SPECIES FACT SHEET

Scientific Name: *Leucorrhinia borealis* (Hagen 1890)
Common Name: Boreal Whiteface
Phylum: Arthropoda
Class: Insecta
Order: Odonata
Suborder: Anisoptera
Family: Libellulidae (skimmers)

Conservation Status:
Global Status (1990): G5
Rounded Global Status: G5 - Secure
National Status (United States): N4?
National Status (Canada): N5
State Statuses: Alaska (SNR), Colorado (SNR), Minnesota (SNR), Montana (S1), North Dakota (SNR), Utah (SH), **Washington (S1)**, Wyoming (SNR). The S1 ranking indicates in Washington that the species is critically imperiled because of extreme rarity or some other factor(s) making it especially vulnerable to extirpation or extinction.
Province Statuses: Alberta (S5), British Columbia (S5), Manitoba (S3), Northwest Territories (SNR), Nunavut (SNR), Ontario (S1), Saskatchewan (SNR), Yukon Territory (S5)
(NatureServe 2008)

Technical Description:
Adult: A small (35-40 mm, 1.4-1.6 in.) dragonfly with a dark brown or red and black body and conspicuously white face. Characteristic of the family Libellulidae, the eyes are broadly contiguous, the wings are held wide open when perched, and the anal loop of the hindwing is distinctive (foot-shaped, with a well-developed toe). Like all *Leucorrhinia* species, the face is white, but *L. borealis* can be distinguished from congenerics as follows: (1) the tops of most abdominal segments have reddish-gold shield-like spots, and (2) the spot on the 7th abdominal segment is longer than wide and extends to the end of the segment (Paulson 2007). The more common Dot-tailed Whiteface (*L. intacta)* has a pale dot on the 7th segment of the dark abdomen.

Immature: *Leucorrhinia* larvae are small, smooth and greenish in appearance with brownish markings (Bright 1998). Genus identification in the Pacific Northwest can be done using a recent key by Tennessen (2007). The following characters distinguish Libellulidae: prementum and palpal lobes cup-shaped (as opposed to flat), palpal lobe with small, regular teeth (as opposed to large, irregular teeth), head without erect, frontal horn, ventral surface of prementum without a basal, median

groove. The following characters distinguish *Leucorrhinia*: paraprocts variable but not strongly decurved, eyes somewhat large with convergent margins of head behind eyes (as opposed to small eyes with nearly parallel head margins), distinct middorsal hook absent on segment IX and present on segment VIII, posterolateral spines of abdominal segment VIII shorter (as opposed to longer) than middorsal length of segment (Tennessen 2007). Species identification is difficult for a non-expert.

Life History:
Adult flight period varies with region. In British Columbia, the adults fly early in the season, from mid-May to early August. The Washington records were collected from 14 June - 14 July. The flight period of a single adult is relatively short, lasting one week to perhaps more than a month. The majority of the dragonfly life cycle is spent as an aquatic larva, which is also the overwintering life-stage of this species. Depending on conditions, individuals may spend more than one winter as larvae, although this may be unlikely since their shallow marsh habitats often dry up. Larvae feed on aquatic animals, including invertebrates (Diptera, Coleoptera, Ephemeroptera, and Trichoptera) and possibly small vertebrates, while adults feed on flying insects (Merritt *et al.* 2008). Upon emergence from the larval stage, young adults (tenerals) may wander for a time before returning to their larval site or another suitable area to mate. Some adults will usually be present at locations where the species reproduces. NatureServe (2008) designates sightings more than 3 kilometers (1.9 miles) apart as separate populations, but little is known about their dispersal and colonization ability. This species is a relatively strong flier and may be a good colonist, able to reach sites a few kilometers apart.

Range, Distribution, and Abundance:
Range-wide: In the Rockies south to central Colorado and Utah, in the upper Midwest and northern Great Plains, and Canada west and north of Ontario. Rare in the southern part of its range, but more common in the north and in parts of the northern Great Plains (NatureServe 2008).

