particulate organic matter) (Merritt et al. 2008).

Pupae: Species-specific information is currently unavailable for the pupal stage. However, we can infer from larvae of other species in the case-making group that prior to the final molt before the pupal stage the larva attaches its case to a firm substrate (e.g. rock or wood) and covers the anterior end. It then reduces the posterior opening with silk to reduce predation during pupation. Additionally, some lepidostomatid larvae congregate for pupation, perhaps to reduce predation or parasitism. After the larva has attached its case, metamorphosis takes about three weeks from pupa to adult (Wiggins 2004).

Range, Distribution, and Abundance:

This species has been given a global status of G2 (i.e. imperiled) due to the few number of specimens collected and a restricted range; however, it is suggested that low detection may be a result of limited sampling sites and efforts (NatureServe 2015).

Range: This species is known from Lincoln County, Oregon (Denning 1971; Anderson 1976; Weaver 1988) and Del Norte County, California (Denning 1956). In Oregon, it has been reported at three sites in Lincoln County including Beverly Beach (August 2, 1969), Flynn Creek (July 19-August 18, 1988), and Big Elk River (August 24, 1969) (Denning 1971; Anderson 1976; Weaver 1988). *Lepidostoma astanea* was collected in California and near the Oregon coast with UV-light traps.

Two potential records for *L. astanea* were considered outside of the known range. *Lepidostoma astanea*, under the epithet *L. astaneum*, was listed as one of two species of caddisflies inside the Oregon Caves (NPS 2003), however a more recent inventory suggests *Lepidostoma* sp. records in the Oregon Caves are *L. rambur* (Dinger 2015); other potential *Lepidostoma* species nearby may include *L. podagrum* or *L. rayneri* (Roth 2016, pers. comm.). *Lepidostoma astanea*, under the synonym *L. goedeni*, was listed as a species of concern that may occur in Hood River County (Hood River SWCD 2015) business plan, however no records of *Lepidostoma astanea,* or *L. goedeni*, have been confirmed (Kim 2016, pers. comm.).

Distribution: Known from the Siuslaw National Forest Flynn Creek Research Natural Area, Big Elk River, and Beverly Beach in Lincoln County. This species has been found in California and Oregon in Watershed Region 17 (Pacific Northwest region) in the following watersheds: Upper Willamette, Siletz-Yaquina, and Alsea. *Lepidostoma astanea* is rare and the distribution is poorly known (Applegarth 1995). It has been found as far north as Lincoln County and as far south as its type locality in Del Norte, California.

BLM/Forest Service Land: This species is recorded on the Siuslaw National Forest from a 1982 collection. However, the Forest currently considers the species "suspected" until additional surveys, including surveys to the historic location, are conducted. There is a reasonable possibility of occurrence on Bureau of Land Management land in the Salem District and Eugene District (now called the Northwest Oregon BLM District) due to the close proximity to known records of *L. astanea* (Applegarth 1995). The synonym *Lepidostoma nr. goedeni* is listed in the H. J. Andrew Experimental Forest Invertebrate List. The experimental forest is located in the Willamette National Forest and cooperatively administered by USFS Research, OSU, and Willamette National Forest. Trichoptera adults were collected from Lookout Creek during a UV-light study by R.W. Wisseman (OSU, Dept. of Entomology 1988) (Parsons et al. 1991); however, this collection (3 males; coordinates 44.21255N, -122.25475W; elevation 250 m) needs to be verified with type specimens and DNA barcoding to confirm the species identity (Wisseman 2016, pers. comm.). Until that work is completed, *L. astanea* is not considered to be documented on the Willamette National Forest; however, in the interim, the Forest considers the species "suspected".

Abundance: Abundance estimates are not available for *L. astanea*. *Lepidostoma astanea* is a rare species and distribution is not well known (Applegarth 1995), possibly due to collection difficulty (Parsons et al. 1991). One male was collected August 2nd 1969 at Beverly Beach and described as the synonym *L. goedeni* (Denning 1971). Additional collections were documented in 1982, however collection numbers were low with 2 males on July 19th, 1 male on August 6th, 3 males on August 18th, and 1 male on August 24th (Weaver 1988).

