

Bulletin of the Oregon Entomological Society

Carabid beetles of Oregon, USA: 1. Some general characteristics of the fauna

James C. Bergdahl¹

“As is well known, the insect life of the deep woods in Oregon is notoriously poor, and few entomologists would think of searching for beetles [there] . . .”

C. V. Piper, 1911

This report provides a brief overview of some general characteristics of the carabid beetle fauna of Oregon, USA (Coleoptera: Carabidae, including subfamilies Cicindelinae, Trachypachinae and Rhysodinae). Carabids are members of the suborder Adephaga, an ancient, relatively specialized and uniform group of beetles whose features usually include predaceous food habits, comparatively long-lived adults inhabiting similar niches as larvae, preference for humid environments, and occurrence in soil, soil surface, or aquatic habitats. There are however many modifications to this general plan in Carabidae, including phytophagy (fruit and seed eaters), ectoparasitic larvae, myrmecophilia, xeric and arboreal life histories. Very few carabids are truly aquatic, although most beetles in the other families in Adephaga are (e.g. dytiscids, gyrenids, haliplids, amphizoids and

noterids). In many faunas, carabids are one of the most diverse beetle families (Table 1). For instance, in Canada and Alaska there are ~7440 beetle species (115 families): 15% staphylinids, 12% carabids, and 8% curculionids (Bousquet 1991). Compared to many primarily aquatic or herbivorous beetle families, carabids have significantly greater species turnover between regions (Bousquet 1991), suggesting smaller geographic range sizes. Carabids have many attributes that make them excellent bioindicators for environmental assessment (Koivula 2011; Bergeron *et al.* 2011). The oldest known carabids are trachypachines from Permian deposits (~250 million years BP) in central Asia; three species of *Trachypachus* occur in Oregon today.

I have collected carabids in the Pacific Northwest (PNW = British Columbia, Washington, Idaho and Oregon) for 27 years, and cu-



Figure 1. *Bembidion transversale* Dejean 1831 (~7 mm), a long-winged (+) gyrophile, one of the largest of ~98 species of *Bembidion* in Oregon's fauna. The species is especially common and widespread along the shorelines of rivers and lakes. Its flight wings can be seen complexly folded beneath its translucent elytra. Many subgenera of *Bembidion* require years of study to master their species determinations. Maddison & Swanson (2010) photo.

Table 1: Approximate number of carabid species and subspecies along the west coast of North America. Pacific Northwest = BC, WA, ID & OR. **Spp** = sp + ssp = species + subspecies. **End** = number of endemic spp. **SppD** = species density = (Spp/km²) × 10³; **EndD** = endemic density = (End/km²) × 10⁴. Spp from Bousquet (2012); End from Bousquet & Laroche (1993).

Region	Spp	SppD	End	EndD
North America	2676	0.15	2071	1.13
Alaska	250	0.17	16	0.11
Pacific Northwest	710	0.45	92	0.58
British Columbia	507	0.53	6	0.06
Washington	464	2.69	8	0.46
Idaho	348	1.62	9	0.42
Oregon	500	2.01	26	1.05
California	660	1.63	230	5.69

¹Conservation Biology Center, 919 S. Adams St., Spokane, WA, USA, 99204; 509-835-5233; <jcbergdahl@gmail.com>

Feel free to distribute this newsletter to others.

Submit content to **Ron Lyons** (pondhawk@uci.net). To be included on the distribution list contact **Jim Johnson** (jt_johnson@comcast.net).



Figure 2. *Scaphinotus hatchi* Beer 1971 (~20 mm), a flightless mesophile endemic to Oregon, apparently restricted to montane forests of the Cascade Mtns. near Waldo Lake. Two closely related species, *S. angusticollis* and *S. velutinus*, are common and widespread in Oregon's coastal forest regions. The Columbia River appears to be a barrier to dispersal of *S. velutinus* north into Washington. *Scaphinotus* species are often described as molluscivores, however many of them probably have a much more catholic diet, including ripe berries. National Museum of Natural History (Smithsonian) photo.

rate a large collection and database of the species. Contrary to Mr. Piper's (1911) observations, I have found carabid beetles to be great subjects for study in the Pacific Northwest for many reasons:

- 1) they are easy to collect and preserve (Bergdahl 2009),
- 2) there are lots of species with diverse life histories,
- 3) they are abundant in most terrestrial habitats,
- 4) good keys to many of the species are available (e.g. Hatch 1953; Lindroth 1961–69), and
- 5) the composition of the fauna and its taxonomy are fairly well known (Carabidae of the World, <<http://carabidae.pro>>; Tree of Life, <<http://tolweb.org/Adephaga>>; Bousquet & Larochelle 1993; Bousquet 2012).

The mean date of description of the carabid species from the Pacific Northwest is ca. 1865. All of the 13 species described from the Pacific Northwest since 1985 are flightless and localized (e.g. Bousquet 1985; van den Berghe 1994; Kavanaugh & LaBonte 2006, LaBonte 2006, Bergdahl & Kavanaugh 2011). Rarefaction analysis suggests there are not many additional species to be discovered, unless they are cryptic sibling species. My primary interest in Oregon's fauna is that it provides clues to answers concerning general questions about the evolution of the PNW's insect fauna, and more specifically the region's many rare and endemic species.

Oregon's carabid fauna is a subset of the Pacific Northwest's, which contains ~710 species and recognized subspecies (sp + ssp, or spp), a list I derived primarily from Bousquet & Larochelle (1993). Over many years I have developed this list into a database that scores each spp for a number of attributes such as body size, wingedness, habitat preference, geographic range, etc. Oregon adds 98 carabid spp to the list of those found in the PNW (i.e. spp found in the PNW, but only in Oregon).

My list of carabids from Oregon now contains 500 spp, including 31 cicindelids, 3 trachypachids, and 2 rhyssids. Thirty-four

(34) of North America's 45 carabid tribes are represented. Oregon's carabid fauna includes 86 genera—the six largest are *Bembidion* (98 spp), *Pterostichus* (39 spp), *Cicindela* (27 spp), *Nebria* (27 spp), *Amara* (26 spp), and *Agonum* (22 spp). The mean number of states and provinces these carabids occur in in North America is 14; therefore most of them are widespread. Oregon's carabid fauna includes 22 introduced spp, and 22 holarctic spp. Adult body sizes range from ~1.5 mm (*Mioptachys flavicauda*) to ~29 mm (*Calosoma semilaeve* and *Pterostichus lama*), with a mean ~7 mm. The Oregon carabid fauna includes 114 spp regionally restricted to Oregon and at least one neighboring state (Washington, Idaho, Nevada or California). Twenty-six (26) spp are found only in Oregon (i.e. they are state endemics). Within the PNW, Oregon's comparatively rich fauna of endemic species is undoubtedly in part a product of the territory having never been inundated by the Cordilleran Ice Sheet during the Pleistocene. Analysis of North American tiger beetle faunas (Bergdahl, unpubl) suggests rarity in carabids is spatially concordant (regionally rare species are often locally rare [Gaston 1994]). No comprehensive data summarizing the distribution of carabid species within Oregon (e.g. by county or ecoregion) are presently available; therefore an appraisal of the geographic distribution of carabid diversity patterns in Oregon is impossible at this time. However, southwest Oregon probably has the highest carabid species richness given its diversity of ecoregions and habitats, and proximity to California (which has a very rich carabid fauna of ca. 660 spp, including 39 spp found only in California + Oregon). The carabids of the US Forest Service's H.J. Andrews Forest, <http://osac.science.oregonstate.edu/projects/2008HJA_REU>, on the west slope of Oregon's Cascade Mountains near Blue River, is by far the best documented local fauna in the Pacific Northwest (~96 carabid spp) (Parsons *et al.* 1991; Luoma 1999).

