

Denali Bug Bioblitz

July 26-29, 2014



Report prepared by
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Photo credits on previous page: (Top row) J. Rykken; (Bottom L) S. McLane, NPS; (Bottom R) K. Thoresen, NPS.

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ABSTRACT

Arthropods make up the majority of animal life in Denali and are critical to maintaining functioning ecosystems, yet despite their ecological importance, park resource managers and visitors know little about their diversity or distribution in the park. The Denali Bug Bioblitz was intended to bring park staff, visitors, scientists, and students together to document arthropod diversity over a four-day period, July 26-29, 2014. The first day focused on activities open to the public. Scientists demonstrated collecting techniques at sites in the front country and later showcased specimens at the Murie Science and Learning Center. An afternoon “catch and release” event drew in children and their families. The following three days focused on more intensive collecting in the backcountry by scientists, students, and park staff. Approximately 1070 specimens were collected, including 514 water mites, 17 bees, 57 syrphid flies, 322 aquatic insects, and 92 terrestrial insects. These represented at least 10 taxonomic orders, and more than 40 families. Many of the taxa represent new records for the park and/or the state, and one undescribed species of Staphylinid beetle in the genus *Phlaeopterus* was previously known only from two other sites in Alaska. Hosting a bioblitz in a vast, remote park with limited accessibility presented some logistical challenges, but the Denali Bug Bioblitz was successful on many fronts: providing opportunities for the public to engage with researchers in both field and lab settings; enabling researchers to gain access to a diverse range of collecting sites in the backcountry; and minimizing huge numbers of “bycatch” by having collections focused primarily on taxa of research interest.

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A successful bioblitz relies on scientists and students to lead the way in biodiversity discovery. Thanks to all of our researchers, who not only collected lots of bugs, but also went out of their way to share their enthusiasm and knowledge with the public: Whitney Nelson, Joseph O'Neill, and Cameron Cheri from the Dowling lab at the University of Arkansas, who opened our eyes to the wonders of water mites; Logan Mullen from the Sikes lab at University of Alaska Fairbanks, whose determination to find elusive beetles hiding in inhospitable places finally paid off; and Dan Bogan from the Alaska Natural Heritage Program at UA Anchorage and Luise Woelflein from the BLM Campbell Creek Science Center who showed us how many insect orders you can catch with a couple of D nets in a stream. Additional thanks to Michelle Locke at the American Museum of Natural History, who identified all the syrphid flies.

INTRODUCTION

Insects and other arthropods comprise an extremely diverse component of Denali's fauna and—in their various roles as pollinators, predators, decomposers, herbivores, and scavengers—are critical to maintaining functioning ecosystems in the park. Yet despite their ecological importance, Denali resource managers know very little about most terrestrial or aquatic arthropod guilds, with the exception of a few pollinator taxa and aquatic macroinvertebrates used for biomonitoring (Milner et al. 2006; Brabets and Ourso 2013; Rykken 2013). Likewise, most visitors come to Denali to view the charismatic megafauna readily visible from buses, and may have little awareness of the tremendous diversity of invertebrates all around them. The scarcity of information on (or interest in) arthropods extends outside park boundaries as well; the arthropod fauna of Alaska is one of the most poorly known of any state, with just under 8,000 arthropod species known as of 2011 (D. Sikes, pers. comm.).

In recent years, short-duration, intense collecting events known as “bioblitzes” have become an increasingly popular way to document biodiversity of lesser known taxa within national parks and other natural areas. More than 30 national parks, from Great Basin to Acadia, have hosted bioblitzes over the last decade (Evans 2008, Chandler et al. 2012, Clement et al. 2012). While these events have varied greatly in scope and size, all bioblitzes in national parks share some common objectives: (1) they bring scientists to parks to conduct research; (2) they allow citizens to participate in the process of biodiversity discovery alongside scientists in the field; (3) they provide opportunities for parks to educate the public about the vast “overlooked” components of biodiversity; and (4) they document the diversity of traditionally under-surveyed and species-rich taxa in parks, contributing to the cumulative knowledge of natural resources under NPS stewardship as well as for the larger region.

In Alaska, bioblitzes on the Kenai Peninsula and in southeast Alaska have significantly increased what is known about invertebrate diversity in these regions (Bowser 2012, Ridling et al. 2014). While these “snapshot” surveys cannot supplant longer, more intensive biological surveys (such as All Taxa Biodiversity Inventories; Nichols and Langdon 2007; Rykken and Farrell 2013), they can make significant contributions to the known fauna of a park or region, including the identification of taxa representing new state records (Ridling et al. 2014), species new to science (Miller et al. 2012), and new range extensions for invasive species (Cohen et al. 2011).