Washington: One known site near Molson in Okanogan Co., peripheral to the main part of its range in Canada. Few surveys have been done in the surrounding area, but knowledge of only a single site suggests that it is not present at very many additional sites. It has not been found in recent years, even at the historic site (Paulson 2008, *pers. comm.*).

Oregon: This species has not been found and is not expected in Oregon.

Forest Service/BLM Lands: There are no documented occurrences on Forest Service or BLM land, but the Washington record is from a pond

approximately 8 km (5 miles) from the Okanogan National Forest (Tonasket Ranger District), and 6 km (3.7 miles) from Spokane District, Wenatchee Resource Area land. The species is suspected to occur in unsurveyed or undersurveyed sedge meadows in the northern parts of both the Colville and Okanogan National Forests.

Abundance: Although both site localities and population sizes are important in evaluating the distribution and stability of a species, abundance estimates for this species are not known.

Habitat Associations:
Leucorrhinia larvae are common in bog lakes and marshy ponds with floating vegetation, and often exhibit unique pH and temperature preferences (Bright 1998). This species is found in a variety of well-vegetated, lentic wetlands, but may prefer deep-water sedge meadows. The larvae are climbers, adapted for living on vascular hydrophytes or detritus, and are often found lurking in vegetation or bottom debris to ambush prey (Merritt *et al.* 2008). Adults can occasionally be found in large numbers, perching on the bark of light-colored trees.

Threats:
Drought and water-level manipulations may be the greatest immediate threats to populations of this species. The wetlands around the only known site in Washington dried up in a 2002-2003 drought, and although they are rehydrated now, the species has not been seen since. Dennis Paulson, who originally documented the presence of this species at the pond at Sanger Lake, has been unable to find it during a few visits in recent years, and wonders if it is now eliminated from the site (Paulson 2008, *pers. comm.*). Continued global climate change will further threaten the long-term survival of this species. Projected changes in this region 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. Moreover, since many aspects of odonate survival (e.g. development, phenology, immune function, pigmentation, and behavior) are sensitive to changes in temperature, global climate change is predicted to have serious consequences on this taxon (Hassall and Thompson 2008). The loss of trees through timber harvest poses additional threats, since this species occupies wooded habitats, and trees provide (1) shade that maintains higher water levels and lower water temperatures for larvae and (2) foraging and nighttime roosting areas for adults (Packauskas 2005).

Since the larvae of this species are dependent on vegetation for foraging habitat and protection from predators, the alteration or degradation of

this resource by herbicide application in the water or watershed is also a threat. Grazing of wetlands, recreational development, and non-point-source pollution could also threaten this species.

It is not known if disease and predation are serious threats to this species, but small populations are generally at greater risk of extirpation as a result of normal population fluctuations due to predation, disease, natural disasters, and other stochastic events.

Conservation Considerations:

Inventory: Follow up on the impact of the 2002-2003 drought. At a minimum, revisit the original site and adjacent habitat to definitively establish the presence or absence of this species. Explore similar deep-water sedge meadows in unsurveyed territory in upland northern Washington for suitable habitat, and survey for this species (Paulson 2008, *pers. comm.*). Because this species is unranked, critically imperiled, or possibly extirpated in all eight US states where it is known to occur (NatureServe 2008), further documentation of its range and habitat is especially critical for advancing our understanding of its needs and taking the appropriate conservation measures. Since population size is important in evaluating the stability of a species at a given locality, abundance estimates for this species would also be valuable.

Management: Protect all new and known sites and their associated watersheds should from practices that would adversely affect any aspect of this species' life cycle. Since the largest proportion of an odonate's life is spent as an aquatic larva, protecting the larval stage is most critical for the species' success (Packauskas 2005)**.** Maintain water quality and water levels at the Molson site and in other potential habitat in Washington. Manage sites to minimize impacts from pollution, logging-related activities, and grazing. Do not use insecticides and herbicides intended to protect the uniqueness of the biota without serious consideration of their sublethal and lethal effects on this species and other sensitive taxa in the community. In alignment with the intention to sustainably meet users recreation needs in a manner most suited to preservation of the Okanogan National Forest ecosystem (USDA 2007), strictly avoid disturbance to areas containing the deep-water, sedge-meadow habitat of this species.