Two features of carabid beetle biology are especially fascinating—habitat specialization and variation in the development of flight wings. Habitat provides a template for the evolution of many life history features in insects, including body size and wingedness



Figure 3. *Zacotus matthewsii* LeConte 1869 (~15 mm), a brachypterous (-) mesophile found in a wide variety of habitats from old-growth forests to dry open grasslands and farm fields. *Zacotus* is in the tribe Broscini, which includes three monotypic genera in the Pacific Northwest. *Broscodera insignis* can be found along small, rainforest streams. *Miscodera arctica* is a rare Pleistocene relict inhabiting dry moraine that has not yet been recorded in Oregon. Photo Henri Goulet, Agriculture & Agri-Food Canada.



Figure 4. *Sericoda quadripunctata* (DeGeer, 1774) (~6 mm), a long-winged (+) pyrophile. Many species of carabids are black or dark brown. *Sericoda* spp. mimic the iridescent sheen of charcoal. Three of the four North American *Sericoda* species occur in Oregon. Lindroth (1961-69) states: "The species are excellent fliers and share a biological property, not yet understood: they are attracted to burning wood and sometime appear in great numbers during and after forest fires, already when ashes are still hot." Photo Henri Goulet, Agriculture & Agri-Food Canada.

(Southwood 1977). The distribution and abundance of habitat types on the landscape strongly affects the species composition of regional carabid faunas. Habitat specialization can be roughly classified as xeric (dry), mesic (damp), and hygric (wet). Xerophiles tend to be sun-loving occupants of open shrublands, grasslands, and barren areas. Mesophiles are primarily in forest and woodland habitats. Hygrophiles are found in a wide variety of vegetation types from lowland forest swamps to exposed periglacial habitats at alpine elevations. Three other habitat specializations should be recognized even though the species represent only a small percentage of Oregon's fauna: haliophiles (alkaline lakes, salt marshes, sea beaches, etc.), arborealists (canopy dwellers), and pyrophiles (burned forests).

With regard to wing development carabid species can be divided into three categories:

- (+) = all individuals with wings fully developed, longer than elytra, complexly folded beneath elytra when not in use, and probably suitable for flight (Figure 1);
- (-) = all individuals with short or vestigial wings (brachypterous) and flightless; and
- (+/-) = species polymorphic for wingedness, i.e. some individuals are (+) and some are (-).

Note: long-winged beetles may not always be capable of flight since wing musculature may not be adequately developed. Beetles capable of flight are better adapted to escape predators, floods, fires, and other inclement conditions, to find mates, and establish new or find existing populations. Many brachypterous species are derived from lineages that have been flightless for many 100,000s

of years and now have fused elytra [e.g. *Omus*, *Scaphinotus* (Figure 2), *Pterostichus* (*Hypherpes*), and *Zacotus* (Figure 3)]. Some brachypterous species have sibling species with full-flight capability (e.g. *Nebria* [Kavanaugh 1985]). Howden (1964) has shown that some large-bodied, flightless beetles in western North America are so sedentary their current geographic distributions coincide with habitat refugia as old as the Pliocene (5 million years BP).

The evolution of flightlessness in carabid beetles is strongly associated with habitat—brachyptery is most common in mesophiles, and also on oceanic islands and on mountains (Darlington 1943; Liebherr 1997). Very few haliophiles, pyrophiles or arboreal species are totally flightless, and most hygrophiles are winged. Table 2 provides a frequency matrix of habitat vs. wingedness for Oregon's 500 carabid species. Approximately 21% of Oregon's carabids are xerophiles (105 spp), 19% (93 spp) are mesophiles, and 51% (257 spp) are hygrophiles. The three pyrophiles are *Sericoda* spp (Figure 4). About 68% (339 spp) are long-winged (+), 20% (102 spp) are brachypterous (-), and 12% (59 spp) are wing-polymorphic (+/-). Fifty-nine (58%) of the flightless carabids are mesophiles. These are primarily forest species, including 14 *Pterostichus* (*Hypherpes*), 9 *P. (Leptoferonia)*, and 3 blind fossorial *P. (Anilloferonia)* spp. The diverse wetland habitats associated with the floodplains of large rivers support the highest number of carabid species. The 25 flightless hygrophiles include *Pterostichus johnsoni*, *P. riparius*, 3 *P. (Pseudoferonia)*, 3 *P. (Hypherpes)*, 5 *Nebria*, 2 *Bembidion*, 2 *Trechus*, 2 *Rhadine*, *Bradycellus fenderi*, and *Agonum belleri*.

Wetlands are at high risk of modification or loss by humans and the long-term conservation of flightless species strictly associated with wetland habitats may present special challenges (Fagen 2002; Matern *et al.* 2008). For instance, it is highly unlikely *Agonum belleri*, a brachypterous *Sphagnum*-bog specialist with only two known Oregon populations near Mt. Hood, is now colonizing any unoccupied bogs. (Note: the species has not been seen for many years at one of these bogs: Bear Spring, Wasco Co.). Also, many of the flightless hygrophiles are narrowly restricted to small, forested, isolated, headwater (0–2nd order) streams that are typically very poorly protected from disturbance by commercial logging and ranching practices. These unique habitats support a rich assemblage including many of Oregon's rarest riparian species (Dietrich & Anderson 2000). Headwater creeks are also likely places to discover new invertebrate species for a number of biogeographic reasons (Darlington 1943; Liebherr 1997; Bergdahl & Kavanaugh 2011; Bergdahl 2012).

Acknowledgements

This project began in 1990 at the University Washington Zoology Department. It took a great leap forward in 1993 when Yves Bousquet (Agriculture & Agri-Food Canada) kindly shared his database of North American carabid beetles with me (Bousquet & Larochelle 1993). Thanks also go to Henri Goulet (Agriculture & Agri-Food Canada), Terry Erwin (Smithsonian Institution), and David Maddison (Oregon State University) for use of their photos. Samuel

Table 2: Wingedness vs. habitat preference for the 500 carabid species and subspecies from Oregon.

	xero (%)	meso (%)	hygr (%)	hali (%)	arbo (%)	pyro (%)	total (%)
(+)	69 (14)	23 (5)	209 (42)	20 (4)	15 (3)	3 (0.6)	339 (68)
(+/-)	21 (4)	11 (2)	23 (5)	2 (0.4)	2 (0.4)	0 (0)	59 (12)
(-)	15 (3)	59 (12)	25 (5)	2 (0.4)	1 (0.2)	0 (0)	102 (20)
total	105 (21)	93 (19)	257 (51)	24 (5)	18 (4)	3 (1)	500

Perry helped with photo processing. Glada McIntyre and Ron Lyons improved drafts of the article.

