Volume 2019 Number 4
Winter 2019/2020

Bulletin of the
Oregon Entomological Society

Inside *Darlingtonia californica* (California Pitcher Plant) *text and photos by Cary Kerst*

Odonata enthusiasts on the west coast have an inherent interest in the *Darlingtonia* wetlands (Figure 1) found in northern California and southern Oregon. This interest is driven by the fact that these wetlands are prime habitat for the petalurid dragonfly, *Tanypteryx hageni* (Black Petaltail). The California Pitcher Plant is considered to be an uncommon plant. However, they can seem common in the right habitat such as these wetlands in the nutrient-poor, serpentine soils of Oregon and California. The California Pitcher Plant is a perennial and reproduces asexually via stolens but also produces flowers and seeds. In fact, a large wetland will produce an abundance of flowers (Figure 2). Insect prey provide these carnivorous plants with nitrogen and phosphorus allowing them to exploit this habitat with its nutrient-poor soil.

The pitcher of the plant is a modified leaf folded over on itself on a stem a foot to a foot and a half tall (Figure 3). The pitcher consists of a domed hood on a tapering stem. There is an opening on the underside of the hood with a forked "tongue." This forked

Figure 1. *Darlingtonia californica* wetland in Curry County, Oregon. April 30, 2019. Note the windows in the pitchers and the emerging bloom (just left of center).

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** <gomphusjim@google.com>.

Figure 2. *Darlingtonia californica* flower

structure led to one of the common names of the plant, Cobra Lily. It was thought that the forked tongue functioned to attract insects and guide them into the hood. However, Armitage (2016) showed that the removal of this structure did not change the biomass or composition of prey. The pool where trapped invertebrates are digested is found at the base of the pitcher stem near the ground (Honda 2013).

The plants put up new series of pitchers every year, and a wetland will have a mix of new and old pitchers from the previous year. Plants bloom early in the year. Pitchers grow away from other pitchers sometimes at odd angles. This growth pattern serves to maximize the area covered by pitchers. Nectar is produced inside the hood attracting insects where they can become confused by the thin windows (fenestrations) in the hood of the pitcher. These transparent light areas lack chlorophyll and can appear to be exits. Insects that become exhausted or merely travel down the opening in the center of the stem are prevented from moving back up by downward-directed hairs. Eventually prey will fall into the liquid at the bottom of the stem where they will be digested with the aid of commensal organisms (Lindzey 2001).

I have been curious about the California Pitcher Plant's ability to attract and capture invertebrates though they are obviously successful given the size and number of populations found on suitable habitat. I opened a couple of stems of pitchers formed during the current year to see what might be trapped inside and was surprised at the quantity and variety of insects. There was a strong odor of decaying insects when I opened the stem. This odor, no doubt, is also attractive to a host of insects. Figure 4 shows the bottom area of the stem with moths and beetles easily identified. You can also see the downward projecting hairs that make it difficult for prey to crawl back up the stem to escape. I was surprised to also note that there were what appeared to be Diptera larvae crawling around in the hairs of the stem. I believe these are the larvae of Phoridae (scuttle flies).

In April, 2019, I found a population of California Pitcher Plants along a remote road in Curry County, Oregon. In opening a

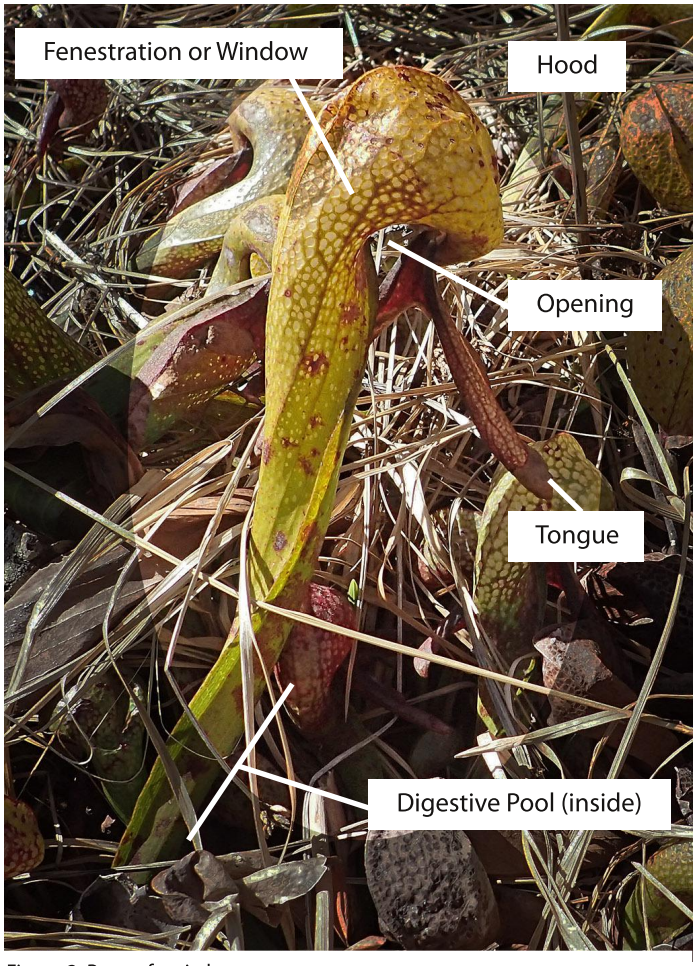


Figure 3. Parts of a pitcher.

couple of the pitcher stems, I found debris from the digestion of invertebrates which consisted of the chitinized portions likely from the previous year. The stem in Figure 5 had about 8 inches of this debris at its base.

Removing the debris from the stem and viewing it under a microscope (Figure 6), entomologists can have a bit of fun trying to identify the head capsules, thoracic parts, legs, and such! In the debris from a single stem, I also found many dipteran larvae (Figure 7). Upon doing some research, I found that the invertebrates inhabiting *Darlingtonia californica* are fairly well known. In fact, the obligate midge, *Metriocnemus edwardsi*, was described over a hundred years ago! There is a small commensal ecosystem in the liquid pool in the bottom of the plant stem that assist with the digestion of invertebrates.

The larvae found were all either Chironomidae or Phoridae though many other invertebrates are known from the plant. *Metriocnemus edwardsi*, along with a mite, *Sarraceniopus darlingtoniae*, are found in virtually every pitcher days after opening (Armitage 2017 supplement). Along with invertebrates, bacteria, protozoa, fungi, ciliates and rotifers are also present.

I found 54 midge larvae in a single stem of the plant which I

assume to be larvae of *Metriocnemus edwardsi*. In addition, there were 127 larvae and pupae of Phoridae which may be *Megaselia orestes*. This scuttle fly larva was found in 43% of pitchers examined in a study by Brandt (2017) conducted in southern Oregon and northern California. Brandt found a total of seven invertebrate taxa in her study. In a study by Nielsen (1990), 21 species of invertebrates were found in *Darlingtonia californica* pitchers in the Klamath Mountains of northern California including several undescribed species.

Nielsen (1990) indicates that the composition of the invertebrate communities in pitchers in his study varied significantly over both large and small geographic areas. There are, without doubt, new discoveries to be made in this fascinating plant.

References

Armitage, D.W. 2016. The cobra's tongue: Rethinking the function of the "fishtail appendage" on the pitcher plant *Darlingtonia californica*. American Journal of Botany 103(4):780–785. (Access the paper at <https://doi.org/10.3732/ajb.1500524>.)

Armitage, D.W. 2017. Linking the development and functioning of a carnivorous pitcher plant's microbial digestive community. ISME Journal 11: 2439–2451. (Download PDFs of the paper from <https://www.openmicroscope.org/s/ISME_2017_armitage.pdf> and the supplement from <https://www.openmicroscope.org/s/ISME_2017_armitage_supplement-ptet.pdf>.)

Figure 4. Insects trapped by *Darlingtonia californica*, Josephine County, Oregon.

Figure 5. Insects trapped by *Darlingtonia californica*, Curry County, Oregon.

Figure 6. Contents of a *Darlingtonia californica* pitcher with larvae of Diptera.

Brandt, S.M. 2017. *Darlingtonia californica* phytotelma organisms: spatial relations within the metacommunity. MSc Thesis. Humboldt State University, Arcata, California, USA. 47 p. (Download the PDF from <https://digitalcommons.humboldt.edu/etd/97/>.)

Honda, M. 2014. Carnivorous Plants in the Wilderness. Self-published. 274 p. (also 2014-2019 available as a Kindle ebook)

Lindzey, S. 2001. The Biogeography of the California Pitcher Plant (*Darlingtonia californica*). Geography 316 paper, San Francisco State University, San Francisco, California, USA. (Access this paper at <http://online.sfsu.edu/bholzman/courses/Fall01%20projects/pitcherplant.htm> [accessed December 2019])

Mellichamp, T.L. 1983. Cobras of the Pacific Northwest. Natural History 92(4): 46–51.

Nielsen, D.W. 1990. Arthropod communities associated with *Darlingtonia californica*. Annals of the Entomological Society of America 83(2): 189–200. (View the abstract at <https://doi.org/10.1093/aesa/83.2.189>.)

Figure 7. Larvae and pupae of Diptera from a *Darlingtonia californica* pitcher.

New OSU Extension Entomology Website

Jessica Green

The Oregon State University Extension Service is changing its approach to delivering online content, and the website now has a new look and feel. The Extension Service partners with people in every county to provide relevant, research-based information and expertise.