Version 2:

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

Edited by: Celeste Mazzacano, Sarina Jepsen & Scott Hoffman Black

Xerces Society for Invertebrate Conservation
Date: October 2008

Version 1:
Prepared by: John Fleckenstein
Natural Heritage Program
Washington Department of Natural Resources
Date: January 2006

Edited by: Rob Huff
Conservation Planning Coordinator
FS/BLM-Portland
Date: June 2007

ATTACHMENTS:

(1) References
(2) List of pertinent or knowledgeable contacts
(3) Maps of Global Range/Conservation Status and Oregon/Washington Distribution
(4) Photographs of Adult (dorsal view) and Larva (dorsal view)
(5) Odonata (Anisoptera) Survey Protocol, including specifics for this species

ATTACHMENT 1: References:

Abbott, J.C. 2007. "*Leucorrhinia borealis* records." OdonataCentral: An online resource for the distribution and identification of Odonata. *Texas Natural Science Center, The University of Texas at Austin* 3 Oct. 2008 < http://www.odonatacentral.org.>.

Bright, E. 1998. "Notes on the Michigan Species of *Leucorrhinia.*" 6 Aug. 1998. *University of Michigan.* 2 Oct. 2008 <http://insects.ummz.lsa.umich.edu/michodo/test/Leucorr.htm>.

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.

Hassall, C. and D.J. Thompson. 2008. The effects of environmental warming on Odonata: a review. International Journal of Odonatology 11(2): 131-153.

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. "*Leucorrhinia borealis.*" *NatureServe Explorer: An online encyclopedia of life [web application]*. Feb. 2008. Version 7.0. NatureServe, Arlington, Virginia. 6 Oct. 2008 <http://www.natureserve.org/explorer/>

Paulson, D. 2008. E-mail exchange with Sarah Foltz regarding Pacific Northwest odonates.

Paulson, D. 2007. "Field Key to Adult Washington Dragonflies (Odonata)." *Slater Museum of Natural History.* Jan. 2007. University of Pugut Sound. 2 Oct. 2008 <http://www.ups.edu/x6518.xml>.

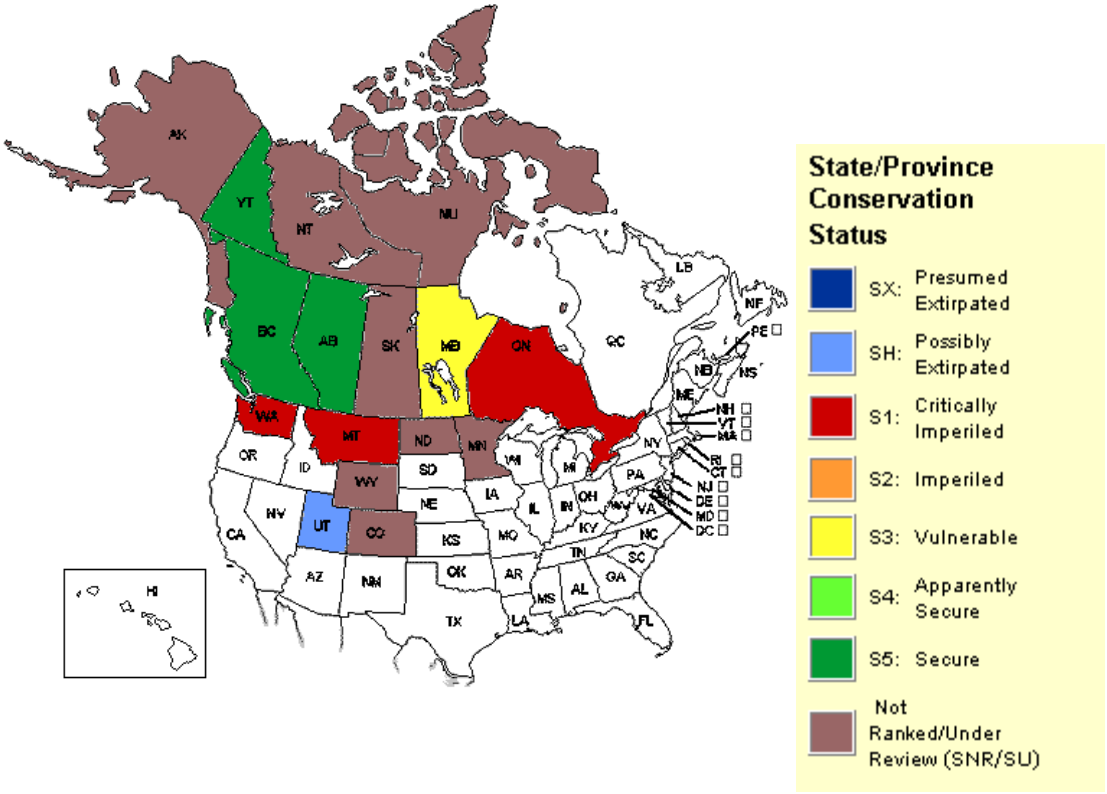
Tennessen, K. 2007. Odonata Larvae of the Pacific Northwest: An Identification Manual. Created for use in a taxonomic workshop sponsored by the Xerces Society and held at Evergreen State College, Olympia, Washington, March 16-18, 2007.