References

- Bergdahl, J.C. 2009. Low-cost insect boxes and high-volume storage cabinets that are efficient and readily available in large quantities. *Bull. Entomol. Soc. Canada* 41(2): 61–63. <http://www.esc-sec.ca/bulletin/Bulletin_June_2009.pdf>.
- Bergdahl, J.C. 2012. New carabid beetle species (Coleoptera: Carabidae) from the mountains of Idaho, USA. unpubl. ms.
- Bergdahl, J.C. & D.H. Kavanaugh. 2011. Two new species of *Pterostichus* Bonelli subgenus *Pseudoferonina* Ball (Coleoptera: Carabidae: Pterostichini) from the mountains of central Idaho, U.S.A. *ZooKeys* 104: 77–96.
- Bergeron, J.A.C., J.R. Spence & W.J.A. Volney. 2011. Landscape patterns of species-level association between ground-beetles and overstory trees in boreal forests of western Canada (Coleoptera, Carabidae). *ZooKeys* 147: 577–600.
- Bousquet, Y. 1985. The subgenus *Pseudoferonina* Ball (Coleoptera: Carabidae: Pterostichus): description of three new species with a key to all known species. *Pan-Pacific Entomol.* 61(3): 253–260.
- Bousquet, Y. 2012. Catalogue of the Geadephaga (Coleoptera, Adephaga) of America, north of Mexico. *Zookeys* 245: 1–1722.
- Bousquet, Y. (ed.). 1991. Checklist of beetles of Canada and Alaska. Agriculture Canada, Ottawa, 430 pp.
- Bousquet, Y. & A. Larochelle. 1993. Catalogue of the Geadephaga (Coleoptera: Trachypachidae, Rhysodidae, Carabidae including Cicindelini) of America north of Mexico. *Memoirs Canad. Entomol. Soc.*, No.167, 397 pp.
- Darlington, P. J. 1943. Carabidae of mountains and islands: data on the evolution of isolated faunas, and on atrophy of wings. *Ecol. Monogr.* 13: 37–61.
- Dietrich, M. & N.H. Anderson. 2000. The invertebrate fauna of summer-dry streams in western Oregon. *Archiv fur Hydrobiologie* 147: 273–295.
- Fagen, W.F. 2002. Connectivity, fragmentation, and extinction risk in dendritic metapopulations. *Ecology* 83(12): 3243–3249.
- Gaston, K.J. 1994. *Rarity*. Chapman & Hall, New York, NY, 205 pp.
- Hatch, M.H. 1953. The beetles of the Pacific Northwest. Part I: Introduction and Adephaga. *Univ. Wash. Publ. Biology* 16:1–340, University of Washington Press, Seattle, WA.
- Howden, H.F. 1964. Speculations on some beetles, barriers, and climates during the Pleistocene and pre-Pleistocene periods in some non-glaciated portions of North America. *Systematic Zoology* 112: 178–201.
- Kavanaugh, D.H. 1985. On wing atrophy in carabid beetles (Coleoptera; Carabidae), with special reference to Nearctic *Nebria*. Pp. 408–431, in: G.E. Ball (ed.), *Phylogeny and zoogeography of beetles and ants*. D.W. Junk Publ., Dordrecht, Netherlands.
- Kavanaugh, D.H. & J.R. LaBonte. 2006. *Pterostichus brachylobus* Kavanaugh and LaBonte, a new species of the carabid subgenus *Hypherpes* Chaudoir, from the central coast of Oregon (Insecta: Coleoptera: Carabidae: Pterostichini). *Proc. Calif. Acad. Sci.*, Ser. 4, 57: 215–223.
- Koivula, M.J. 2011. Useful model organisms, indicators, or both? Ground beetles (Coleoptera: Carabidae) reflecting environmental conditions. *ZooKeys* 100: 287–317.
- LaBonte, J.R. 2006. *Pterostichus lattini* LaBonte, a new species of carabid beetle (Coleoptera: Carabidae: Pterostichini) from Oregon. *Proc. Calif. Acad. Sci.*, Ser. 4, 57(4): 203–213.
- Liebherr, J.K. 1997. Dispersal and vicariance in Hawaiian platynine carabid beetles (Coleoptera). *Pacific Science* 51(4): 424–439.
- Lindroth, C. H. 1961–1969. The ground-beetles (Carabidae, excl. Cicindelinae) of Canada and Alaska. Parts 1–6. *Opuscula Entomologica*, Suppl. XX, XXIV, XXIX, XXXIII, XXXV: 1–1192.
- Luoma, J.R. 1999. *The Hidden Forest: a biography of an ecosystem*. Henry Holt, New York, NY, 228 pp.
- Maddison, D.P. & A. P. Swanson. 2010. A preliminary characterization of *Bembidion perspicuum* LeConte, with a reclassification of related species (Coleoptera, Carabidae) north of Mexico. *ZooKeys* 43: 15–31.
- Matern, A., C. Drees, H. Meyer & T. Assmann. 2008. Population ecology of the rare carabid beetle *Carabus variolosus* (Coleoptera: Carabidae) in north-west Germany. *J. Insect Conservation* 12(6): 591–601.
- Parsons, G.L., G. Cassis, A.R. Moldenke, J.D. Lattin, N.H. Anderson, J.C. Miller, P. Hammond & T.D. Schowalter. 1991. *Invertebrates of the H.J. Andrews Experimental Forest, western Cascade Range, Oregon. V: An annotated list of insects and other arthropods*. Gen. Tech. Rpt. PNW-GTR-290. US Dept. Agric., U.S. Forest Service, PNW Research Station, 168 pp.
- Piper, C.V. 1911. Notes on *Pterostichus johnsoni* Ulke (Coleoptera: Carabidae). *Proc. Entomol. Soc. Wash.* 13: 62–64.
- Southwood, T.R.E. 1977. Habitat, the template for ecological strategies? *J. Animal Ecol.* 46: 337–365.
- van den Bergh, E.P., 1994. *Omus cazieri*, a new species from southern Oregon (Coleoptera: Cicindelidae). *Cicindela* 26(3/4): 33–39.

***Bembidion ricei* (Coleoptera; Carabidae) Paper Published**

At the fall 2011 Northwest Lepidopterists' Workshop, Dr. David Maddison announced that he would be naming a new species of *Bembidion* after Harold Rice, in appreciation for what Harold had done for him personally and for systematic entomology in general.

The paper describing *Bembidion ricei* has recently been published:

Maddison, D. and L. Toledano. 2012. A new species of *Bembidion* (Ecuadion) from Ecuador (Coleoptera, Carabidae, Bembidiini), with a key to members of the *georgeballi* species group. *ZooKeys* 249: 51–60

The entire paper is available online as either HTML or PDF at <<http://www.pensoft.net/journals/zookeys/article/4149/abstract/>>

Northwest Lepidopterists' Workshop 2012

On 27–28 October 2012, about 50 people gathered in Cordley Hall on the campus of Oregon State University for the 34th annual workshop meeting of Lepidopterists of the Pacific Northwest. The meeting was hosted by Drs. Paul Hammond and David McCorkle and sponsored by the Oregon State Zoology Department and the Oregon State Arthropod Collection (OSAC).

Oral presentations were made by David Maddison, Lars Crabo, Jon Shepard, Dana Ross, Ann Potter, Dave Specht, Katy Prudic, David Lee Myers, and Jeff Miller. There was an informal discussion of public education/outreach. In the pages that follow I (Ron Lyons) have summarized the presentations, as well as some of the other business discussed. Resources (in print and online) mentioned at the meeting are included with the relevant material.

The lepidopteran groups for emphasis this year were:

- ▶ Butterflies: Hairstreaks and Coppers, Anglewings
- ▶ Moths: general moths, Arctiidae

David Maddison—Formal Welcome and Entomology Collection Announcements

Dr. David Maddison, director of the Oregon State Arthropod Collection (OSAC), a cosponsor of the event, welcomed the workshop participants on behalf of OSU and OSAC. While his personal research interest is in beetles, David is strongly connected to the Northwest Lepidoptera community. He occupies the Harold and Leona Rice Professorship in Systematic Entomology. The position is named after Harold and Leona Rice who were prominent members of the Northwest Lepidoptera community for many years and whose donation to OSU created his position.

Last year David announced that the OSAC was setting up an annual award in honor of Harold as a way of giving something back to his community. The Northwest Lepidopterists' Fund in honor of Harold E. Rice made its first two awards earlier this year to:

- ▶ Dana Ross for a project on moths of the pristine oak bunchgrass site near The Dalles, and
- ▶ David Droppers, a graduate student working on seasonal change in butterfly distributions in North Cascades National Park. Unfortunately the butterflies didn't cooperate for David's project so the funds were returned.

The upcoming deadline for applications is a bit earlier than last time so that recipients can better know what their finances will be as they prepare for their field season. (More information, as well as directions for how to apply, can be found by downloading the PDF from <http://osac.science.oregonstate.edu/PNWLepidopteristsFund.pdf>).