The updated "Topic Page" for Extension Entomology can now be found at <https://extension.oregonstate.edu/pests-weeds-diseases/insects>. This new website framework automatically collates university-produced news, Extension publications, and other informative content aimed at a public audience. Because of this, some of the links on this page take you to pages in other topic areas of the Extension Website. If this happens and you want to return to the entomology topic page either use the arrow keys in your browser or click on the 'TOPICS' tab at the top of the page, select 'Pests, weeds and diseases' on the first menu and 'Insects' on the second one.

The items in the black band at the top and the bottom of the page relate to the Extension Service as a whole, rather than just the insect topic page. For instance, select 'ABOUT' to learn about the scope of the Extension Service. The 'CONTACT US' tab brings up a map and contact information for county offices. The 'TOPIC' tab at the top of the page allows you to narrow your browsing efforts, and this is where visitors can select specific areas of interest to explore.

The items in the white navigational band under the header image help visitors navigate through "insect-related" Extension content.

The 'INSECTS HOME' page is laid out with featured resources, quick links based on common searches, and articles or publications that may be seasonally relevant. It also features a 'PEST MANAGEMENT IN CROPS' section. These are 'COLLECTION's of related content based on cropping system.

At any point, users can 'BROWSE RESOURCES' (button or tab at top), which brings up all content, and can be filtered by type, keyword, etc. using the filter menu on the left.

Select 'EVENTS' for details on all the upcoming Extension-related insect events statewide across Oregon. Another way to find local events would be to contact your local Extension office.

The 'OUR EXPERTS' tab reveals only the 8-or so staff with Extension responsibilities and their job titles. For a full list of faculty entomologists at OSU, use the academic website mentioned below.

Site visitors can ask their own insect-related questions through the convenient 'ASK AN EXPERT' portal, which directs community questions to qualified people who may be able to assist them. This is a national component of Extension, so answers do not always come from OSU, but the response rate is fast.

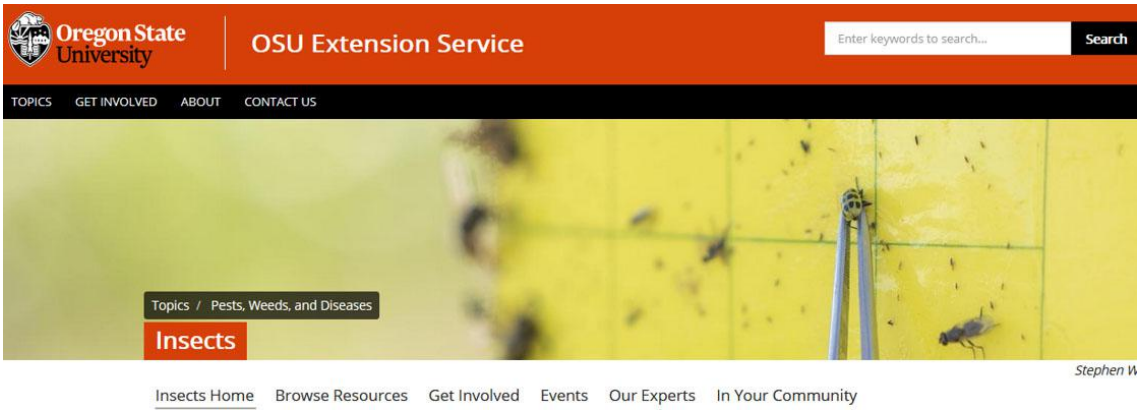
To access the Service's extensive catalog of PUBLICATIONS, use the link at the bottom of the page. Within the catalog, 'Insects' is not a specific topic that you can call up using the subject panel on the right hand side. However, at the top of the catalog page there is a Search function specifically for the catalog.

You can explore the various links offered to find the information you want or you can use the SEARCH function (the entire Extension website is searched). Searching sites is sometimes not as effective as it could be. If you run into problems the link at the bottom of the page, 'How to use this website,' might help.

If you have problems with the new Extension site or have some suggestions you can report them at the bottom of any page (black footer bar), or by using the floating orange feedback button along the right side of the page.

To learn more about OSU Entomology Research programs, or to look for a specific academic faculty entomologist, one would be better off using the <https://entomology.oregonstate.edu> website.

Enjoy!



First record of *Nebria gouleti* Kavanaugh in Montana (USA), and its probable occurrence in Canada (Coleoptera, Carabidae)

James C. Bergdahl [1]

Introduction – The purpose of this report is to record the first state record for Montana of the ground beetle *Nebria gouleti* Kavanaugh, 1979 (Coleoptera, Carabidae), and comment on its probable occurrence in Canada in southeast British Columbia and southwest Alberta.

The ground beetle fauna of the Pacific Northwest is very large and extremely diverse, with about 715 described and recognized species and subspecies in Washington, Idaho, Oregon and British Columbia, including 47 *Nebria* species (Bousquet 2012). There are about 502 carabid species known in Oregon alone (Bergdahl 2013). Although a majority of the species are closely associated with wetlands (hygrophilc), none of them are truly aquatic. About 95 of the carabid species known from the Pacific Northwest, including the upper Columbia Basin in northwest Montana, are endemic to the region, such as *Nebria gouleti*. Most *Nebria* in our area are closely associated with running waters of some type.

***Nebria gouleti* –** This is a remarkable carabid because the adults are large bodied, it is fairly common and easy to collect, and it occurs in well-collected regions of the Pacific Northwest at low elevations, yet it was not until 1979 that Dr. David Kavanaugh (California Academy of Sciences, San Francisco) formally described it. The mature adults are about 13 mm long (excluding antennae) and dark brown (piceous) in color (Figure 1). The distal segments of the long legs and antennae are testaceous (lightened). The elytra have a somewhat dull sheen (due to deeply impressed microsculpture). The adults of many *Nebria* species have brachypterous flight wings (i.e., they are totally flightless); adults of other species may be long-winged or polymorphic for wingedness (Kavanaugh 1985). *Nebria gouleti* appears to be constantly long-winged; therefore some of the adults are probably capable of fight at some point in their short life. Kavanaugh (1985) places *N. gouleti* in a clade with *N. hudsonica* LeConte, 1863 and *N. lacustris* Casey, 1913, both of which are long-winged and appear to occur in similar habitat as *N. gouleti* (see below). Bousquet (2012) places *N. gouleti* in the subgenus *Boreonebria*, which includes two other species in the Pacific Northwest (*N. crassicornis* Van Dyke and *N. gyllenhali* Schonherr) that are long-winged.

This species was named after Dr. Henri Goulet (carabidologist, Agriculture Canada, Ottawa), who took the photo in Figure 1. *Nebria* species are typically referred to as gazelle beetles because of their long legs and ability to run fast when warm; hence the common name of this species is Goulet's Gazelle Beetle.

Type Locality – Rattlesnake Creek, ~16 kilometers (10 miles) southwest of Anatone, Asotin County, Washington. The holotype was collected on 25 August 1973 near Highway 129 at 915 meters (3,000 feet) elevation.

Figure 1. *Nebria* (*Boreonebria*) *gouleti* Kavanaugh. It's folded up flight wings can barely be seen underneath its elytra along the midline. Image courtesy of Henri Goulet.

Rattlesnake Creek flows into the Grande Ronde about 3 miles north of the Oregon border where the Highway 129 crosses the river. Kavanaugh (1979) refers to this town as "Antone", but the correct spelling is Anatone.

Habitat – *Nebria gouleti* is not included in Lindroth (1961) because it was unknown at the time he wrote his comprehensive catalog of 1,110 North American carabid species, which includes notes on their habitats. Surprisingly, Kavanaugh (1979) does not include any notes on the species habitat in his original description of the species. I have personally collected *N. gouleti* at a number of sites in central Idaho during intensive sampling of streamside carabid communities over many years and am somewhat familiar

1 – Conservation Biology Center, University of the Wilderness, 919 S. Adams St., Spokane, WA 99204, USA, <jcbergdahl@gmail.com>

with its habitat affinity; however I have never sampled specifically for the beetle to investigate is full habitat range. In fact, the focus of my sampling has been along low-order streams, and *N. gouleti*, in my experience, appears to prefer high-order streams. Hence, I am usually only sampling stream margins in the upper reaches of a watershed and outside of what appears to be its typical habitat range.

My estimation is that *Nebria gouleti* is an acute ripicolous hygrophile, occurring along the shores of large rivers and streams in the Columbia River watershed. In this regard, as mentioned above, its habitat affinity is similar to *N. lacustris* and *N. hudsonica*, both of which Lindroth (1961) describes as being associated with the barren, usually stony banks of large rivers and streams, not always in mountainous or hilly districts, and not confined to really cold water. He indicates *N. lacustris* is often found along slower, silty reaches with some clay as substrate, which is consistent with the site description of the Montana *N. gouleti* record reported below. In Idaho I have rarely seen it along 0–3rd order streams. The highest elevation record Kavanaugh (1979) mentions is 1,800 meters (5,904 feet) near Stanley, Custer County, south-central Idaho, along the Salmon River near the headwaters of the Columbia/Snake River (Redfish Lake). These are also the southernmost records of the species. The lowest elevation records must be those near Portland, Multnomah County, Oregon, at ~15 meters (50 feet).