USDA, 2007. Okanogan National Forest News Release: Okanogan and Wenatchee National Forests seek help in planning the future of Developed Recreation Sites. 5 Nov. 2008. <http://www.fs.fed.us/r6/oka/news/2007/20070605-rec-site-developed.shtml>.

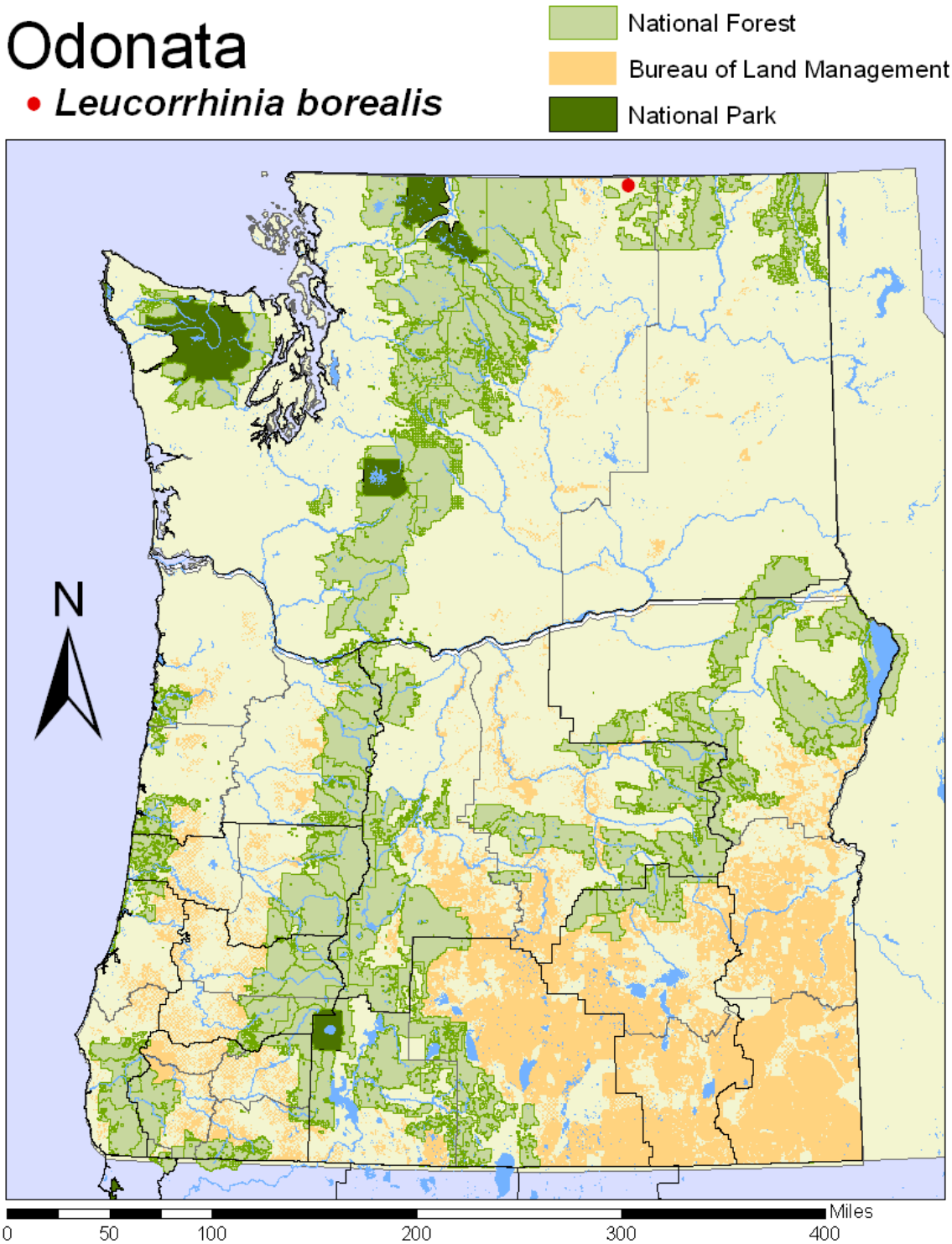
ATTACHMENT 2: List of pertinent, knowledgeable contacts:

Dennis Paulson
Steve Valley
Ken Tennessen
John Abbott

ATTACHMENT 3: Maps of Global Range/Conservation Status and Oregon/Washington Distribution:



Leucorrhinia borealis North American State/Province Distribution and Conservation Status. Map by NatureServe 2008.



Records of *Leucorrhinia borealis* in Washington and Oregon, relative to Forest Service and BLM lands. BLM District boundaries are shown in black, and Resource Area boundaries are shown in grey.

ATTACHMENT 4: Photographs of Adult (dorsal view) and larva (dorsal view):

Leucorrhinia borealis adult, dorsal view. Photo by Charlene Wood.

Congeneric *Leucorrhinia intacta* larva, dorsal view. No photo documentation available of *L. borealis.* Photograph (digital scan in life) by Dennis Paulson.

ATTACHMENT 5: Odonata (Anisoptera) Survey Protocol, including specifics for this species:

Survey Protocol

Taxonomic group:
Odonata

Species:
Leucorrhinia borealis

Where:
Adult odonates can be found feeding in range of terrestrial habitats, but are most effectively sampled at the aquatic habitat where they mate and oviposit. Ponds, streams, rivers, lake shores, marshes, bogs, and fens support a range of odonate diversity. Some species (e.g. *Gomphus kurilis*) frequent a variety of habitats, while others (e.g. *Leucorrhinia borealis*) have highly specific preferences with regard to substrate, vegetation, and water quality. For species-specific habitat information, see the section at the end of this protocol.

When:
Adults are surveyed in summer, during the often-short window of their documented flight period. Adult odonates are most active in warm temperatures, and usually begin to fly at the aquatic habitat with the morning sun. Depending on the species, males arrive as early as 9 am and leave as late as 6 pm. Females tend to arrive several hours later, after the males have established their mating territories (Campanella 1975). In the high temperatures of the late afternoon, some species seek shade in trees and vegetation.

Although larvae are present all summer, it is preferable to sample later in the season (i.e. just prior to and during the early part of adult emergence), when a higher proportion of the more easily identified late larval instars will be found.

Adult Surveys:
Use a long-handled, open-mesh aerial net, light enough to be swung rapidly. Triplehorn and Johnson (2005) recommend a 300-380 mm diameter net with a handle at least 1 m long.