Habitat Associations:

Caddisflies are predominantly found in lotic (running) waters (Wiggins 2004; Merritt et al. 2008). The caddisfly *L. astanea* is associated with the coast range ecoregion (Christy and Titus 1997; ORBIC 2013). This species is known from only a few sites in the Alsea and Siletz-Yaquina watersheds (HUC8) in Oregon and one site in California. The three Oregon sites include a river, creek, and beach habitat near a creek. Christy and Titus (1997) aimed to link rare species with community information and grouped *L. astanea* (i.e. Goeden's lepidostoman caddisfly) in two community groups. The first grouping includes the perennial springs and uppermost stream reaches, saturated to semi permanently flooded coast range ecoregion and the second includes the rivers, streams, meadows, mires, ponds and lakes, and seasonally to semi permanently flooded coast range ecoregion (Christy and Titus 1997). In general, larvae in the lepidostomatid family live in springs, streams, and large slow-moving rivers (BugGuide 2016), as well as small and mid-size rocky streams and their margins (Applegarth 1995). *Lepidostoma astanea* has been collected

in an upper watershed at an elevation between 150-300 meters, near rivers with moderate to high gradient and a cobble-gravel substrate (Weaver 1988).

Threats:

Aquatic insects are generally sensitive to disturbances including altered hydrology which can change important microhabitats and can lead to sediment loading, chemical and thermal pollution which degrades water quality, and removal of organic input sources (i.e. coarse woody debris) (LaBonte et al. 2001). Specific threats to this species have not been identified. However, *L. astanea* is listed as a species of conservation concern in the Yaquina Basin where critical habitats (e.g. stream channels, tributaries, and estuaries) are under pressure from forestry, agriculture, and climate change, all of which can reduce water quality (Bauer 2011). Sedimentation from forestry and agricultural practices may be of particular concern and can result in habitat loss. *Lepidostoma* larvae are shredders – detritivores and they play an important ecological role in both intact and disturbed communities; these larvae consume and convert detritus into fine particulate organic matter for different guilds of insects (Whiles and Wallace 1995; Wiggins 2002; Merritt et al. 2008). Caddisflies are also important as a food source for fish, birds, bats, reptiles, amphibians and other invertebrates. Since this species is also associated with wetland habitats in Oregon's coastal ecoregions, it may be additionally at risk since those habitats have declined in both quality and quantity (Christy and Titus 1997).

National Forests are actively managed and management activities can often lead to stream degradation and altered hydrology. This could be a threat to the few occurrences of *L. astanea* in creeks and rivers on National Forest land. Potential threats from land management activities, such as logging, livestock trampling, and pesticide use, can result in water pollution and sedimentation. Many of these activities likely pose a threat to remaining habitat for this species.

Conservation Considerations:

<u>Research:</u> Since *L. astanea* is currently only known from adults and mature pupae, larvae could also be collected at known collection localities, described, and reared to adulthood to confirm the association of larvae and adults. Additional research should investigate this species' response to habitat altering disturbances. Climate change may disrupt this species' habitat by altering annual rainfall, water temperature, and seasonal channels. The larvae depend on heavy debris inputs to create microhabitats and could be negatively affected by logging if large overstory trees are removed from their habitat, altering the stream morphology. Additionally, logging and road construction may increase erosion and sedimentation and research is needed to determine if these

activities result in the loss of cobble-gravel substrate needed by this species. Further research is needed to: 1. compare collected specimens to type specimens, 2. document range in variability, and 3. further identify and classify these individuals with DNA barcoding (Wisseman 2016, pers. comm.).

Inventory: Detections for *L. astanea* have been very low, and surveys in Siuslaw National Forest are recommended to determine the current range of this species. Additional surveys in the Willamette National Forest are also recommended to identify new sites and to investigate this species' potential range. DNA barcoding is needed to determine if this species is limited to the coast range or if its range expands to the Cascades (Wisseman 2016, pers. comm.). Applegarth (1995) suggests that *L. astanea* is rare within Oregon, however it is documented north (i.e. Lincoln County; Denning 1971; Anderson 1976; Weaver 1988) and south (i.e. Del Norte, California; Denning 1954) of the Eugene District. *Lepidostoma astanea* is likely found in suitable habitats such as streams or stream margins in the Eugene District in the Coast Range and South Valley Resource Areas adjacent to Lincoln County (Applegarth 1995). Lincoln County is the only confirmed location of *L. astanea* in Oregon (Denning 1971; Weaver 1988).