In connection with this, Paul Hammond prepared the drawer of common northwest arctiid moths, shown in the accompanying figure, for exhibit. The moths were not labeled, providing you with the opportunity to use the newly released PNW Moths website (discussed below) to identify them.



"Common Arctiid Moths of the Pacific Northwest" selected by Paul Hammond from specimens in the Oregon State Arthropod Collection (OSAC) (click to view full size image). Photo by Ron Lyons

David also announced a fundraising effort to upgrade the collection. OSAC is raising funds to provide new cabinets for the Lepidoptera and Hymenoptera collections to match the new cabinets that currently house the Coleoptera. About \$150,000 is needed for this purpose. The Colleges of Science and Agricultural Sciences have each agreed to provide matching funds for all donations received or committed before 15 April 2013, up to \$50,000 each. That means that OSAC only actually needs to raise \$50,000. Because of the very generous donation of one of the members of the community who has also agreed to match subsequent donations, the symbol of the fundraising effort, a large butterfly, is nearly full (as of 15 December). (To find out more about the progress of the Cabinet Campaign or to find out how you can help support the efforts of the OSAC, visit http://osac.science.oregonstate.edu/Campaign_2013. Donations to the University in aid of the Collection should specify somewhere that they are for the Friends of the Oregon State Arthropod Collection. They are tax deductible.)

David indicated that both he and Chris Marshall, Curator and Collections Manager, are open to discussing suggestions or concerns that people might have about the collection, including the problem of off-hours availability.

Northwest Lepidopterists' Workshop 2012 (cont.)

Lars Crabo—Introduction to the Pacific Northwest Moths Website

Merrill Peterson defined the main goal for this project—to advance moth knowledge and make it available to everyone. The end result was the Pacific Northwest Moths website, <<http://pnw-moths.biol.wvu.edu/>>. The website product was a three year NSF funded collaborative effort that involved many people and organizations (see the Site Credits for a list of people and organizations involved). Data were gathered from a number of sources including institutional collections, private collectors, photographers, and various independent experts.

The first decision that needed to be made was to define the area to include in the “Pacific Northwest”. As you can see from the map on the home page that shows all the locations for which moth data is present, it was defined to include Washington, Oregon, Idaho, Montana west of the Continental Divide, and southern British Columbia to the latitude of northern Vancouver Island. Data from the surrounding areas like northern Nevada and Alberta was also included. Eventually, a decision was made to include data from the entire province of British Columbia.

An historical way of thinking about moths is to divide them by size, into macromoths (large moths) and micromoths (small moths). This website basically deals with the bigger moths, the macromoths, although one group, the inchworm moths (Geometridae), has not been included yet. The micromoths were excluded, partly because many groups are poorly known.

The website has three main components:

- 1) species fact sheets,
- 2) photographic plates of groups of species, and
- 3) identification key.

The Species Fact Sheets

The species are arranged in checklist order by family and thumbnail images of some of the species involved are shown. If you click on one of the families, it will expand to show the subfamilies together with thumbnail images. You can go further, to bring up the tribes and the genera. From here, you can bring up the page for an individual species. All of the images have a 1 cm scale bar on them. If you really want great detail you can zoom right in from the species page.

The species page has a map showing where each of the relevant specimens in the database was collected or observed. Click on one of the locations spots and the program will display the recorded location. You can find out where the actual specimen is and see any additional notes.

The species page includes a phenogram so you can see what time

of year the moths were collected. Portions of the data can be selected by the use of the filters (you can filter by collection, state, date, time of year, etc.). The map and the phenogram will change to reflect the filtered data set.

Additional specimen pictures are available on the species page. Although underside views are generally not as important for moths as they are in butterflies, these are shown because they are really helpful in some species. The species page also has images of similar species that you can click on.

The species descriptions are fairly technical ones, referring to the diagnostic features of the key. Lars put into words what features he uses when he looks at a moth to distinguish it from other possible species. If you wonder what a term in the description means, you can hover it and its definition will appear or you can click on the term and get into the illustrated glossary.

The species page contains information about subspecies, habitats and distributions in the Northwest and elsewhere in the world, life history information as well as notes on economic importance. Since all sorts of people will be using this site, literature references and useful web links are also on the species page.

The Photographic Plates

If you want to get a general overview of moths, look at the photographic plates. There are about 80 of them. The moths are arranged just like they would be in a field guide and you can go from one plate to the next. With a lot of websites and field guides, everything is the same size so you don't know, just by looking, if you are dealing with something that is 3 mm or a foot across. The plates are particularly useful because they give you an idea of the relative sizes of the various species.

The Relational Key

The final feature is the key, a non-technical key that a beginner can use, with little real knowledge of what the parts of a moth are called, to identify a given moth. This key is a relational key, not the more familiar dichotomous key, so you can start at any point and jump around as necessary. This is particularly helpful when you have something like a photo in hand rather than a specimen. While for some species it is really useful to know if a moth has hair on its eyes or not, this item is listed last since most people will not be able to answer it. During the identification process, you can use the magic wand tool to help you determine which item will be the most useful to consider as the next step or the pruning tool to remove items that will not be helpful.

Northwest Lepidopterists' Workshop 2012 (cont.)



Figure 1: Unknown moth for identification (this is the same species Lars used, but this specimen was in the drawer prepared by Paul Hammond depicted above)

The identification screen is set up with four boxes. As you select features from the first box, the program will populate the other boxes. The two boxes on the right hand side show which species are still under consideration and which species have been eliminated based on the information the user has filled in to that point.

Lars demonstrated the use of the key. [The key takes a few seconds to load. At the moment, Firefox produces a couple of warning security messages. Answer so as to continue.] He used a picture of the moth shown in Figure 1, knowing that the moth, a fairly big one with a wingspan over 25 mm, was collected in the north Cascades of Washington. He started by filling in the state and then the ecoregion. There is a map to help you figure out the ecoregion if you don't know it (you can click on it to make it bigger). By specifying the moth's size he was already down to 212 possibilities from the 1215 species known in Washington. After specifying the primary and secondary forewing colors, black and white, only 14 species were left. The magic wand tool indicated that the next characteristic that would be most useful was this moth's hindwing color. Filling that in left six species, which Lars then toggled through to find the match. The species page indicated that the only other one species could possibly be confused with the species he came up with, *Gnophaela latipennis* which occurs in western Oregon—that is not where the specimen came from so we had a match. His specimen was *Gnophaela vermiculata* (Grote 1864), the Police Car Moth. (A lot of people like common names so Merrill insisted on putting common names on the entries.)

Perhaps the biggest limitation of the key is that if you pick an ecoregion and the moth has not yet been collected there you can



Figure 2: *Leucoma salicis*, the Satin Moth [USA: Oregon: Klamath County: Klamoya Casino (Highway 97 in Chiloquin): parking lot—2011 July 22 2:00 am]. Photo by Ron Lyons.

get in trouble. If you do run into trouble, perhaps because the moth came from an area with little or no data, try the state level or avoid specifying the location at all.

Data Mining and the Future

Lars showed how the database could be used to provide information on the spread of an invasive species, *Leucoma salicis*, the Satin Moth (Figure 2), a shiny white species which first showed up in North America in 1920 in Vancouver, B.C. If you filter the data at five year intervals, you can see how it expanded its range fairly gradually. By 2010 it could be found over most of our area.

Lars is happy to identify photos or specimens—anything to get you excited about moths. Members of the public who made moth collections when they were teenagers find that they can now really use them, and have sent in data. Nowadays, Lars puts his collecting field notes onto the computer and Merrill Peterson imports the information into the database before the specimens are even spread. Lars said, "It is really exciting that what you do today makes a difference and helps us update a site like this."