We proposed to host Denali's first bioblitz as a means to gather information about selected arthropod taxa in a very short time frame (four days). As for most bioblitzes, the two main goals of the Denali Bug Bioblitz were: (1) to encourage invertebrate taxonomists to catalog the diversity of their focal taxa in Denali and lay foundations for future collaborative research; (2) to invite the public to engage with scientists collecting and examining lesser-known realms of biodiversity in the park. These were no small aspirations in a park primarily known and visited by biologists and the public alike for its charismatic vertebrate megafauna. Hosting a bioblitz in Denali also presented a significant logistical challenge because the park is vast and remote, with limited accessibility even once inside the park. Additionally, visitors are generally at the park for a limited period of time, and spend much of their visit in buses viewing wildlife and scenery in the back country. Thus, attracting scientists and public to participate in this event was one of the significant hurdles in event planning.

METHODS

Study area

Denali National Park and Preserve comprises more than six million acres (approx. 2.46 million ha) in subarctic Alaska. Predominant terrestrial habitat types include taiga forest at lower elevations in the eastern end of the park, wet and dry tundra above treeline, with thick shrub cover below and alpine meadows above, rocky slopes and ridges, and at the highest elevations, the snow-covered peaks and glaciers of the Alaska Range. Aquatic habitats include large braided rivers, tributary streams of various sizes, boggy wetlands, lakes, and kettle ponds. The park road, which provides the easiest access to the backcountry, runs east to west for nearly 150 km, paralleling the Alaska Range, beginning in the east at an elevation of approximately 475 m and reaching its highest point at Highway Pass, mile 59 on the road, at more than 1200 m. The western end of the road passes by Wonder Lake and ends in Kantishna, both at 500-600 m elevation. During the four days of the bioblitz, sampling occurred at multiple sites along the entire length of the park road (Table 1, Figs. 1,2). Aquatic sampling was generally very near to the road, and terrestrial sampling was conducted within 3-4 km of the road.

Table 1. Sampling sites used by aquatic and/or terrestrial researchers during the Denali Bug Bioblitz. Site locations are approximate in places where multiple researchers collected in the same general area.

Site #	Site description	Latitude	Longitude	Elev. (m)	Date
1	Horseshoe Lake outlet	63.7434	-148.9123	471	7/26/2014
2	Horseshoe Lake	63.7425	-148.9101	472	7/26/2014
3	Horseshoe Creek at Taiga Tr. Bridge	63.7360	-148.9188	536	7/26/2014
4	MSLC-DVC trail	63.7323	-148.9178	583	7/26/2014
5	Trails south of DVC	63.7278	-148.9197	555	7/26/2014
6	Near Hines Creek bridge	63.7255	-148.9152	516	7/26/2014
7	Trib. to Savage River	63.7307	-149.3687	928	7/27/2014
8	Trib. to Sanctuary River	63.7254	-149.4075	881	7/27/2014
9	Sanctuary River	63.7211	-149.4775	462	7/27/2014
10	Kettle pond NE of Tek Camp	63.6744	-149.5793	774	7/27/2014
11	Teklanika campground	63.6711	-149.5793	775	7/27/2014
12	Tattler Creek	63.5679	-149.6401	1033	7/27,29/2014
13	Trib. to Tattler Creek	63.5608	-149.6508	1219	7/29/2014
14	Trib. to East Fork	63.5567	-149.7544	1020	7/28/2014
15	Trib. to Toklat River	63.5164	-149.9602	1093	7/28/2014
16	Road N of Stony Dome	63.4649	-150.1984	1169	7/28/2014
17	Stony Dome area	63.4399	-150.1746	1318	7/28/2014
18	Stream E of Eielson VC	63.4325	-150.3084	1148	7/28/2014
19	Kettle pond E of Wonder Lake	63.4493	-150.7776	749	7/28/2014
20	Wonder Lake inflow	63.4957	-150.8842	611	7/28/2014
21	Nugget Pond	63.5185	-150.8983	647	7/28/2014
22	Moose Creek	63.5162	-150.9097	549	7/28/2014
23	Eureka Creek	63.5268	-150.9622	509	7/28/2014

The first day of the bioblitz (July 26, 2014) took place in the front country, so that scientists could engage easily with the public. Aquatic teams collected on Horseshoe Creek where it runs along the Taiga Trail and at Horseshoe Lake, including the outlet (sites 1-3; Fig. 1). Terrestrial teams headed for the trails leading south from the Denali Visitor Center (DVC) towards the bridge over Hines Creek (sites 4-6; Fig. 1).