Approach the site quietly, observing the environment and natural behaviors occurring prior to sampling. Note the number of different

species present, and what their flight patterns are. This will help in predicting the movement of target species, and in evaluating whether the site has been surveyed "exhaustively" (i.e. all species observed at the site have been collected or photodocumented). Since dragonflies are wary of humans and readily leave an area when disturbed, it is important to be as discreet in your movements as possible, at all times.

Watch vegetation, logs, tree-trunks, and large, flat rocks for perched individuals, particularly those in the Gomphidae and Libellulidae families. Since dragonflies are powerful fliers and notoriously challenging to catch, try to quietly photo-document specimens prior to attempting to capture. Use a camera with good zoom or macrolens, and focus on the aspects of the body that are the most critical to species determination (i.e. dorsum of abdomen, abdominal terminalia (genitalia), pleural thoracic markings, wing markings, eyes and face). For helpful tips, see the article "Photographing Dragonflies" (Nikula 1997) available at: http://www.odenews.org/PhotoArticle.htm (last accessed: 25 Oct. 2008).

When stalking perched individuals, approach slowly from behind, covering your legs and feet with vegetation, if possible (dragonflies see movement below them better than movement at their level). When chasing, swing from behind, and be prepared to pursue the insect. A good method is to stand to the side of a dragonfly's flight path, and swing out as it passes. After capture, quickly flip the top of the net bag over to close the mouth and prevent the insect from escaping. Once netted, most insects tend to fly upward, so hold the mouth of the net downward and reach in from below when retrieving the specimen. Collected specimens should be placed on ice in a cooler long enough to slow their movement (a few minutes), and then set on a log or stone and comprehensively photographed until the subject starts to stir. Specimens to be preserved should be placed alive, wings folded together, in glassine or paper envelopes, as they lose color rapidly once killed. Record the eye color and locality/collection data on the envelope, including longitude and latitude if possible.

Acetone, which helps retain bright colors, is recommended for killing odonates. Glassine envelopes with the lower corner clipped and the specimen inside should be soaked in acetone for 24 hours (2 to 4 hours for damselflies) and then removed, drained, and air-dried. The resulting specimens are extremely brittle, and can be stored in envelopes, pinned with wings spread, or pinned sideways to conserve space. Mating pairs in tandem or copula should be indicated and stored together, if possible. Collection labels should include the following information: date, time of day, collector, detailed locality (including water-body, geographical coordinates, mileage from named location, elevation, etc.), and detailed habitat/behavior (e.g. "perched on log near sandy lake shore"). Complete

determination labels include the species name, sex (if known), determiner name, and date determined.

Relative abundance surveys can be achieved by timed watches at designated stations around a site. We recommend between 5 and 10 stations per site, each covering one square meter of habitat, and each monitored for 10 to 15 minutes. Stations should be selected in areas with the highest odonate usage, and spread out as evenly as possible throughout the site. During and one minute prior to the monitoring period, observers should remain very still, moving only their eyes and writing hand. Recorded information should include start and end times, weather, species, sex, and behavior (e.g. male-male interaction, pair in tandem). Observations occurring near, but outside of, the designated station should be included but noted as such.

Catch and marked-release methods can help evaluate population sizes, species life-span, and migration between sites. This strategy (most appropriate if several sites are being surveyed repeatedly throughout a season) involves gently numbering the wing with a fine-tip permanent marker before release.

Larval Surveys:

When surveying for larvae, wear waders, and use care to avoid disrupting the stream banks, vegetation, and habitat. Depending on the habitat, a variety of nets can be useful. D-frame nets are the most versatile, as they can be used in both lotic and lentic habitats. Kick-nets are only useful when sampling stream riffles, and small aquarium nets are most effective in small pools. If desired, relative abundance between sites or years can be estimated by standardizing sampling area or sampling time. When the use of a D-frame net is not feasible (e.g. in areas that have very dense vegetation, little standing water, and/or deep sediment), an alternative sampling device, such as a stovepipe sampler, can be used. This cylindrical enclosure trap (~34 cm in diameter and 60 cm in height) is quickly forced down through the water/vegetation and firmly positioned in the bottom substrate. Material and organisms are then removed by hand using small dip nets (Turner and Trexler 1997).