Phenology – Lindroth (1961) indicates *N. lacustris* and *N. hudsonica* are larval or pupal hibernators since teneral adults have been recorded in late May and early June in southern British Columbia or southern Ontario. If *N. gouleti* has the same phenology, its larvae/pupae must either tolerate flood/high-water events in winter and spring, or they move out of the flood zone as best they can before hibernation. Kavanaugh (1979) mentions examining hundreds of specimens, but he does not record if any of them were teneral, nor does he comment on the stage that hibernation takes place. He does indicate adults have been collected from April through October, even at the same locality, such as near Lewiston, Idaho, which is the lowest elevation in that State (227 meters/745 feet). I have about 50 specimens in my collection but none of them are teneral. Most of the long distance flight activity by females may take place early in the season just after the teneral stage. Since many adult specimens in collections have been collected during summer months, they do not appear to aestivate. Some of the adults may live ~1 year, perhaps laying eggs early in the second spring/summer before dying.

Geographic Distribution – (From: Kavanaugh 1979: 94; Bousquet & Larochelle 1993: 45; Bousquet 2012: 158; Bousquet et al. 2013).

Nebria gouleti is previously known primarily from low elevations of interior ecoregions of the Pacific Northwest of the United States in Idaho, Oregon, and Washington. All records are from the Columbia River watershed (basin). Its westernmost populations appear to be in both Washington (White Salmon) and Oregon (Hood River, Portland) in the Columbia River Gorge, and outliers in Leavenworth (Washington) area. The northernmost records are in Idaho near Sandpoint, Hayden Lake and Coeur d'Alene, in Bonner and Kootenai counties. The southernmost records are on the Middle Fork and mainstem Salmon River near Stanley and Salmon (Idaho). The species is easy to find along the mainstem Salmon River east of Riggins (Figure 2). What appear to be outliers in the Columbia River Gorge and near Leavenworth on Kavanaugh's range map may be artifacts of insufficient collecting.

Kavanaugh (1979: 94; Figure 51) reports the beetle from the following counties in the United States. IDAHO: Adams, Bonner, Clearwater, Custer, Idaho, Kootenai, Latah, Lemhi, Nez Perce, and Shoshone counties. OREGON: Baker, Hood River, Multnomah, Umatilla, Union, and Wallowa counties. WASHINGTON: Asotin, Chelan, Columbia, Franklin, Klickitat, Skamania, Spokane, Walla Walla, and Whitman counties.

Kavanuagh (1979, Figure 51, page 159) provides a map of the Pacific Northwest indicating localities where *N. gouleti* has been collected. If the density of localities where the species has been collected is an indication of the concentration of its populations, then it is clear the species is closely associated with the "Clearwater River Refugium" of central Idaho (Lichthardt & Moseley 1994). This region experiences high levels of rain and snowfall as wet storms move easterly, funneling up the Gorge of the Lower Columbia River, and confront the west slope of the Bitterroot Mountains in Idaho. This region served as a refugium for species closely associated with inland coniferous temperate rainforest during the Pleistocene, and is a hotspot of endemic species and genetic diversity (Lichthardt 1999; Brunsfeld & Sullivan 2006; Bergdahl & Kavanaugh 2011; Carstens et al. 2005). What may be somewhat isolated, westernmost outlying populations in the Columbia River Gorge could be derived from downstream drift (rafting) out of central Idaho.

New State Record for Montana – Kokanee Bend, Flathead River, muddy side channel, 3 km southwest of Columbia Falls, Flathead County, northwest Montana, 10 August 1998, elevation ~910 meters, J. C. Bergdahl, coll. One pointed male specimen in excellent condition.

This new record is a significant outlier; it is about 177 kilometers (110 miles) due east of the nearest reported record in Sandpoint, Idaho (Kavanaugh 1979). This first Montana record was acquired during the course of intensive sampling (hand-collecting) for carabid beetles in a wide variety of wetlands in the Flathead River Basin for the Montana State Natural Heritage Program/The Nature Conservancy.

The Flathead River (Figure 3) is in the upper Columbia/Pend Oreille/Clark Fork basin; most of watersheds of northwest Montana west of the Continental Divide drain into the Clark Fork, and then into Lake Pend Oreille near Sandpoint, Idaho. Hence, the record of *N. gouleti* in Montana near Columbia Falls is consistent with all the other records of the species being located exclusively in the

Columbia River Basin, and primarily in inland regions.

Possible Occurrence of *Nebria gouleti* in Canada –

– Southwest Alberta: Kavanaugh (1979) mentions seven specimens of *N. gouleti* in the collection at California Academy of Sciences that are labeled as having been collected along Highwood River, Longview, Alberta. He indicates they were found in July, but does not mention the year they were collected nor the collector. Kavanaugh (1979) considered them "doubtful." Highwood River flows down the east slope of the Rockies with its headwaters joining the headwaters of the Columbia/Kootenay/Elk River on the Continental Divide. These are the only specimens of the species recorded from Canada; hence the species is not given credit for occurring in Canada (Bousquet et al. 2013). Since the species is now known from northwest Montana near Glacier National Park, its occurrence in Alberta (and Canada) should, in my opinion, be elevated to "probable", and new records sought along the east slope of the Rockies near the Montana border.

– Southeast British Columbia: Although *N. gouleti* has been recorded from northern Idaho in Bonner County near Sandpoint, Idaho, which is about 80 kilometers (50 miles) south of the International Border, the species has not been recorded in British Columbia. There is a good chance the beetle occurs just north of the International Border in the vicinity of Porthill and Creston (British Columbia) along the lower Kootenay and lower Goat Rivers. The distance from Sandpoint to the lower Kootenay River at Bonners Ferry (Boundary County, Idaho) is only 38 kilometers (24 miles). Similarly, records in British Columbia should be sought by avid beetle hunters along the upper Kootenay River (now flooded by Koo-can-usa Reservoir) and lower Elk River just north of the Montana border near Waldo, and in the upper North Fork Flathead River in British Columbia north of Columbia Falls, Montana. The latter watershed in British Columbia borders southwest Alberta near Waterton Lakes National Park.

Conclusion – At this time *Nebria gouleti* is not officially recognized as occurring in Canada (Bousquet et al. 2013). These robust beetles have long flight wings and are probably strong and regular fliers. Since the species is known to occur near the International Border in Idaho and Montana, it is very possible the north end of the species' range occurs in both in the Kootenay Region of southeast British Columbia, and in southwest Alberta on the east slope of the Rockies near the Montana border. The records of the species (7 specimens) in southwest Alberta that Kavanaugh (1979) considered as "doubtful" may be the first record of an established population of this species in Canada. Any records from Alberta would also be a first record of the species occurring outside of the Columbia River Basin, and the first record east of the Continental Divide.

References

Bergdahl, J.C. 2013. Carabid beetles of Oregon, USA: 1. Some general characteristics of the fauna. Bulletin of the Oregon Entomological Society 2013(1): 1–4. (Access the issue at <http://odonata.bogfoot.net/oes/>.)

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. (View this at <https://doi.org/10.3897/zookeys.104.1272>.)

Bousquet, Y. 2012. Catalogue of Geadephaga (Coleoptera: Adephaga) of America, north of Mexico. ZooKeys 245: 1–1722. (Download the PDF from <https://doi.org/10.3897/zookeys.245.3416.>)

Bousquet, Y. & A. Larochelle. 1993. Catalogue of the Geadephaga (Coleoptera: Trachypachidae, Rhysodidae, Carabidae including Cicindelini) of America north of Mexico. Memoirs of the Canadian Entomological Society, No. 167: 397 p. (View the abstract at <https://doi.org/10.4039/entm125167fv>.)

Bousquet, Y., P. Bouchard, A.E. Davies & D.S. Sikes. 2013. Checklist of beetles of Canada and Alaska. 2nd edition. Pensoft Series Faunistica No. 109, Pensoft Publishers, Sofia, Bulgaria. 402 p.

Figure 2. Mainstem Salmon River ("River of No Return"), end of the road at Milepost 26 east of Riggins (Idaho County, Idaho), at low water. I have collected many *N. gouleti* on the lower reaches of large side creeks at their confluence with the Salmon River in this area. 27 July 2009. Photo by James Bergdahl.

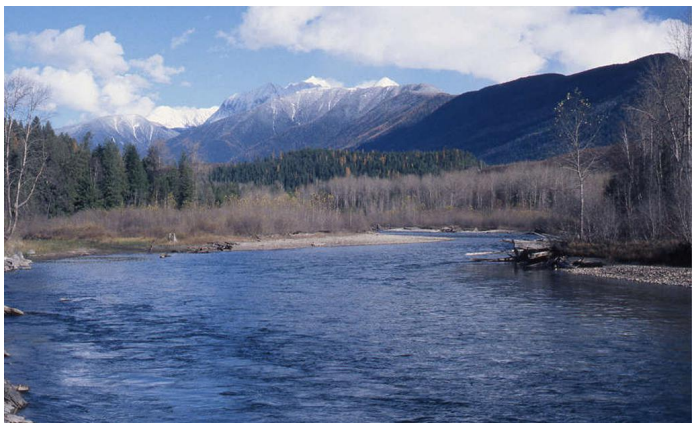


Figure 3. North Fork Flathead River near Columbia Falls, Montana. *Nebria gouleti* adults are usually found on wet ground under rocks and woody debris near the strandline of large rivers and streams at sites where slower backwater and eddies allows silt to settle into a muddy substrate. October 1998. Photo by James Bergdahl.

Brunsfeld, S.J. & J. Sullivan. 2006. A multi-compartmented glacial refugium in the northern Rocky Mountains: evidence from the phylogeography of *Cardamine constancei* (Brassicacceae). Conservation Genetics 6: 895–904. (View the abstract at <https://link.springer.com/article/10.1007/s10592-005-9076-7>.)