Management: Management for this and other aquatic invertebrates should aim to protect and improve existing habitat conditions. Threats can be mediated by conserving and maintaining riparian areas and implementing suitable buffers from actively managed areas and pesticide applications, limiting road construction activities and taking out unused roads, implementing erosion and sedimentation prevention, and managing grazing in riparian areas (LaBonte et al. 2001). Adequate buffers would retain trees and shrubs along streambanks to provide food sources, regulate water temperatures, and reduce erosion. Managing for stream health and stability is imperative for sensitive aquatic invertebrates and beneficial for ecosystem health as stable streams maintain features (e.g. dimension, pattern, and profile) over time and are less likely to degrade. Retaining channel features such as pools, riffles, and banks provide habitat diversity, increase dissolved oxygen content, and cover. Natural resource managers should restore degraded streams to natural stream channel features to ensure stream health and protect remaining habitat.

Prepared by: Katie Hietala-Henschell and Emilie Blevins
Xerces Society for Invertebrate Conservation
Date: August 2016

Edited by: Sarina Jepsen
Xerces Society for Invertebrate Conservation
Date: August 2016

Final edits by: Rob Huff

Forest Service and BLM Interagency Special Status and Sensitive Species Program
Date: October 2016

Attachments:

[1] References
[2] List of pertinent or knowledgeable contacts
[3] Map of known records in Oregon
[4] Photographs and illustrations of this species
[5] Trichoptera Survey Protocol, including specifics for this species

Attachment 1: References

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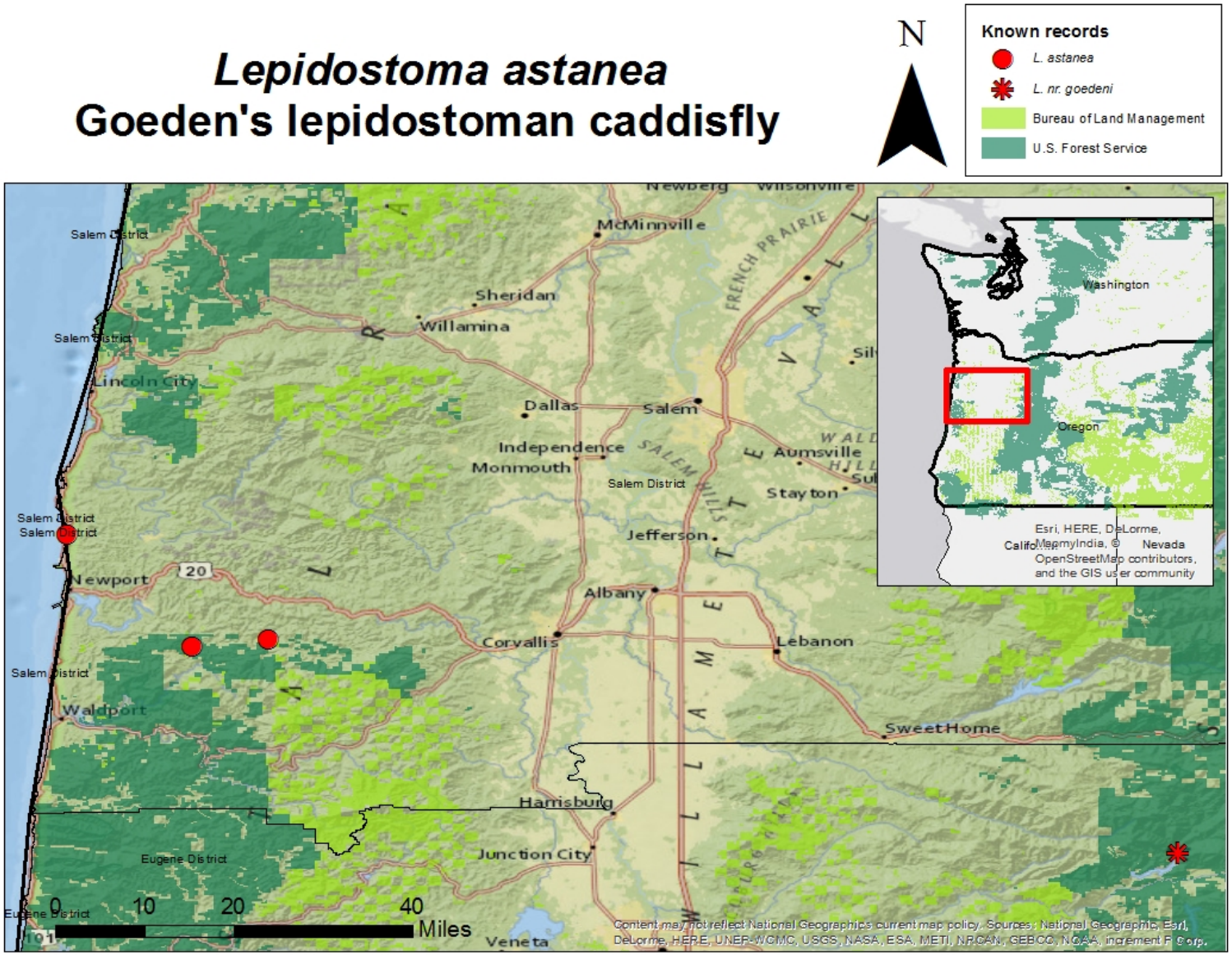
Attachment 2: List of pertinent, knowledgeable contacts