Rare Lepidoptera Books Donated

Jon Shepard has donated his copy of William Henry Edwards' "Butterflies of North America" (3 volumes, 1860s–1890s) to Oregon State University. These will be placed in the rare book room collection.

Northwest Lepidopterists' Workshop 2012 (cont.)

Jon Shepard—The Database of the PNW Moths Website

The database covers the greater Pacific Northwest to a southern limit of 40° North and an eastern limit of 108.5° West.

So far Jon has databased about 65000 total records, of which only about 5000 are not based on actual specimens. Lars Crabo databased his own collection. The project started with five major sources of data—the three big public collections and two large private collections (Table 1).

Table 1. Approximate number of specimen records from major collections databased.

OSAC	WSU	UI	ODA	Lars Crabo	Jon Shepard
20,700	12,400	6,600	4,000	11,000	11,000

To illustrate the strengths and weaknesses of the various major collections as far as coverage went, Jon brought up the information for *Habrosyne scripta* (Figure 1), a common, widespread moth in the Family Drepanidae Subfamily Thyatirinae, <<http://pnw-moths.biol.wvu.edu/browse/family-drepanidae/sub-family-thyatirinae/habrosyne/habrosyne-scripta/>>. For this particular species there are a lot of records. Clicking on the “Collections” tab under the “Data Filters” brings up a list of all the collections that contain databased records of this species. Jon used the “Collections” filter to select the records for each major collection one at a time. Since a number of old historical collections are included, you can also see everyone’s contribution to PNW Lepidoptera over the years.

One point to be aware of concerns the seasonal bar graphs for each species. Each unique locality and collecting date only contributes one unit to the bar graph. The actual number of specimens col-



Figure 1. *Habrosyne scripta*—Lettered Habrosyne (USA: Oregon: Coos County: Bandon, porch light, 2006 June 18). Photo by Ron Lyons

Activity Reports

Dana Ross—Oregon Season Summary

Dana indicated that a number of projects were carried out over the past year which will probably produce a number of new moth records, but that the material has not been processed yet. These include his own project (plus Paul Hammond and Terry Stoddard) in The Dalles where sampling began in the spring and will continue into November with the efforts of Dick Stentz, some September collecting done at Malheur NWR in Harney County, and a continuation of the collecting at the Klamath Marsh NWR by Faye Weekley. Paul Hammond also has a project in the coast range.

John Roth from Oregon Caves National Monument in Josephine County has done some recent collecting and has new moth records for *Polychrysis morigera*, a noctuid moth which usually has to be reared from larvae collected from its *Delphinium* host plant because it rarely comes to lights, *Autographa sansoni*, and *Eurhinosia flavaria*—a small yellow geometrid collected at Bigelow Lake. *Apamea acera* was also collected.

On the butterfly front, Bob Pyle reported finding the Arctic Skipper (*Carterocephalus palaemon*) on the bluffs in the St. Helens area of Columbia County. Ann Musché found Persius Duskywing (*Erynnis persius*) at Kings Mountain. Bill Yake had some interesting late season records from the lower reaches of the confluence of the Rogue and Illinois Rivers in Curry County. He found Common Checkered Skipper (*Pyrgus cummunis*), Mylitta Crescent (*Phyciodes mylitta*), and California Sister (*Adelpha bredowii*) on 3–4 October, and recorded Zerene Fritillary (*Speyeria zerene gloriosa*) on 4 October from the upper Illinois canyon.

Lois Hagen, President of the Eugene–Springfield Chapter of the North American Butterfly Association, indicated that their 4th of July Butterfly count in the Cascade–Siskiyou National Monument this past summer came up with 57 species. The results for this count and the other counts in Eugene and Browder Ridge are on their website <<http://www.naba.org/chapters/nabaes/>>.

Ann Potter—Washington Season Summary

Ann indicated that a few people have been looking in areas that haven’t been done before. John Baumann reported several finds which appear to be new county records. In Spokane County he found the Duskywing Skipper (*Erynnis pacuvius*) and Arctic Skipper (*Carterocephalus palaemon*).

continued next page...

Northwest Lepidopterists' Workshop 2012 (cont.)

Activity Reports (cont.)

From Whitman County he reported Sagem (*Atalopes camp-estris*), the first one outside the edges of the Columbia–Snake River, way north in Whitman County at higher elevation, 2400'. We know from Lisa Crozier's research that this butterfly in particular is responding to warming temperatures (2004. Warmer winters drive butterfly range expansion by increasing survivorship. *Ecology* 85: 231–241. Online at <<http://www.co2science.org/articles/V8/N44/B2.php>>).

The Variegated Fritillary (*Euptoieta claudia*) was reported for the first time in the state—first in Spokane County and then one month later in Benton County, so presumably more than one individual was involved. Jon Pelham pointed out that this is a much more common visitor to British Columbia than Washington or Oregon. The species apparently flies up the east side of the Rockies and crosses over the mountains in British Columbia. From there it disperses south into Washington, rather than coming up from California. Jon Shepard attributed the lack of earlier Washington records to the lack of collectors.

Jon Shepard reported the first Monarch (*Danaus plexippus*) from Pend Oreille County and indicated that he found no Painted Ladies before August. The season started late but once it did, everything came out at once.

The finding of the Monarch precipitated a general discussion about the release of captive bred butterflies for events and from school activities and the impact this is having on the scientific integrity of the observations for the species involved. Ann Potter pointed out that Monarchs are more expensive than Painted Ladies so the latter are more commonly used. Since there are also school kits for raising Painted Ladies, the data for this species are much less reliable. She indicated that it is technically illegal to buy animals from outside Washington and release them in the state. The Oregon Department of Agriculture has changed the requirements concerning Monarchs on the current list of insects approved for release in the state (download the PDF of the current list at <http://www.oregon.gov/ODA/PLANT/IPPM/Documents/ippm_app_insect_list_1.1.pdf>). For educational purposes, people indicated that educators should be encouraged to change their emphasis and use local resources, as promoted by Todd Stout from the Utah Lepidopterists' Society. The impact on local populations should not be significant if locally sourced material is released.

lected is not reflected in the bar graph. (The website of the University of Alberta makes bar graphs of the total number of specimens available as well.)

The database can be used to indicate areas that need further investigation. For instance, there is a big gap in coverage in central and eastern Idaho and western Montana, so that is an area that needs work. While databasing the OSU collection, Jon realized there wasn't a single oak species recorded on the east side of the Cascades in Oregon and yet across the border in Washington, there were a bunch of them. This fact led to Dana Ross's project in The Dalles this past year. Some people have started using the data to look at changes in invasive species distributions and possible impacts resulting from climate change. For the season summary you now can be pretty sure when you have a new county record.

Some Questions and Answers

1) What about inventory data (i.e. listings that are not specimen based)?

Jon indicated that it would be hard to illustrate this kind of data on the maps since many of the points would overlap (e.g. the copious data from the Andrews Forest study). However, he had no fundamental problem provided the data were well vetted. Some small databases have already been included.

2) What about caterpillar photos?

Jon indicated he would love to have the photos of the larvae if they can be reliably identified. It would be relatively easy to add another box that would allow you to scan through the immature stages.

3) Status going forward

WWU is committed to hosting the website. Adding more data for existing species is straightforward. There is a bit more work involved to include a species that is not currently in the database. Other collections, such as the College of Idaho, Utah State and Montana State, have granted access to their collections. Their arctiid data have already been added so this group is much more complete than any other in the database. Jon has started to include the data from the Yukon. The next step is to apply for funding for the Geometridae and perhaps some others.

Nelson Curtis supplied computer files of all his Idaho butterfly records; Jeff Miller and Dana Ross have already databased all of Hinchliff's Oregon butterfly records. The Washington Department of Environment [Ann Potter] has databased Washington butterfly records.

4) What are the restrictions, if any, on the use of the data?