Carstens, B.C., S.J. Brunsfeld, J.R. Demboski, J.M. Good, & J. Sullivan. 2005. Investigating the evolutionary history of the Pacific Northwest mesic forest ecosystem: hypothesis testing within a comparative phylogeographic framework. Evolution 59(8): 1639–1652. (Download the PDF from <http://www.amphibiatree.org/sites/amphibiatree.org/files/CarstensETAL2005.pdf>.)

Kavanaugh, D.H. 1979. Studies on the Nebriini (Coleoptera: Carabidae), III. New Nearctic *Nebria* species and subspecies, nomenclatural notes, and lectotype designations. Proceeding of the California Academy of Science 42(4): 87–133. (Download the PDF from <https://www.researchgate.net/publication/260562991_Studies_on_the_Nebriini_Coleoptera_Carabidae_III_New_Nearctic_Nebria_species_and_subspecies_nomenclatural_notes_and_lectotype_designations>.)

Kavanaugh, D.H. 1985. On wing atrophy in carabid beetles (Insecta: 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 Publishers, Dordrecht, Netherlands. (Download the PDF from <https://www.researchgate.net/publication/260562780_On_wing_atrophy_in_carabid_beetles_Insecta_Coleoptera_Carabidae_with_special_reference_to_Nearctic_Nebria>.)

Lichthardt, J. 1999. Inventory of giant western redcedar groves on the Clearwater National Forest: 1998 Survey. Conservation Data Center, Idaho Dept. Fish & Game, Boise, Idaho. 16 p. (Download the PDF from <https://idfg.idaho.gov/ifwis/idnhp/cdc_pdf/groves.pdf>.)

Lichthardt, J. & R.K Moseley. 1994. Ecosystem analysis and conservation planning for the Clearwater Refugium, Clearwater and Nez Perce National Forests. Conservation Data Center, Idaho Dept. Fish & Game, Boise, Idaho. (Download the PDF from <https://idfg.idaho.gov/ifwis/idnhp/cdc_pdf/lichj94a.pdf>.)

Lindroth, C.H. 1961. The ground-beetles (Carabidae, excl. Cicindelinae) of Canada and Alaska, Part 2. Opuscula Entomologica, Supplement 20: 1–200.

2020 Western Monarch Summit

January 10–12, Carmel–Pacific Grove, California

This summit provides an opportunity to hear nationwide speakers, discuss what happened in 2018/2019, hear an update on overwintering sites and consider the impact of climate change on Monarchs. For details, please visit <https://socan.eco/event/2020-western-monarch-summit/>.

NOTE: Oregon State Arthropod Collection (OSAC) Relocating

While the west side of Cordley Hall is being renovated, the Oregon State Arthropod Collection will be temporarily moving to a new spot on Research Way in Corvallis. The move itself will take place over the summer, but preparations will commence in early 2020. An effort will be made to save the most heavily used portions of the collection (e.g., Lepidoptera and Coleoptera) for last, but please realize that some portions of the collection and visitation hours will be limited until the collection is up and running again at the new temporary space in September.

For additional details please see the collection update on page 10.

Pacific Northwest Lepidopterists' Fund in Honor of Harold Rice

The Pacific Northwest Lepidopterists' Fund provides one or two awards annually for up to $500 each to encourage activities directly related to PNW Lepidoptera and/or activities related to the improvement of OSAC's Lepidoptera collection. More information can be found at <http://osac.oregonstate.edu/PNWLepidopteristsFund>. Applications must be received by January 31; late applications may be considered.

US Fish and Wildlife Service Section 6 Opportunity—Oregon

The US Fish and Wildlife Service and the Oregon Parks and Recreation Department have requested proposals for rare invertebrate research projects to be funded under their Section 6 program for fiscal year 2020. Funds will be available to study federally listed, proposed, and candidate invertebrate species, or those having a state status similar to the federal equivalent. The money will be used for projects in the 2021 field season, and projects are expected to be completed by December 31, 2021. Proposals need to be submitted to Eleanor Gaines at the Oregon Biodiversity Information Center by February 7, 2020. If you would like to submit a proposal, please contact Eleanor at <egaines@pdx.edu> for full submission details.

Northwest Lepidopterists' Workshop 2019

On 19–20 October 2019, over 50 people gathered in Cordley Hall on the campus of Oregon State University for the 41st annual workshop for lepidopterists of the Pacific Northwest. The meeting was hosted by Drs. Paul Hammond and David McCorkle and sponsored by the Oregon State Department of Integrative Biology and the Oregon State Arthropod Collection (OSAC).

Oral presentations were made by David Maddison and Christopher Marshall, Jon Shepard, Jon Pelham, Dana Ross, Alison Center, Paul Hammond, Dr. Richard Brown, David McCorkle, David and Carol Specht, Neil Bjorklund, David Lee Myers, Tyson Wepprich and Bob Pyle. Dana Ross also presented a short video.

On Saturday afternoon, Dr. Richard Brown from the Mississippi Entomological Museum at Mississippi State University gave two presentations on microlepidoptera, one emphasizing the Tortricidae. Dr. Brown also gave the keynote address on Saturday evening.

In the pages that follow, I (Ron Lyons) have summarized the presentations, as well as some of the other conversations. The summaries have been looked over and enhanced and/or corrected as necessary by the various speakers. Resources (in print and online) mentioned at the meeting are included with the relevant material.

The groups of Lepidoptera for emphasis this year were:

- Butterflies: *Euphydryas* (checkerspots), *Oeneis* (arctics) and *Erebia* (alpines)
- Moths: Tortricidae (leafrollers)

David Maddison and Christopher Marshall—Welcome and Arthropod Collection Update

David Maddison, Director of the Oregon State Arthropod Collection (OSAC) welcomed the group on behalf of the university and the collection.

David was on sabbatical last year and spent time in Australia, Tasmania, and New Zealand pursuing his interest in Coleoptera (beetles).

Christopher Marshall, Curator of the OSAC, and David updated the group on the planned remodel of Cordley Hall and the impact it will have on the OSAC. The remodel will take place in 2 phases: the first phase involves the west half of the building and is scheduled for mid–2020 to mid–2022. OSAC, currently housed on the fourth floor in the west half of the building, will be temporarily relocated to an off-campus facility on Research Way about 3 miles away. When the renovations on the west half of Cordley Hall are completed in the summer of 2022, the OSAC will be moved to its new home on the 2nd floor; during that summer, renovations will begin on the east half of the building. The newly renovated space will handle the entire collection in one space (some parts are currently located in other rooms). However, because of code restrictions for hazardous materials, the alcohol collection will still remain separate.

While housed off-campus, the OSAC will still be available to students and researchers. It will take some time to get totally organized in the temporary facility; those parts of the collection known to be under active use will be made available first.

The move to the temporary facility is a massive job; OSAC has to be out of Cordley Hall by June 1, 2020. Researchers planning to use the collection in late winter – late summer time period should keep abreast of the moving situation. Anyone planning to make a sizeable donation to the collection next year should contact Christopher to make workable arrangements.

Activity Report—British Columbia

Jon Shepard went to British Columbia this summer. For the most part, he collected in the north along the Yellowhead Highway which runs from Prince Rupert southeast through to Jasper. He also visited Atlin, in the extreme northwest, east of Skagway, a famous collecting spot from about 1914 on when the first entomologist in Victoria went up there for the museum. While much of the habitat had been totally destroyed, he found most of the species he had found in the 70s, but they were not in the places they had been historically.

One of the interesting spots in southern British Columbia near the Washington border was the Ashnola River mouth where it joins the Similkameen River near Keremeos. Jon collected 4 of the 7 known specimens of the noctuid *Tarachidia semiflava*—the inner half of the forewing of this moth is yellow and the outer half is black.

Northwest Lepidopterists' Workshop 2019 (cont.)

Activity Report—Washington

Jon Pelham gave this year's report on butterfly activity in Washington.

Dennis Deck reported *Satyrium auretorum* (Gold-hunter's Hairstreak) in Klickitat County previously but there was some skepticism because this was so far from the nearest populations down in southern Oregon. Bob Pyle commented that this is a residential butterfly—it does not go wandering hundreds of miles from the nearest populations. This year Dennis went back to his site and documented the find with photographs, voucher specimens and a couple of new sites nearby. So *Satyrium auretorum* is now officially a member of Washington fauna, it is not a stray. Bob Pyle indicated that the area where Dennis made his find has been well sampled—there are lots of records of *Satyrium californica* (California Hairstreak) and *Satyrium sylvinus* (Sylvan Hairstreak), but Dennis is the first to find *Satyrium auretorum*. Bob encouraged people to go out in Oregon to fill in the intervening gap.

The wet spring in Washington meant one thing to Jon who has been fascinated with *Speyeria coronis* (Coronis Fritillary) for about 3 years now. The violets are abundant when the spring is early and wet; this year the violets were everywhere and *Speyeria coronis*, which overwinters in the egg stage, was very successful. *Speyeria coronis* has an annual migration which has been mapped to some extent; that migration pattern was well illustrated this year. By June 5, some butterflies were sighted at 5500' flying with *Celastrina echo* (Echo Blue) and *Callophrys augustinus* (Brown Elfin).

Nymphalis californica (California Tortoiseshell) was abundant this year. Jon described their dispersion strategy: "they don't really migrate, they just go, they go beyond where they have any place else to go, they still go." They have been observed 2 years in a row flying into the ether from Camp Muir on Mount Rainier at 10,000'. They survive at low elevations all over the state, mostly in places where they can't find *Ceanothus*, so in the spring wherever they survive, they start going again. When they find *Ceanothus* they lay their eggs and the caterpillars feed; after pupation, the adults emerge and move on; wherever they end up they just start going the next year.