Net contents are usually dumped or rinsed into shallow white trays to search for larvae more easily, as they are quite cryptic and can be difficult to see if they are not moving. White ice-cube trays may also aid in field sorting. Voucher collection should be limited to late instar larvae, which can be most readily identified. If necessary, early instars can be reared to later stages or adulthood in screened buckets/aquaria with tall grasses added for emergence material. However, since the rearing process often takes many trials to perfect, it is only recommended if

knowledge of species' presence-absence status at a particular site is critical, and few-to-no late instars or adults are found.

Voucher specimens can be either (1) preserved on-site in sample vials filled with 80% ethanol, or (2) brought back from the field in wet moss/paper-towels, killed in boiling water, cooled to room temperature, and transferred to 80% ethanol. Although the latter method is more time intensive, it is recommended for maximum preservation of internal anatomy (Triplehorn and Johnson 2005). Live specimens should be separated by size during sorting to reduce cannibalism/predation.

Although easily overlooked, larval exuviae left on rocks, sticks, or vegetation on which the adult emerged are valuable for species documentation. These cast-off exoskeletons of the final larval instar can be identified to species using larval traits, and offer a unique, conservation-sensitive sampling method for odonates (Foster and Soluk 2004). Since exuviae indicate the presence of successful breeding populations at a particular locale, their habitat data can be very informative, and should be documented with as much care as that of larvae and adults.

Species-specific survey details:

Leucorrhinia borealis

This species is not found (or expected) in Oregon, and is known in Washington from only one small wetland near Molson (Okanogon Co.). Dr. Paulson has been unable to find specimens during visits to this site in recent years (Paulson 2008, *pers. comm.*). The wetlands where it was found previously suffered an extended drought, although they are currently rehydrated. At a minimum, the original site and adjacent habitat should be intensively surveyed to definitively establish the presence or absence of this species. Unsurveyed territory in upland northern Washington should be explored for suitable habitat (i.e. shallow, well-vegetated marshes) and surveyed for *L. borealis* and other rare northern species (Paulson 2008, *pers. comm.*).

Sites should be surveyed at midday, between mid-June and mid-July, taking care in wooded areas to watch for perched adults. At the aquatic habitat, territorial males of this family will frequently return to the same or nearby perch, even after disturbance (Nikula 1997).

While researchers are visiting sites and collecting adults and exuviae, detailed habitat data should also be acquired, including substrate type, water source, water velocity, and presence/use of canopy cover (Packauskas 2007).

References (Survey Protocol Only):

Campanella, P.J. 1975. The evolution of mating systems in temperate zone dragonflies (Odonata: Anisoptera) II: *Libellula luctuosa* (Burmeister). Behaviour 54: 278-310.

Foster, S.E. and D.S. Soluk. 2004. Evaluating exuvia collection as a management tool for the federally endangered Hine's emerald dragonfly, *Somatochlora hineana* Willaimson (Odonata: Cordulidae). Biological Conservation 118: 15-20.

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.

Nikula, B. 1997. "Photographing Dragonflies" 13 September 1997 *Ode News.* 22 Oct. 2006 <http://www.odenews.org/PhotoArticle.htm>.

Packauskas, R.J. "Hudsonian Emerald Dragonfly (*Somatochlora hudsonica*): a technical conservation assessment." 24 Aug. 2007. *USDA Forest Service, Rocky Mountain Region.* 16 Oct. 2008 <http://www.fs.fed.us/r2/projects/scp/assessments/hudsonianemeralddragonfly.pdf >

Paulson, D. 2008. Personal communication. E-mail exchange with Sarah Foltz regarding Pacific Northwest odonates.

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

Turner, A.M. and J.C. Trexler. 1997. Sampling Aquatic Invertebrates from Marshes: Evaluating the Options. Journal of the North American Benthological Society 16(3): 694-709.