Robert Wisseman, Senior Scientist, Aquatic Biology Associates, Inc. Corvallis, OR 97330.

John Morse, Professor Emeritus of Entomology and Director Emeritus of the Clemson University Arthropod Collection, Clemson University Clemson, SC 29634.

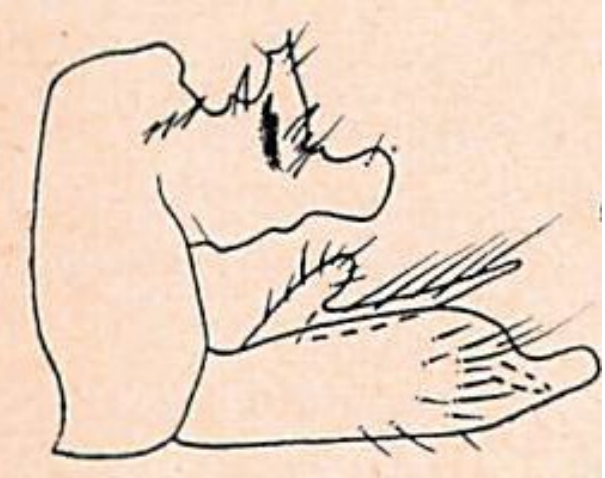
Attachment 3: Maps of *Lepidostoma astanea* distribution



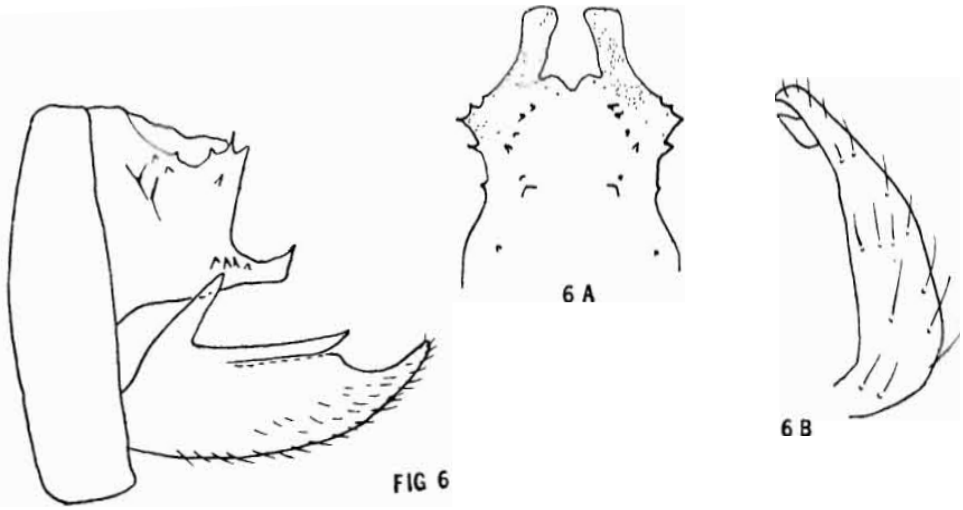
Known records of *L. astanea* (red circles) and suspected record under the synonym *L. nr. goedeni* (red asterisks) in Oregon, relative to BLM and Forest Service land.

Attachment 4: Photographs and illustrations of *Lepidostoma astanea*

Adult Lepidostomatidae sp. (dry) note that this specimen is closely related and is a suitable representation of *Lepidostoma astanea* as it is dark brown with fairly broad wings and simple antennae and palps. Used with permission from G. Williams 2016.