Cheryl Bellin found *Apodemia mormo* (Mormon Metalmark) in Winthrop, Washington—west of the previously recognized western limit in Washington (Okanagan Valley).

Bob Pyle indicated that it had been a bad year for the western population of Monarchs. David James has a lot of details on the Pacific Northwest Monarchs' Facebook page, <https://www.facebook.com/MonarchButterfliesInThePacificNorthwest/>. Bob pointed out that according to new state regulations, it is now illegal to bring Monarchs into Washington or Oregon and release them.

Jon thanked the enormous number of people who are contributing to the effort to document Washington's butterflies. He encouraged people to include the latitude-longitude coordinates with their reports to make entering the information into his database easier. He also pointed out that when you have higher resolution for your average species you can start to recognize different distribution and movement patterns.

Activity Report—Oregon

Dana Ross gathers records of butterfly and moth activity for the Season Summary for Oregon.

This was a big year for *Vanessa cardui* (Painted Lady), an enormous northward migration occurred in the spring from well-watered plants to the south. It was also a good year for the *Pontia protodice* (Checkered White) in eastern Oregon; John Carr photographed one which turned out to be a record for Hood River County. It was a also big year for the silk moth *Coloradia pandora* (Pandora Moth) in the Cascades.

While teaching a field course for the Siskiyou Field Institute, Dana found a fresh *Papilio indra* (Indra Swallowtail) on top of Steens Mountain, not a common butterfly in that area. There were reports of *Ascalapha odorata* (Black Witch) in northern Oregon and southern Washington.

Dana along with Gary Pearson and Linda Kappen continued their Lepidoptera survey work at Crater Lake National Park They made 3 trips: June–July, late July, and late August. These were good time periods for the butterflies and moths—there had been a lot of winter precipitation and the plants and insects responded well. *Euphydryas editha lawrencei*, the high elevation Edith's Checkerspot, was quite common in patches. Gary Pearson found a female *Speyeria cybele pugetensis* (Great Spangled Fritillary), a new butterfly record for the Park. *Erynnis propertius* (Propertius Duskywing) was also recorded for the first time. They found an individual up high in the pumice lands and another one on the lower east side. Several moths of note were found up high in the pumice lands: *Proserpinus clarkiae* (Clark's sphinx), *Schinia*

Northwest Lepidopterists' Workshop 2019 (cont.)

honesta, *Schinia vacciniae*, and a number of little *Gyros muirii*, a little ruby gem.

North American Butterfly Association Eugene–Springfield Chapter

Alison Center, president of the Oregon/Eugene–Springfield Chapter of the North American Butterfly Association (NABA), reported on the group's activities. They held a number of field trips mostly around Eugene but they also carried out a Cascades survey at Frissell Ridge and Iron Mountain.

The Cascades count was held on July 20. About 1000 *Nymphalis californica* (California Tortoiseshell) were recorded. Despite the high count, there were even more around in August and September, and they could still be found in the Willamette National Forest on sunny days at the time of the workshop. On the Cascades count, 3 checkerspots—*Euphydryas editha* (Edith's Checkerspot), *Chlosyne palla* (Northern Checkerspot), and *Chlosyne hoffmanni* (Hoffman's Checkerspot)—were present so the participants were able to compare the different species. At the time, the spring butterflies were on their way out and the summer and late summer butterflies were on their way in.

The results from past counts can be found on the Chapter's website, <https://www.naba.org/chapters/nabaes/>. (The group is based in the Eugene–Springfield area, but is the only NABA Chapter in Oregon.)

Activity Report—Midwest

This summer Paul Hammond got 3 exciting records from the Rocky Mountains and Great Plains where he has been working the last few years.

In Montana, he was trying to come up with new county records for Steve Kohler. He finally got a record Steve did not have, *Colias alexandra* (Queen Alexandra's Sulphur) in Sheridan County, the most northeastern county of Montana, right on the North Dakota–Manitoba border.

For a couple of years, Paul has been searching along the Manitoba border in the Turtle Mountains of North Dakota for *Speyeria atlantis dennisi*, the northern Great Plains subspecies of *Speyeria atlantis* (Atlantis Fritillary). This subspecies occurs across the Canadian prairies from Manitoba, through Saskatchewan, and into Alberta, just reaching the border of the United States at the very south end of its range. This year he found a small colony of butterflies at an old abandoned schoolhouse with a nearby stand of white spruce and a lot of violets in the understory.

Finally, in the Green Mountains of central Wyoming, Paul found the northwesternmost population of *Colias scudderii scudderii* (Scudder's Sulphur) in Fremont County. This population is strictly a vaccinium feeder and was pretty common in a lodgepole pine forest around 10,000' elevation feeding on *Vaccinium caespitosum* and *Vaccinium scoparium*.

The Question of Disjunct Populations

Dennis Deck's find of *Satyrium auretorum* in Klickitat County, Washington was a disjunct population. The Washington location is (at least for now) widely separated from the location of the next nearest populations.

Bob Pyle wrote more details on Dennis's find in his column "Watching Washington Butterflies" in the Fall 2019 issue of G'num, the newsletter of the Washington Butterfly Association, and discussed the whole question of disjuncture. A PDF of the issue can be downloaded from <https://wabutterflyassoc.org/wp-content/uploads/2019/08/GnumVol20No3.pdf>.

Satyrium auretorum collected at Cecilville in Siskiyou County, California. Photo of Oregon State Arthropod Collection specimen by Ron Lyons.

Northwest Lepidopterists' Workshop 2019 (cont.)

Richard Brown—Overview of the Diversity of Microlepidoptera

Richard spoke briefly about a number of families and displayed one or two members of each. Some of these families are mentioned below.

The Yponomeutidae (ermine moths) have quite a few species both in the east and the west. Richard Worth from the Oregon Department of Agriculture indicated that he had once seen an old, very large apple tree on Sauvie Island, near Portland, which had such a high population of the exotic *Yponomeuta malinellis* (Apple Ermine Moth) that almost the entire tree was webbed. Only a small percentage of the leaves were still visible and it looked like a ghost.

The Pterophoridae (plume moths) are not strong flyers. The front wing is split down the middle and the hind wing is split a couple of times. The hairs on the wings are modified scales which have little barbs on them so the wings sections can be locked together effectively creating a solid wing surface.

Choreutidae is a showy family; the moths have metallic markings and silvery and golden bands. Rota and Wagner (2006) discussed a choreutid that mimicked a jumping spider.

Cossidae (carpenter moths) have wings that are not strongly banded. Rather the wing pattern is sort of reticulated—there is a network of lines and scattered spots.

Collectors of moths in the family Sesiidae (clear-winged moths) use traps with different pheromones for different species. Some species like the Peachtree Borer are economically important.

The caterpillars of the Limacodidae (slug caterpillars) are slug-like, having very small prolegs; they inch along when they are moving. Most of these caterpillars, together with the caterpillars of the Megalopygidae (flannel moths), have stinging (urticating) hairs that can cause a painful irritation, rash, or serious allergic reaction if touched.

The Superfamily Gelechioidea has 12 families that are common here. These moths are characterized by having labial palps that curve up in front of the head.

The Coleophoridae are casebearers. The caterpillar comes out of its case just far enough to feed on the tissue between the upper and lower epidermal layers of the plant leaf. As this tissue is eaten, the caterpillar reaches out more and more to reach it. While the caterpillar can extend out quite a ways, its hind end remains in the case. When it has exhausted the tissue that it can reach without leaving its case, it picks up the case, moves it and starts again. Eventually, there will be small spot mines, each with a little uneaten circle in the middle, dotting the leaf.

Questions

During the question period, Richard provided some tips for people who want to collect and mount microlepidoptera.

Small moths tend to avoid mercury vapor lamps preferring to land on nearby foliage instead. So Richard uses lower wattage black lights or a strategy of cycling the mercury vapor lamp with or without accompanying black lights depending on his materials and his goals. Any lights should be placed in a relatively clear open area to make collection easier. Nowadays, many collectors use a bucket trap that they run all night—this method is much more efficient than using a sheet, or collecting off the nearby foliage.

In the field, Richard collects microlepidoptera as well as macrolepidoptera. He uses small cyanide killing jars for the micros and larger ones for the macros. For the micros, Richard will collect a small number (1–3) of individuals in one of the small jars and then put the jar aside or dump it into a larger jar lined with padded cotton at its bottom to keep moths from sliding. He carries several small jars so he can rotate them. His colleague, Sangmi Lee, uses small vials to collect the micros and then places them in a freezer overnight. Richard has found that most scale loss, and with that the concomitant loss of the pattern, results from the collection process, not the pinning process. By dealing with small numbers, this loss is reduced.

Richard pins his specimens using a microscope to insert a minuten pin (usually the 0.2 mm or the 0.15 mm minuten, although the Neptipulidae require 0.1 mm minutens). After this, he blows on the specimen from the underside to release the wings. He then places the specimen in the incised groove on a foam pinning board. Using his forceps, he scrapes the top of the foam. The scraping creates a static charge and the wings pop out and stay open. Finally, he use small strips of tracing paper tacked down with minutens over the wings to hold them in place. On a good day, Richard can pin about 15–20 specimens/hour. Sangmi Lee demonstrates collecting and pinning microlepidoptera in an instructional video available online (Lee, Brown and MacGown [2009]).

Often when doing dissections of Lepidoptera, only the genitalia is dissected out. Instead of just doing genitalia for micromoths, Richard found it useful to dissect the whole moth. Some of this work was published by Lee and Brown (2006).