On July 27, 2014, on the way to base camp at Teklanika Campground (mile 29 of the park highway), both aquatic and terrestrial teams sampled at several places along the road, including stream crossings, a kettle pond, and Sanctuary River (sites 7-11; Fig. 2).

On July 28, 2014, the mite team traveled to the end of the park road at Kantishna. Along the way, they stopped at several places, including tributary streams to Toklat and East Fork rivers, Wonder Lake, and Nugget Pond (sites 14,15,18-23; Fig. 2). The terrestrial insect team searched along small drainages in the vicinity of Stony Dome, southwest of Highway Pass (sites 16,17; Fig. 2).

On July 29, the terrestrial team searched along Tattler Creek, and up one of the steep tributaries running into it from Sable Mountain (sites 12,13; Fig. 2).

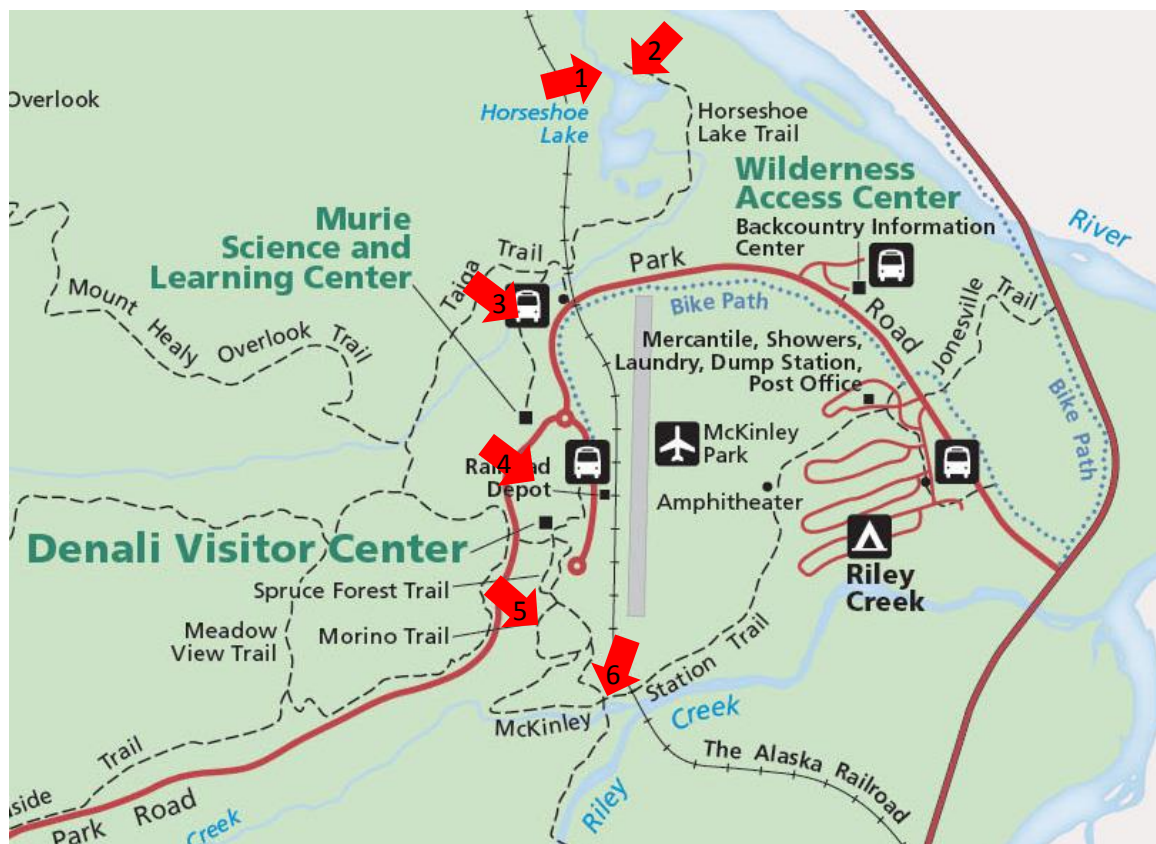


Figure 1. Approximate bioblitz collecting sites in the front country of Denali NPP, July 26, 2014. Site numbers correspond with Table 1.