Each collection has the right to say whether their data can be

Northwest Lepidopterists' Workshop 2012 (cont.)

used outside the website (see the end of the web page "About the Data" under the "Explore Data" heading at the bottom of the page). There is a need to track the records when multiple sources are combined to avoid future confusion. Data gets duplicated and people lose track of where it came from originally. There is a national effort to get ID numbers on specimens so we don't get confusion, e.g. same images or different images of the same specimens from different sources. This effort also applies to photographs.

4) What about new submissions?

People who have new data they would like to submit should contact Jon or Merrill Peterson. If necessary photos or small collections will be vetted.

Dana Ross—Beyond *Leona*: Lepidoptera and other insects of the Sand Creek area

Dana reported on a study he carried out with the assistance of Gary Pearson which took place at Sand Creek in Klamath County, just downslope and to the east of Crater Lake. The area is the site of one of Harold Rice's many discoveries, a small blue butterfly described by Paul Hammond and David McCorkle named *Philotiella leona*, or more commonly *Leona's Little Blue*, after Harold's wife. To this day as far as we know, *leona* only occupies a several square mile area in northern Klamath County. The study ran from late June through late August of 2011 while *leona* was present as an egg, larva or adult.

Sand Creek is an interesting spot because not everything fits the mold there. Situated at the base of the east side of the Cascades, it receives influences both from the Great Basin and from the Cascades. The eruption of Mt. Mazama, which also made Crater Lake, left an extremely deep layer of pumice ash soil there. Alluvial fans, a source of subsurface water, also feed into the area. The result is a fairly unique habitat, in the sense that it is much more open there, even in its more natural state, than it might otherwise have been and this has created a nice little boundary for the *leona* habitat. Some logging of lodgepole pines has occurred and slash piles are either present or have been burned. Spurry Buckwheat, *Eriogonum spergulinum*, is the food plant for the larvae and a nectar source for the adult butterflies. In the more natural areas, Spurry Buckwheat is interspersed with other vegetation; in the more disturbed areas, it occurs in dense stands.

The Sand Creek area is a favorite haunt for collectors that are after some of the regionally endemic species of butterflies—things like Moeck's Egleis Fritillary, *Speyeria egleis moecki*, have been named from there. A number of other interesting butterflies and moths have turned up there as well. The site is slow to warm up in the mornings with many butterflies not active till 11 AM or so.

Rather than looking at *leona* specifically, the study focused on the community of insects and other arthropods that surround *leona* to gain some baseline understanding about the greater Sand Creek insect community. The assemblage of butterflies flying when *leona* was active was documented. The study also focused on potential competitors of *leona* and predators that might be using the butterfly as a food source, such as dragonflies and damselflies, robber flies and hornets/yellowjackets since these eat insects and other Lepidoptera. Since *leona* larvae are very

Dave Specht—Seasonal Butterfly and Moth Activities

Dave presented a summary of his observations of lepidoptera activity during 2012 at Powell Butte (Powell Butte is located in east Portland, east on Powell out of town, main entrance is at SE 162nd Ave) where he has been documenting activity since 2005.

Ranchman's Tiger Moth (*Platyprepia virginialis* [Boisduval]) numbers were down a bit from 2011 but they were still very noticeable. Dave attributes their abundance to recent lupine planting in the park, particularly along the drainage ditch banks for erosion control. A few Woodland Skippers were seen in June and July, but unexpectedly surged to 100 on 24 August. In prior years only small numbers were seen the Park.

He and his wife Carol participated in an Audubon-sponsored butterfly trip led by Bill Neill to the Satus Pass area (on US 97, about 12 miles north of Goldendale, Washington, up from the Columbia Gorge). Dave showed pictures of butterflies from this trip.

A Digital Archive

David Lee Myers suggested that the group create a digital archive of its history, with the idea of eventually creating a group website. Until a repository is available it was also suggested that participants start sharing their materials so that multiple copies exist.

The first step in such a project is to make a list of the materials—meeting programs, meeting notes, photographs (digital, negatives and/or prints), articles and so on—that would be available for inclusion. If you have some materials you think should be included, please write down a brief description [if you know the year(s) the materials apply to please indicate this] and send it to Ron Lyons at <pondhawk@uci.net>, or David. Please don't send any materials just yet. The purpose of this request is to see what is available (certainly for some of the recent material, multiple copies undoubtedly exist) before proceeding.

Northwest Lepidopterists' Workshop 2012 (cont.)

close to the ground on the tiny buckwheat plants and the pupae also remain pretty much at ground level, it made sense to look at activity on the ground in the areas with *spergulinum*, thus ants and ground beetles were included. In addition, activity around other nectar sources that *leona* used was documented, both in terms of potential competitors for the nectar and potential predators.

The area was sampled over five different 6-day intervals throughout the late June–August period. The same tasks were carried out in each interval. On each visit Dana and Gary would document the butterflies, day-flying moths, dragonflies and damselflies, robber flies and yellowjackets/hornets that they found, some of which were uncommon that summer. They identified the primary flowers that *leona* was visiting each field session. They spent defined time periods focused on areas where these nectar flowers, such as aster or woolly sunflower, were particularly abundant, and gathered specimens and information about the arthropod communities attracted to them, especially the species who might be potential competitors or predators. They also spent some time collecting insects that were on the Spurry Buckwheat.

Moths were collected using uv/black light traps at 10 permanent sites, resulting in 50 samples from the five sample periods. Fortunately this was a normal year for Pandora Moths, otherwise, based on past experience during population outbreaks, the large moths would have overwhelmed the moth traps and virtually destroyed the other moths collected, making identifications impossible.

Pitfall traps were placed at five sites of various disturbance levels to sample ground predators. Each site had three double pitfall traps within stands of Spurry Buckwheat. Pitfall traps were placed in the ground about June 20th and the samples removed each 10 days or so after that though the end of the study.

Katy Prudic—How The Butterfly Got Its Beautiful Wings

Katy Prudic, PhD, is a research scientist working with butterflies in David Maddison's lab at OSU.

The main theory in butterfly evolution is that butterflies speciate, i.e. go from one to many species, in response to the defense strategy of their host plants which include chemical and physical defenses (Erich & Raven 1964). That theory, however, doesn't really explain why butterflies have such beautiful wings.

If the relationship between the larva and its host plant is leading to speciation then why do we see all these different wing patterns among adult butterflies? This question is what has focused Katy's research from her undergraduate days to the present. She studies the form and function of butterfly wing patterns across space and time and the ecological aspects, such as how the butterflies use

Over this essentially two month period, 37 species of butterflies were recorded. Dana indicated that a dozen or more additional species may be present at some time. *P. leona* itself was found on the east side of Highway 97 for the first time. For whatever reason, its larval host plant Spurry Buckwheat seems to be expanding its range in the area and *leona* is expanding its range with it.

The samples from the black light traps added considerably to our knowledge about moth distributions.

Dana was impressed by the number of robber flies, and the number of species these represented at the site. While he thought that some robber fly species might take small butterflies including *leona*, there was only one observation that he knew of where a robber fly had, in fact, taken a *leona*.

A number of grasshoppers and beetles were collected in the pit fall traps. Perhaps surprisingly, there was only one scorpion taken, but there were numerous solpugids (wind scorpions) in the samples.

The effort documented many of the insects occurring in the Sand Creek area, created a baseline on the Lepidoptera around when *leona* is active, and established a representative insect collection, thanks to interest and funding from the USFWS in Klamath Falls, and to biologist Tia Adams in particular. The project included oversight and contributions by Debbie Johnson of Applegate Forestry, LLC.

Dana indicated that a number of insect species sampled were regionally uncommon to rare, but were fairly common at Sand Creek, suggesting the area is unusual and worthy of conserving for more species than just *leona*'s Little Blue.

their wings in interactions within and between species. She also looks at how wing patterns change in butterfly species and how that relates to their biodiversity.