References

Rota, J. and D.L. Wagner. 2006. Predatory Mimicry: Metalmark Moths Mimic Their Jumping Spider Predators. PLoS ONE

Northwest Lepidopterists' Workshop 2019 (cont.)

1(1): e45. (Access the article at <https://doi.org/10.1371/journal.pone.0000045>.)
Lee, S.M. and R.L. Brown. 2006. A new method for preparing slide mounts of whole bodies of microlepidoptera. Journal of Asia–Pacific Entomology 9: 249–253.
Lee, S., R. Brown, and J. MacGown. 2009. Collecting and Pinning Microlepidoptera. Watch this video at <https://www.youtube.com/watch?v=W_B0EYgsb_0>.

Richard Brown—Quick Review of the Family Tortricidae

Richard gave a separate presentation on the Tortricidae, his favorite group of microlepidoptera.

Although the tortricids are called fruit moths, more species feed in stems or roots than on fruit. Most of our species are not really very colorful—they tend to be different patterns of brown. Some are important pest species.

Characteristics of adult Tortricidae:
- the palpi are porrect (they stick straight out in front)
- they have an ocellus (simple eye)—many microlepidopteran families don't
- they have a chaetosema (a bristly clump of sensory hairs on the head between the antennae and the ocellus).

Tortricid eggs are flat and most species lay the eggs so that they overlap (some species in other families also have flat eggs). The tail end of the larva has a structure called the anal comb, which is used to flip fecal pellets away. The pupae have small teeth running across each segment that they use to get out of their cocoons (some other families also have pupae with teeth).

At rest, the wings for some adults:
- lie flat (typical of the Subfamily Tortricinae)
- are rolled around their body
- are rolled but in profile the adults appear rather humpbacked.

Richard briefly mentioned a number of tribes, including these:
- the Tortricini are a major group here in Oregon,
- the Enarmoniini (genus *Ancylis*) are distinctive in that most species have hook-tipped (i.e., falcate) forewings (e.g., Strawberry Leaf Roller),
- the Olethreutini are pretty diverse here in the United States and Canada, and have a complex wing pattern compared to most other tortricids,
- the Eucosmini are a major tribe with the most species (~600) in the United States and Canada (e.g., pine tip moths),
- the Grapholitini includes the Codling Moth, the worm of the wormy apple.

Richard outlined the interesting feeding strategy for a leaf-rolling olethreutine, *Olethreutes ochrosuffusanum*, that feeds only on buckeyes—trees that produce defensive chemicals to discourage feeding. First, the caterpillar girdles the small petiole of one of the leaflets. Then it takes an adjacent leaflet and wraps it around the girdled leaflet. The caterpillar then feeds on the girdled leaflet whose vascular system is cut off, thereby preventing the defensive chemicals from reaching it. At the same time the larva is protected from desiccation by being wrapped by the outer leaf.

Richard was unaware of any tortricids that are endemic or restricted mainly to the northwest. Species that are here tend to be present across southern Canada and the northern tier states to Minnesota and/or down into California.

People interested in the Tortricidae will find the following resources useful:
1) TortAI–Tortricids of Agricultural Importance, <http://idtools.org/id/leps/tortai/> , a website put together by Todd Gilligan and Mark Epstein with the generous help of numerous individuals and funding from USDA/APHIS/PPQ/CPHST, Colorado State University and the California Department of Agriculture. A lot of the species included are present in Oregon. It contains keys for larvae and adults and includes species fact sheets and a glossary.
2) Tortricid.net–Tortricidae Resources on the Web at <http://www.tortricidae.com/>, a website by Todd Gilligan.

Tortricid specimen: *Cydia latiferreana* (Filbertworm Moth) collected in Benton County Philomath 10 July 2002 by Brower and Judd. Oregon State Arthropod Collection specimen. Photo by Ron Lyons

Northwest Lepidopterists' Workshop 2019 (cont.)

Richard Brown—Innovations in Morphology of Lepidoptera Revealed by Scanning Electron Microscopy (SEM)

Richard got his start in entomology at the age of 10 working on an entomology project at the local 4–H club. His initial collecting took place on the family farm in Arkansas. Two moths cemented his early interest in Lepidoptera – his first Pandora Sphinx and the pink and yellow Rosy Maple Moth. As well as this world of colors and patterns, he has also been intrigued by the morphology of the small structures.

Part I: the clinging structures of Lepidoptera – the pretarsus

Working out from the body, the moth leg is made up of a number of segments: the femur (the largest segment), followed by the tibia, followed by the small tarsal segments, then at the very end of the tarsi is this other segment, the pretarsus. The pretarsus is a complex region made up of different structures—claw, pulvillus (a hairy pad), and arolium (an expandable pad) being the major ones, not all of which are present in all species.

Using scanning electron microscopy (SEM), Richard showed images of the pretarsus of a number of species to illustrate some of the structural differences that occur between species. These differences affect the means and effectiveness by which these creatures hold onto substrates with different properties.

He indicated that obtaining images of the legs and other features is the most difficult and challenging type of SEM work that he has done because of all the little projections that discharge electrons and cause streaks in the image.

One of the preparation problems occurred with the cleaning of the samples. Supposedly clean samples were still covered with structured debris—numerous little buckyballs, 1/3-1/2 micron across. These interesting structures, called brochosomes, turned out to result from the secretions of leafhoppers; the brochosomes were picked up by the moths when they walked across the plants. (Information on brochosomes can be found on the Wikipedia site <https://en.wikipedia.org/wiki/Brochosome>.)

Part II: velcro-like wing-locking mechanism

Some lepidopteran species use a physical velcro-like mechanism to lock the forewings onto the thorax when they are at rest. The locking mechanism consists of a special patch with little projections on the underside of the forewing that interlocks with a corresponding special patch on the thorax. (This wing locking is only weakly developed in the Trichoptera.) Other lepidopteran species such as sphinx moths, saturniids, geometrids, and butterflies hold their wings away from their bodies at rest and lack this mechanism.

Moths which employ this physical locking mechanism at rest conserve energy that can be diverted for other purposes like keeping warm. Such a physical mechanism might be useful in stressful conditions such as:

1) preventing desiccation in dry areas or under windy conditions;
2) helping with thermoregulation—in cold areas the wings become a blanket.
3) concealing the insect to avoid notice by predators—when resting in exposed areas, locking the wings would prevent their movement by air currents.

This wing-locking mechanism was recognized over 100 years ago (e.g., Cooley 1896). Common (1969) thought it might also be involved in stridulation since the wings make a sound when they open.

When pinning specimens of species with this wing-locking mechanism, Richard puffs on the underside of specimens before spreading the wings in order to break that connection.

Part III: male sex scales

Lepidopteran scales are hollow structures covered by longitudinal ridges that are connected by spaced cross bars. Because the cross bars are spaced, windows are created which provide access to the inside of the scale. Most Lepidoptera have bags of pigment inside the scales that show through the windows. The hairs on Lepidoptera are not really hairs but are, in fact, round scales that have no windows. These scale features are common throughout the Lepidoptera except the very primitive moths.

While we have learned a lot about female pheromones (scents) beginning in the late 60s with the work of Wendell Roelofs and his peers, male pheromones have only been identified for a small number of species. The male produces pheromones using a variety of structures on every segment of the body except the first abdominal segment and the prothorax. The male pheromones are involved in different aspects of female acceptance and possibly have other functions. The butterfly *Bicyclus anynana*, a model organism for a number of different studies, has 3 major compounds in its male sex pheromone (Nieberding et al. 2008).

The scent organ of Lepidoptera has glandular scales where the pheromone is created and stored, disseminator scales (similar to

Northwest Lepidopterists' Workshop 2019 (cont.)

wicks of commercial air fresheners), and a protective pocket enclosing the glandular scales and disseminators scales to prevent evaporation of the scent.

Richard showed how the complexity of the scent organ, including the glandular and disseminator scales and their protective pocket, can be modified to alter the production and dissemination of the male pheromones. In some species, the same scales produce and disseminate the pheromone; in other species, the glandular scales are separate from the disseminator scales and may even be located on a different part of the body.

The work on the male sex scales was done in collaboration with Joaquin Baixeras at the University of Valencia, Spain and Sangmi Lee at Arizona State University.

References

I.F.B. Common. 1969. A Wing-locking or Stridulatory Device in Lepidoptera. Australian Journal of Entomology 8(2): 121–125. (Download the PDF at <https://doi.org/10.1111/j.1440-6055.1969.tb00744.x>.)

R. A. Cooley. 1896. A New Structural Character in Insects. Psyche 7(243):395–398. (Download the PDF at <https://www.hindawi.com/journals/psyche/1896/094191/abs/>.)

Nieberding, C.M., H. de Vos, M.V. Schneider, J-M Lassance, N. Estramil, J. Andersson, J. Bång, E. Hedenström, C. Löfstedt, and P.M. Brakefield. 2008. The Male Sex Pheromone of the Butterfly *Bicyclus anynana*: Towards an Evolutionary Analysis. PLoS ONE 3(7): e2751 (Download the article at <https://doi.org/10.1371/journal.pone.0002751>.)

Roelofs, W. 2016. Reminiscence of the early days. Pp. 3–9 in: J.D. Allison and R.T. Cardé (eds.), Pheromone Communications in Moths. Univeristy of California Press, Oakland, California.

David McCorkle—Reflections on My Work with Lepidoptera

At the urging of Bob Pyle and Jon Pelham, Dave McCorkle related some of his personal history working with Lepidoptera.