Lateral aspect of *Lepidostoma astanea* male genitalia (Denning 1954). Used with permission from *The Pan-Pacific Entomologist* 2016.



Lateral aspect of *Lepidostoma astanea* male genitalia, described under the synonym *L. goedeni,* 6A tenth tergum, dorsal aspect and 6B clasper, ventral aspect (Denning 1971). Used with permission from *The Pan-Pacific Entomologist* 2016.

Attachment 5: Trichoptera Survey Protocol

Survey Protocol:

Taxonomic group: Trichoptera

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, habitat information, and feeding behavior, see the section at the end of this protocol.

When:

Adults are surveyed year-round, 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). However, adults of some species may be found only in the winter or very early spring (Ruiter 2014, pers. comm.). Larvae and pupae are most conveniently surveyed at the same time as adults, although immature stages may not always be present during this time due to seasonal variation and each species' particular life cycle.

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 affnd 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 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 can be killed and preserved in 80% alcohol, or killed in cyanide and transferred to alcohol. However, preservation in 95% ethanol is preferred for future DNA analysis (Wisseman 2014, pers. comm.). 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 stable rocks and sticks/logs. 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 DNA analysis or rearing is an objective. Specimens collected for DNA analysis should be preserved in 95% ethanol. 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 12 September 2014).

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:

Species: *Lepidostoma astanea* Denning, 1954

Where: Surveys for this species are recommended to determine the current distribution. Applegarth (1995) indicates that *L. astanea* is scarce within Oregon. This species has been found north (i.e. Lincoln County, Salem District, Oregon) and south (i.e. Del Norte, California) of the Eugene District, Oregon. This species possibly occurs in streams or stream margins in the Eugene District Coast Range Resource Area and South Valley Resource Area (Applegarth 1995). Surveys in Siuslaw National Forest and the Willamette National Forest are recommended to determine the current range of *L. astanea.* This species has been found in streams located in maritime climates, with about 250 cm annual rainfall and dry summers, at elevations between 150-300 meters. Microhabitat requirements include streams with monthly water temperatures ranging between 7.5-12.5°C and generous detrital inputs from surrounding riparian areas. Riparian areas of interest consist of mature second growth *Pseudotsuga menziesii*, Douglas fir forest with *Alnus rubra* (red alder) and *Acer macrophyllum* (big leaf maple) as overstory components and dense *Rubus spectabilis* (salmonberry) in the understory. Dense vegetation provides

detrital inputs such as large woody debris which facilitate stream health, erosion control, and microhabitats for *L. astanea*. The upper watersheds where this species has been found were described as a dense network of seasonal channels and 1st order tributaries with a moderate to high gradient and bed materials of bedrock, cobble, and gravel substrates; whereas, the lower watersheds were described as having a low to moderate gradient and bed materials of sand or gravel substrates.

Additional surveys in appropriate habitat on the Siuslaw National Forest, Central Coast Ranger District-ODNRA and on Bureau of Land Management public land located in Lincoln and Lane County are recommended. Subsequent survey efforts should focus first on H. J. Andrews Forest in the western Cascade Range in the Willamette National Forest as it has appropriate habitat, coasts, large tracts of undisturbed forests and a variety of stream community types; over 3400 arthropods have been represented and *L. near (?) goedeni* was collected less than two decades ago (Parsons et al. 1991).

When: Previous collections of *L. astanea* in Northwestern California and Western Oregon suggest that surveys should occur from June through August (Weaver 1988). In Oregon specifically, surveys should align with previous Oregon specific *L. astanea* collections and therefore should occur from mid-July through August (Weaver 1988).

How: Adult *L. astanea* are dark brown with broad wings (Wisseman 2016, pers. comm.) and have simple antennae and palps (Ruiter 2016, pers. comm.). Adults will be found in riparian areas along streams and appear to be attracted to UV-light traps in appropriate habitats. Since species level identification is based on adult male genitalia, adults should be collected and stored for identification under a microscope. Immature individuals can be collected and reared to adulthood for identification. *Lepidostoma astanea* larvae may build cases entirely of sand grains similar to closely related *L. recinum* larvae (Wisseman 2016, pers. comm.). Basic research of the habitat, range, life history, and abundance of this species is needed.

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