For her undergraduate thesis, working with Art Shapiro and Nicky Clayton at UC Davis, she studied the mimicry relation between the Lorquin's Admiral and the California Sister. They found that Lorquin's Admiral (*Limenitis lorquini*) is a tasty mimic of the unpalatable model, the California Sister (*Adelpha californica*) (Prudic *et al.* 2002).

As a graduate student she worked with Dan Papaj, an insect behavior biologist at the University of Arizona, and his group. Here she studied the mimicry relationship between the Viceroy (*Limenitis archippus*) and the Queen (*Danaus gilippus*) butterflies (Prudic 2007, 2011). It turns out the palatability of the Viceroy as far as

Northwest Lepidopterists' Workshop 2012 (cont.)

predators are concerned depends on whether or not the Queen is in the same population as the Viceroy. If the Queen is present the Viceroy is palatable; if not it is unpalatable. Since the Viceroy's host plants have the same chemical defenses in both cases, there seems to be some response in the Viceroy that causes it to sequester more chemicals when Queens are not present. So, butterflies use their wings to fool predators and to honestly signal them.

She also worked on a project that involving admiral butterflies (*Limenitis*) that showed that butterflies can re-evolve cryptic ancestral wing patterns based on whether or not their model is in the same population. This showed that changes in mimicry or interactions between predator and prey can lead to changes in wing pattern (Prudic & Oliver 2008).

Another project on *Papilio* caterpillars (Prudic *et al.* 2007) showed that caterpillars evolve warning color patterns based on their ecological context, not on the plant that they feed on. Caterpillars which have prominent warning coloration are easier for predators to find, but these color patterns are also easier for predators to remember, particularly when they are associated with a nasty taste. It is the shape of the leaf that the larva is sitting on that actually determines whether or not that warning color pattern will evolve.

After receiving her doctorate, Katy went to Yale and worked with Antonia Monteiro, professor in ecology and evolutionary biology, and others in her lab. Here the research emphasis was on evolution and development. Since the development of the wing pattern begins in the caterpillar's 4th and 5th instars, the question arose as to how larval conditions during that period might affect the form and function of the adult wing pattern. Using *Bicyclus anynana*, the Squinting Bush Brown Butterfly (distributed in nature from equatorial Africa down to south Africa on the east coast—the eyespots look like it is winking at you), under controlled conditions in the lab, they found that the male and female butterfly sexual roles changed based on the ecological experience during the larval stage (Prudic *et al.* 2011). When the larva were raised at 27° C (wet season equivalent), the females were choosing and the males were courting—the male eyespots were really important as to how the female was going to make her decision. However when the larvae were raised at 17° C (dry season equivalent), much cooler conditions, it was the females who did the courting and the males who did the choosing. So this kind of explains why you see eyespots in this group on the dorsal wing surfaces in both sexes, called sexual monomorphism. They are both using them to signal, but that varies based on which season the generation is occurring in. There are phenotypic differences between the cold and warm broods noticeable in the white center of the eyespot, having to do with its size and uv brightness. The eyespot center in the warm season males and dry season females is bigger and brighter, i.e. when it is signaling, than in the warm season females and cool season males. Katy and Antonia placed a short video on YouTube, <https://www.youtube.com/watch?v=_1AJNkJuyX0>, to illustrate the courtship differences between the warm season and the cool season *Bicyclus* adults.

In conclusion, butterflies use their wings to escape predators and attract mates. These various functions and forms interact with how and when one butterfly species becomes two butterfly species. The biodiversity seen today in butterflies is not all explained by the relationships butterflies are having with their host plants.

David Lee Myers—Artistic Photographic Images of Butterflies

As one of his favorite photographic subjects, David showed a number of his butterfly images. He likes to take images that are “emotionally and aesthetically expressive”. Unfortunately, most photographs only convey one aspect of any given experience. For that reason, David has been experimenting with composite images to better convey his fuller experience.

For examples of David's photography, including some early composites, visit his website, <<http://www.davidleemyersphoto.com>>.

Jeff Miller—Documenting through Photography Thailand's Butterflies and Moths: Caterpillars and Adults

In looking for something a little different, Jeff has become an avid photographer with a very artistic eye. He said,

“I've learned that I love doing coffee table books—the most rewarding publication format one could ever experience”.

In this effort he is conducting an ongoing project in Thailand to document the taxonomy, the biogeography, and the food plants of the local caterpillars, photograph them through their development, and rear them so that they can be associated with their adult forms, because all the names are associated with the adult forms.

He employs teams of between 4–9 people to go on walkabouts to collect caterpillars. The caterpillars are then reared and their behavior documented. Jeff is on the committee of a Thai graduate student who is involved in this effort.

Before his presentation, Jeff showed some pictures of caterpillars and the associated adults. An informal poll indicated that people overwhelmingly thought the caterpillars were prettier, certainly more interesting, than their adults. Jeff showed images of a number of these interesting caterpillars and the associated adults, some of which will undoubtedly make it into his next coffee table book.

Northwest Lepidopterists' Workshop 2012 (cont.)

Katy wants to explore where and when the different interactions—plant–larva, sexual, predator–prey—come into play for butterfly speciation and biodiversity.

In order to pursue these studies Katy needs lots of butterfly data—geographic range data of the butterflies, who they are interacting with, when they are out, what they are eating, and who is eating them. To that end, Katy is collaborating with Drs. Jeremy Kerr and Max Larrivee from the University of Ottawa, to expand a citizen science website originally developed in Canada, <<http://www.ebutterfly.ca/>>, to include the United States.

The idea with the website is that you get to build your own virtual collection of butterflies. It allows you to upload photos and get them validated by experts; it lets you keep track of your life list, your state list and your year list in the US and Canada. You can find out what butterflies you have not seen in a particular area, and what butterflies you should see that no one has reported yet. You can share your sightings and communicate with others in the butterfly community. The data are primarily being used for research but the information is also important for science education and outreach. As an added bonus, you can be notified when your data has been used in a scientific research project.

There will be several announcements when the new website is available, but right now, you can test and probe the development site at <<http://dev.macroecology.ca>>. Feedback from interested users is always welcome. Users of the development site will have the option of moving their data over to the new site. The new website, <<http://www.eButterfly.us>>, should be up and running early in 2013.

References

Ehrlich, PR and P.H. Raven. 1964. Butterflies and plants: a study in coevolution. *Evolution* 18: 586–608.

Next Year: Northwest Lepidopterists' Workshop 2013

In 2013 the groups of emphasis will be:

- ▶ Butterflies: Blues and Swallowtails
- ▶ Moths: general moths, especially Geometridae of the Macarías Group

In addition, a special session is scheduled to discuss teaching young people.