When Dave was 5, he and his family moved to north Seattle where they lived near a woods. One summer evening a hawkmoth came to their light, and someone remarked that it must be a rare one. That remark stimulated Dave's interest in Lepidoptera.

Before learning that you were supposed to pin your specimens, Dave tried a couple of methods for displaying them. In one method, he placed the spread specimen and the collection label between two layers of cellophane and sealed them inside with an iron. That method worked pretty well and he still has some samples from those early days.

Dave went to Seattle Pacific College (now a university) and then went to the University of Washington to pursue graduate studies. Under his advisor, coleopterist Dr. Melville H. Hatch, Dave studied water beetles in the family Hydrophilidae. Eventually he wrote the section on these beetles in Hatch's 5 volume series, "Beetles of the Pacific Northwest." He still works on these beetles, although many of the sites he used to visit are no longer freely accessible.

Over the years including during his graduate studies, Dave has continued his work on butterflies.

Bob Pyle indicated that Dave and Bill Sieker wrote the very first pieces about butterfly conservation in the Lepidopterists' News. In 1967 at a meeting of the Lepidopterists' Society in Cordley Hall at Oregon State University, Dave put forth a proposal to create a conservation committee; the committee was created that weekend and also held its first impromptu meeting (News of the Lepidopterists' Society 9 [5, 15 July 1967]: 4). Bob thinks that this was the first butterfly conservation meeting in the country. He also noted that Dave was responsible for the very first butterfly preserve in the United States, a sphagnum post-Pleistocene relict bog in the Moxee Valley east of Yakima, established in the 1960s with the Nature Conservancy (News of the Lepidopterists' Society 11 [2, 01 March 1969]: 2).

Unmentioned in the discussion was that fact that the annual Northwest Lepidopterists' Workshop grew out of lepidopterist meetings held by Dave during his tenure at Western Oregon State College (now Western Oregon University) in Monmouth, Oregon.

For quite a while Dave worked on swallowtails. Dave figured out how to hand pair these butterflies and he and Paul Hammond created a number of swallowtail hybrids. Now they are working on *Speyeria* with Bill Bergman in Michigan. As part of this effort Dave has developed a procedure that allows him to successfully overwinter the larvae. Paul and Dave presented some of their *Speyeria* findings in the keynote address "Hybridization Study of Fritillaries (*Speyeria*)" at the Northwest Lepidopterists' Workshop in 2015 (for more on this presentation see the write-up in the Bulletin of the Oregon Entomological Society 2015[4]: 13–14).

Northwest Lepidopterists' Workshop 2019 (cont.)

Dave and Carol Specht—Benefits of Butterfly Photo Collection

While Dave and Carol didn't plan any specific butterfly trips this year, they were able to take advantage of their other trips to collect butterfly observations using photo collection. Since they always have their cameras along, they can take advantage of opportunities as they come up.

Dave and Carol made 3 trips this past year:
- – Dave's La Sierra University homecoming in Riverside, California (May),
- – a short RV trip in Oregon from Florence to Lincoln City,
- – Dave's 60th high school class graduation anniversary reunion in the San Francisco Bay Area (October).

On their May trip to Riverside, they visited Anza Borrego State Park. While the largest butterfly populations are around mid-March, they did find Ceraunus Blues, a Funereal Duskywing, and Variable Checkerspots in the west branch of Plum Canyon. Later, they found checkerspots and California Sisters at the Santa Rosa Plateau Ecological Reserve in Riverside County. In this area, fogs role up from the Pacific Ocean and densely settle. Dave has camped there and indicated you can hear what sounds like rain in the live oak trees but the sound actually comes from the fog condensing on, and then dripping from the tree leaves. At the Antelope Valley California Poppy Reserve near Lancaster, they caught the end of this spring's large desert-flower-induced Painted Lady population explosion. Adjacent to Bob's Gap, the outflow of Big Rock Creek forms a nice little delta where the creek starts to dry up. There are a number of different plants and it is a good place to watch for butterflies. Carol photographed a courting pair of Checkered Whites. There were also a lot of Painted Ladies present.

On their RV trip Carol photographed a large Anise Swallowtail at Cape Foulweather.

In October, Dave and Carol visited the San Francisco Bay area. One of the guidebooks indicated that September and October are the 2 sunniest months in the entire year for the area so they had a good chance to see any butterflies that might be around. A friend told Dave that a good place to see Pipevine Swallowtails was Angel Island, the largest natural island in San Francisco Bay (<https://www.parks.ca.gov/?page_id=468>). They bought tickets for the earliest ferry going over to the island and the latest ferry returning. On their arrival, they started hiking up to the top of Mt Livermore. On the way Dave photographed the albinoid form of the Orange Sulphur which, fortuitously, showed the top of the wings---the wings were beating down as it started to take off. They spent about half an hour on top of Mt Livermore where they found hilltopping Pipevine Swallowtails. The butterflies were very wary; there were no nectar plants to slow them down, so they were difficult to photograph. Carol happened to photograph the top side of one, in flight with its wings spread wide open. Dave was able to photograph the underside of another after waiting for a rare settling event, but only from 30' away. They made it back to the ferry with just 30 minutes to spare before departure.

In the past, Dave has regularly updated the group about his survey work on the butterflies and a couple of moths found at Powell Butte Nature Park in Portland, Oregon. Some of this work was published this year in the Summer issue of the News of the Lepidopterists' Society.

A Note on the Season Summary

Jon Shepard announced that Ann Potter will no longer be coordinating the butterfly records for Washington and Dana Ross indicated he can't do as much work on the Oregon records. In both cases, someone else has to do it or at least help. For now Jon requested that you should send any records you want included in the Season Summary of the Lepidopterists' Society directly to him. You may certainly post your records on other sites if you wish, but for now, there is no one available to process them for the Season Summary.

Literature Notes

David Lee Myers announced that his book "Wings in the Light: Wild Butterflies in North America," a collection of some of his butterfly photographs with accompanying butterfly information, was published earlier in the year by Yale University Press. More information is available at <https://yalebooks.yale.edu/book/9780300236132/wings-light>.

Caitlin LaBar's Washington butterfly materials, including a new updated edition (3rd) of "Pocket Guide to the Butterflies of Washington," are available on her website, <https://northwestbutterflies.com/> The site includes Caitlin's butterfly blog.

Northwest Lepidopterists' Workshop 2019 (cont.)

Neil Bjorklund—What I Went to Photograph and What I Actually Found

Neil worked for more than 20 years in habitat conservation planning—he was the city's lead staff for the creation of the West Eugene Wetlands Management Plan.

Neil is the creator of the Butterflies of Oregon website, <https://ButterfliesofOregon.com>. The site has information on all of Oregon's butterflies—for each species there is a write-up with all the basic information, including identification tips, range, flight timing, similar species and conservation status. There are photographs, often multiple photographs, for each species, but there are 11 species which only have photographs of pinned specimens. In addition, for some species all the variations aren't shown, and not every subspecies of *Speyeria* is shown, and some lack photographs of the females. Neil continues to work on filling in these gaps in his collection of live photographs. Since this site is for the butterflies of Oregon, he has decided only to feature photos of butterflies taken in Oregon, even though some of the species might be more easily located and photographed outside of the state. (This requirement means that he has to work a bit harder to get the images he wants.) In the future, this site will include the county record information. Neil wants to develop the Butterflies of Oregon website into a one-stop, comprehensive guide to Oregon's butterflies.

Over the past 15 years, Neil has developed a set of cross-linked databases to track his work; these databases contain his sightings of the butterflies of Oregon, all of the sites he has visited, and all of his photographs. So far he has made more than 550 site visits in Oregon.

Neil described his adventures this year as he attempted to get live photos of the species that are now only shown as pinned specimens. He also described some visits he made to check up on butterfly populations he had not visited for some time. As part of his presentation he included a state map marked with the location of the site he was going to talk about. He also included some overall scenery shots of the various habitats. On several of his trips in 2019, he arrived a little too late in the season to find his target butterfly species, so he showed a number of very nice images of the butterflies he did find.

At Ditch Creek in Morrow County, he found a *Lycaena heteronea* (Blue Copper) individual that had just emerged. The weather was such that it sat and posed for a long time before flying off. Neil indicated that he had probably taken about 100 pictures of it.

While Neil has used a variety of photographic equipment over the years, nowadays he uses the mirrorless Fujifilm XT–3 camera coupled with Fujifilm's new 80 mm macro lens; he indicated that the combination had helped him improve his results tremendously.

David Lee Myers—Butterfly Related Activities in 2019

David showed images he had taken this year in New York, Oregon, and California particularly on the Sierra Nevada Butterfly Course offered through San Francisco State University by Paul Opler and David Droppers. A number of his images made use of backlighting which David finds makes an "appealing and energetic photograph" although not one suitable for a field guide.

One colorful image featured a Clouded Skipper on a passionflower. Another showed a Pale Tiger Swallowtail nectaring on an orange lily and using the stamens for some support.

While visiting a large *Darlingtonia* meadow at the Butterfly Valley Botanical Area near Quincy, California, David noticed number of butterflies landing on the tops of the cobra hoods. Some would just sit there, while others would explore a bit before flying away. One Lorquin's Admiral, however, crawled down and disappeared inside. David waited patiently but after 18 minutes it still had not come back out.

This past June, the 100th Annual Conference of the Pacific Division of the American Association for the Advancement of Science was held at Southern Oregon University in Ashland. David was invited to speak in the symposium titled "Puttin' the Public to Work—Community Science around the world!" In his presentation, "Citizen Science Collaborations in Pacific Northwest Lepidoptery," the Northwest Lepidopterists' Workshops and participants featured prominently. He discussed the way in which different people are brought together and the tremendous cooperation and sharing between people with and without formal degrees in a given subject area.

While David had a number of great experiences this past year, the highlight of the year was the publication of his book of butterfly photographs, "Wings in the Light: Wild Butterflies in North America," by Yale University Press in March.

Northwest Lepidopterists' Workshop 2019 (cont.)

Tyson Wepprich—Ongoing Work with the Ohio Lepidopterists' Survey

Last year at this workshop Tyson discussed some work that he had done using the Ohio Lepidopterists' Survey (for a brief account of last year's presentation see the the Bulletin of the Oregon Entomological Society 2018[4]: 17). For the survey, volunteers go out every single week from April to the end of October and use the Pollard walk method to count every butterfly they see along their path. These counts have been going on all over the state for the last 20 years; there are 50 sites that have 10 years or more of data.

This year he updated the group on what they had found and how their work was contributing to global conservation research and what we know about insects in general.

Tyson looked at the abundance trend of all the butterflies in aggregate. He also looked at the individual abundance trends for 80 species and compared these trends for species with similar life history strategies to see if the species were varying the same way. Correlated trends could be related to changes in the environment. He compared his results for Ohio with the results from European butterfly monitoring programs.

Some examples of individual trends are:

- The population trend for Monarchs mirrors the population trend at the overwintering sites in Mexico.
- The Cabbage White population is declining; perhaps their population in farmland areas is being reduced or the nature of the sites being monitored is changing.
- The Wild Indigo Duskywing population has tripled over 20 years; it can now use an exotic host plant which is planted for erosion control.
- The population of Gemmed Satyr has increased many times; it is a southern species becoming more common as it moves into southern Ohio.

Based on the Ohio data, Tyson found that the best monitored group of all insects, butterflies, is declining at 2% per year. More species are declining than increasing but many are stable. The results for Ohio are similar to those found in Europe.

Tyson pointed out some problems with the Ohio data. Even with all the dedication of the volunteers over the years, there was insufficient data to determine a population trend for 20 species (20% of the species available). Most of the sites that people are monitoring are near urban areas where people live so there are parks and other types of urban sites. He pointed out that we do not know how representative the butterflies are when compared to other insect groups or how trends in temperate climates compare to trends in tropical areas.

This work with the Ohio Lepidopterists' Survey was recently published (Wepprich et al. 2019). A less formal write-up can be found in the News of the Lepidoptera Society (Wepprich 2019).

Tyson recommended an article by Forister, Pelton and Black (2019) from the Xerces Society which stresses the policies we can enact because, despite the uncertainties, we know enough to take some conservation action now.

Tyson is looking into how, if possible, the results from systematic monitoring can be combined with records from museum collections and observations from iNaturalist and similar websites. He is also involved in a literature project led by University of Connecticut graduate student Eliza Grames to evaluate articles on insect abundance published over the last 100 years to determine which ones might be useful in the determination of global insect trends (see EntoGEM – a systematic mapping project to build a global evidence map of insect population and biodiversity trends, <https://entogem.github.io>).

References

Forister, M.L., E.M. Pelton, and S.H. Black. 2019. Declines in insect abundance and diversity: We know enough to act now. Conservation Science and Practice 1(8): e80 (Download the PDF from <https://onlinelibrary.wiley.com/doi/10.1111/csp2.80>.)

Wepprich, T. 2019. Statewide butterfly monitoring by volunteer recorders in Ohio reveals a persitent [sic] decline in abundance, so what can we do? News of the Lepidoptera Society 61(3): 128–130. (Download the entire issue at <http://images.peabody.yale.edu/lepsoc/nls/2010s/2019/2019_v61_n3.pdf>.)

Wepprich T., J.R.Adrion, L. Ries, J. Wiedmann, and N.M. Haddad. 2019. Butterfly abundance declines over 20 years of systematic monitoring in Ohio, USA. PLoS ONE 14(7): e0216270. (Download the PDF from <https://doi.org/10.1371/journal.pone.0216270>.)

Northwest Lepidopterists' Workshop 2019 (cont.)

Bob Pyle—Reflections on the World Around Us

Every single day, we need to remind ourselves of 2 principles of science.

The first principle is the concept of stochastics. Conditions or events we become aware of are usually determined by multiple factors, not all of which are known or appreciated. These multiple interactions can invalidate the simple "cause and effect" explanations we are often inclined to jump to.

The second is the principle of "Occam's Razor." When we consider a set of facts, we can apply this principle to distinguish between various interpretations as to which is the most likely. Provided we have enough information to begin with, the simplest interpretation is usually the one that is ultimately proves correct. Occam's Razor is an expression of the idea of parsimony—what is the simplest interpretation that explains all the facts?

As conservationists and observers of the natural world, we need to remember to keep our explanations as simple as possible and resist making unwarranted, particularly complex, assumptions based on the material available. We need to fill in any data we are missing and test our explanation as much as possible with repetition and/or experimentation, and think critically when evaluating new facts. In that way we will become better observers of the natural world.

Bob pointed out that despite the disheartening stories coming out recently regarding our insect fauna, there is still a lot more diversity around than any of us can appreciate in our lifetimes, and it is still possible to be gratified and excited by the natural diversity that is present. And perhaps in some cases, we can, or nature can, restore some of the perceived lost diversity.

Dana Ross—Video of a Collecting Trip with June and Floyd Preston

Dana and his friend John Anderson met up with noted American lepidopterists June and Floyd Preston on a collecting trip in the lower Rio Grande Valley of Texas in the October 2008. Dana presented a short piece of video taken by John (Terramar Productions).

Next Year: Northwest Lepidopterists' Workshop 2020

In 2020 the groups of emphasis will be:

- *Butterflies:* Pieridae with emphasis on *Pontia* and Lycaenidae: *Satyrium*
- *Moths:* Geometridae

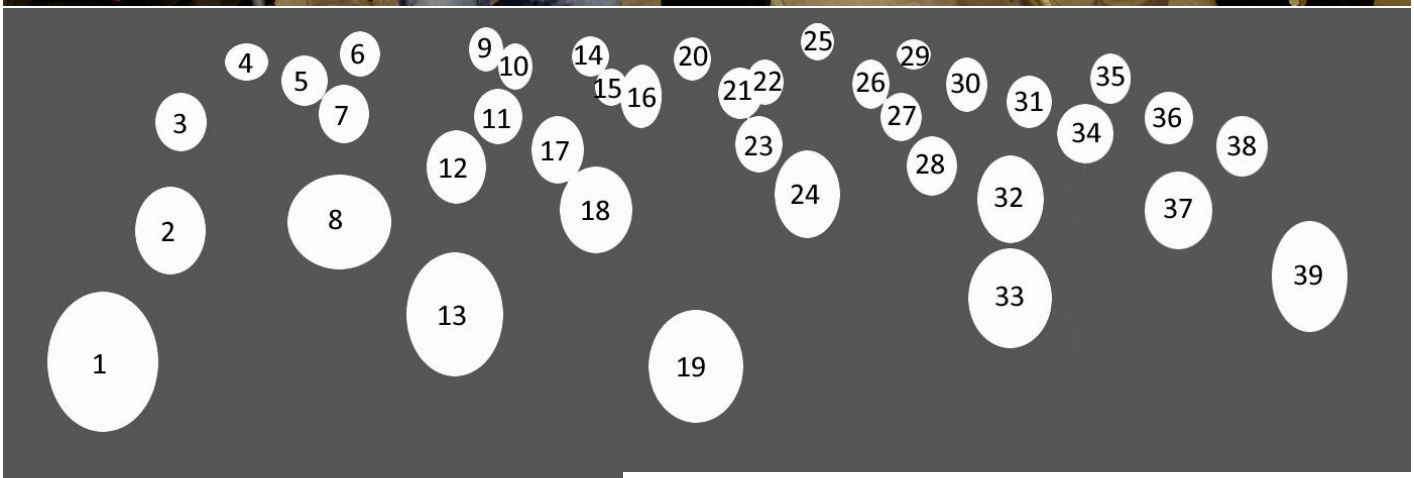
Acknowledgements

I would like to extend my sincere thanks and appreciation to all the presenters for their comments, corrections, and changes to the summaries. I know all the input improved the accuracy and usefulness of the material.

Thank you all very much. *Ron Lyons*

Northwest Lepidopterists' Workshop 2019 (cont.)

Ron Lyons



Northwest Lepidopterists' Workshop 2019—Participants Photo Key

1 Ray Stanford
2 Merrill Peterson
3 Koji Shiraiwa
4 Mae Esquibel
5 Ross Tewksbury
6 Jonathan Pelham
7 Dana Ross
8 Steve Northway
9 Ben Mous
10 Ron Sleeter
11 David McCorkle
12 Dave Specht
13 Matthew Campbell
14 John Davis
15 Mike Raschko
16 Jon Shepard
17 Carol Specht
18 David Lee Myers
19 Liam Campbell
20 Jim Johnson
21 Dr. Richard Brown
22 Riley Duncan
23 Rik Littlefield
24 Caitlin LaBar
25 Vern Covlin
26 Lars Crabo
27 Paul Hammond
28 Linda Kappen
29 Terry Stoddard
30 Bob Pyle
31 Alison Center
32 Cameron Thomas
33 David Droppers
34 Neil Bjorklund
35 Ron Lyons
36 Lori Humphreys
37 Christopher Jason
38 Rick Ahrens
39 Christopher Marshall