- Prudic, K.L. 2007. Warning and Deception: Chemical, Behavioral, and Phylogenetic Studies of Aposematic Coloration and Mimicry. PhD thesis University of Arizona Department of Ecology and Evolutionary Biology: 143 pp. (PDF from <<http://arizona.openrepository.com/arizona/handle/10150/194374>>)
- Prudic, K.L. 2011. A mimic without its model—geographic variation in viceroy butterfly chemical defenses, palatability, and mimicry. Entomological Society of America 2011 Annual Meeting Program (Abstract). (abstract at <<http://esa.confex.com/esa/2011/webprogram/Paper58800.html>>)
- Prudic K.L., C. Jeon, H. Cao and A. Monteiro. 2011. Developmental plasticity in sexual roles explains mutual sexual ornamentation. *Science* 331: 73–75. (download PDF from <<http://lepdata.org/monteiro/publications.html>>)
- Prudic K.L., J.C. Oliver and F.A. Sperling. 2007. The signal environment is more important than diet or chemical specialization in the evolution of warning coloration. *Proceedings of the National Academy of Sciences of the United States of America* 104(49): 19381–19386. Epub 2007 Nov 20. doi: 10.1073/pnas.0705478104. (available through <<http://www.ncbi.nlm.nih.gov/pubmed/18029450>>)
- Prudic, K.L. and J.C. Oliver. 2008. Once a Batesian mimic, not always a Batesian mimic: mimic reverts back to ancestral phenotype when the model is absent. *Proceedings of the Royal Society B* 275(1639): 1125–1132. doi: 10.1098/rspb.2007.1766. (available through <<http://rspb.royalsocietypublishing.org/content/275/1639/1125.abstract>>)
- Prudic, K.L., A.M. Shapiro and N.S. Clayton. 2002. Evaluating a putative mimetic relationship between two butterflies, *Adelpha bredowii* and *Limenitis lorquini*. *Ecological Entomology*, 27: 68–75. doi: 10.1046/j.0307-6946.2001.00384.x (abstract at <<http://onlinelibrary.wiley.com/doi/10.1046/j.0307-6946.2001.00384.x/abstract>>)

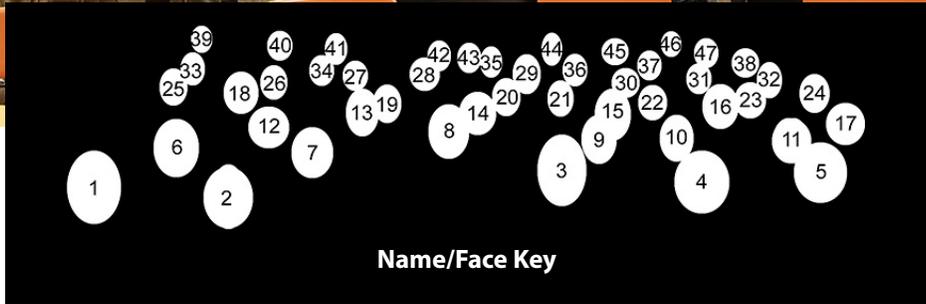
Acknowledgements

I would like to extend my many thanks to all the presenters for their comments, corrections, and changes to the various summaries I prepared from the meeting record. I know all the feedback improved the accuracy and usefulness of the material. Thank you all very much.

Ron Lyons



Northwest Lepidopterists' Workshop 2012 attendees: Jon Shepard (1), Bill Neill (2), Jon Pelham (3), Ann Albright (4), Dennis Streng (5), Jim Reed (6), Paul Hammond (7), Gary Lindberg (8), Dave Specht (9), Carol Specht (10), Steve Van Campen (11), Idie Ulsh (12), David Maddison (13), Dave Nunnallee (14), Jo Nunnallee (15), Ross Tewksbury (16), Emma Van Campen (17), Vernon Covlin (18), Terry Stoddard (19), Dave Hagen (20), Lois Hagen (21), Sue Anderson (22), Dennis Deck (23), Steve Kohler (24), Lars Crabo (25), Richard Worth (26), John Davis (27), David Lee Myers (28), Ray Stanford (29), Robin Cushman (30), Lori Humphreys (31), Katy Prudic (32), Jeff Oliver (33), Paul Severns (34), Ann Potter (35), Andrea Peters (36), Gary Peters (37), Dave McCorkle (38), Ron Lyons (39), Lucas Reed (40), Dave McNeese (41), Alan Richards (42), Anne Musché (43), Dana Ross (44), Jeff Miller (45), Rick Ahrens (46), Jim Anderson (47).



2013 Pacific Slope Meeting of The Lepidopterists' Society—Help Wanted

Plans are being formed for the Pacific Slope Meeting, to take place during the summer of 2013 in Oregon. Several dates and venues are still being considered, and more information will be posted in the Spring Bulletin, as well as at the OSAC website, <http://osac.science.oregonstate.edu/pacificslope_2013>, and on the Lepidopterists' Society website.

If you would like to participate in the planning of the meeting, please contact Christopher Marshall at the Oregon State Arthropod Collection at <christopher.marshall@oregonstate.edu>, before 1 March 2013.

North American Butterfly Association

Upcoming Meetings of the Eugene–Springfield Chapter

Meetings of the Chapter are free and open to interested members of the general public.

Meetings are held at the EWEB Training Center, 500 E. 4th Avenue, Eugene, Oregon. Doors open at 7:00 PM for social time; the presentation begins at 7:30 PM.

Meeting: Monday, 11 February 2013

Fauna in the West Eugene Wetlands with Rick Ahrens

Meeting: Monday, 8 April 2013

Oregon Butterflies and their Relationship to Flowering Plants with William Neill

For more information on the Chapter and its activities visit their website <<http://www.naba.org/chapters/nabaes/>>.

The Northwest Lepidopterists' Fund in honor of Harold E. Rice—2013 Call for Proposals

Submissions are now being accepted for the 2013 Northwest Lepidopterists' Fund in honor of Harold E. Rice.

This fund, which provides one or two awards for up to \$500 each, is given annually to encourage activities directly related to PNW Lepidoptera and/or activities related to the improvement of the Oregon State Arthropod Collection's (OSAC) Lepidoptera collection. For full consideration applications must be received by 31 January 2013. More information, as well as directions for how to apply, can be found by downloading the PDF from <<http://osac.science.oregonstate.edu/PNWLepidopteristsFund.pdf>>.

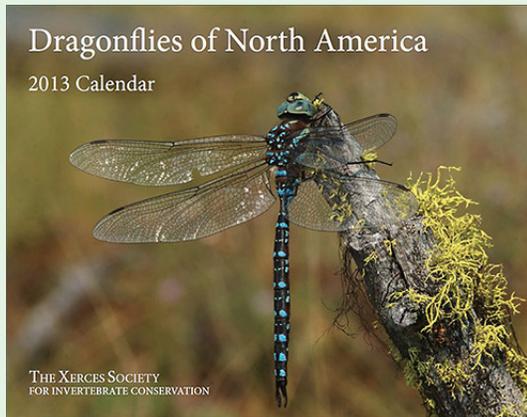
2013 ESA Pacific Branch Annual Meeting

The 97th Annual Meeting of the Pacific Branch of the Entomological Society of America will be held at Harrah's Hotel at Lake Tahoe 7–10 April 2013. The theme for the meeting is: "Entomology in the Pacific Branch: A Sustainable Science for a Sustainable Future!"

For full conference details visit <<http://entsoc.org/Pacific/2013-esa-pacific-branch-annual-meeting>>.

2013 Dragonflies Of North America Calendar

Produced by the The Xerces Society, this 9" × 12" calendar features stunning photography of these dramatic insects, accompanied by brief notes about their natural history, behaviors, and conservation needs. Calendars cost \$15 each. For more information or to order visit <<http://www.xerces.org>>.



On Flies

"Watching flies in a bottle is not the most stimulating pastime in the world. It is astonishing how much of a fly's life is spent doing nothing. A fly sits, rubs its front legs together, its front legs over its head, its front legs and its middle legs, its back legs over its wings, its back legs together, and on and on. It crawls, it flies, it drinks, it makes fly specks. But mostly it just sits. Such a wanton waste of time is devastating to the morale of one who himself can think of so many better ways to use time."

Vincent G. Dethier, To Know A Fly ©1962 (McGraw-Hill) pg 41–42

OSAC's 2013 Cabinet Campaign

As publicly announced at the Northwest Lepidopterists' Workshop, the Oregon State Arthropod Collection (OSAC) kicked off a fundraising event to provide state-of-the-art cabinetry for the Lepidoptera and Hymenoptera collections. To find out more about our progress with the Cabinet Campaign or to find out how you can help support the efforts of the OSAC, visit <http://osac.science.oregonstate.edu/Campaign_2013>.