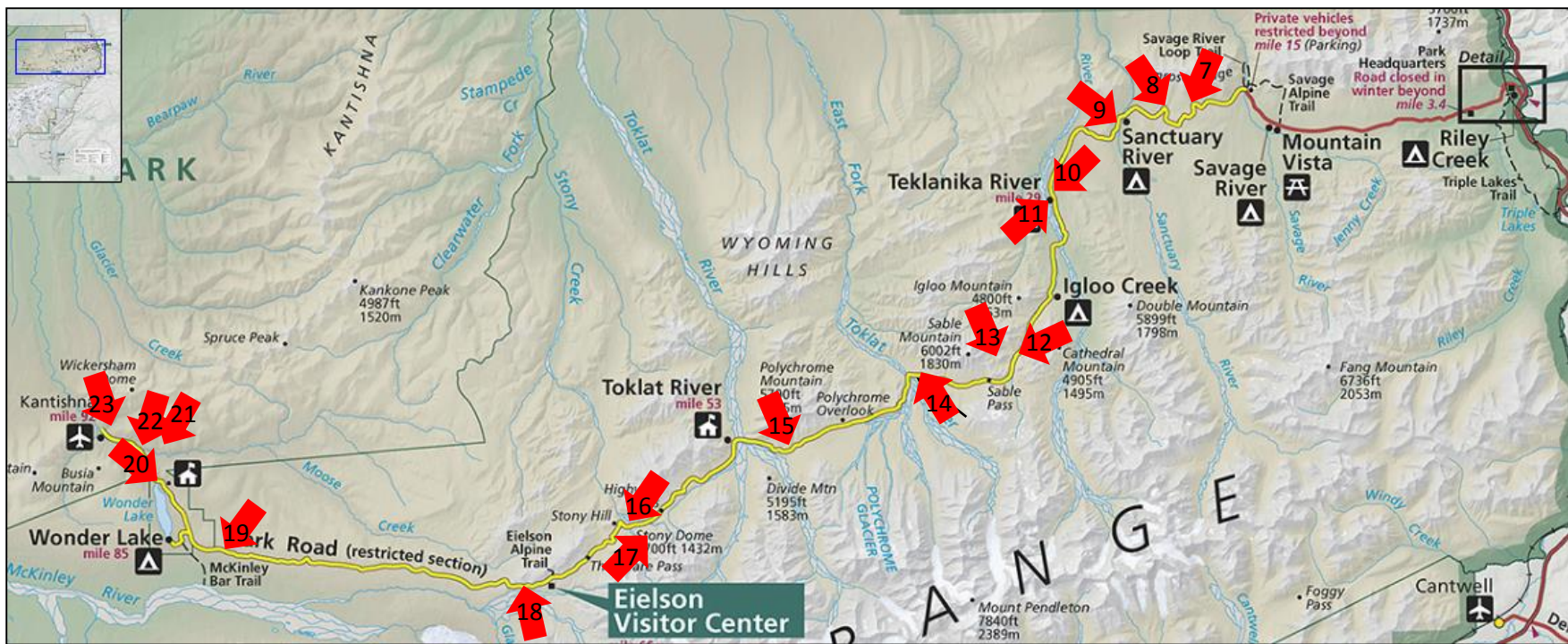


Figure 2. Approximate bioblitz collecting sites in the backcountry of Denali NPP, July 27-29, 2014. Site numbers correspond with Table 1.

Pre-event planning

A bioblitz coordinator (J. Rykken) was hired to assist Sierra McLane, Education Coordinator for Denali, and also NPS Director at the Murie Science and Learning Center (MSLC), organize the event. Scientists were recruited by posting an announcement to the Alaska Entomological Society listserv, and by networking with other researchers throughout Alaska. Because of the high expense of traveling to Denali from the lower 48, it was assumed that most participants would be coming from inside Alaska or they would already be in Alaska for other reasons.

Ultimately, four researchers and research groups participated in the bioblitz. Their focal taxonomic interests determined the target taxa for the event. Logan Mullen, a graduate student from the Sikes lab at the University of Alaska Fairbanks focused on rove beetles (Staphylinidae; in particular, the genus *Phlaeopterus*); Dan Bogan from the Alaska Natural Heritage Program at UA Anchorage and Luise Woelflein from the BLM Campbell Creek Science Center collected aquatic macroinvertebrates; Whitney Nelson, Joseph O'Neill, and Cameron Cheri, all students from the Dowling lab at the University of Arkansas, but already on the Kenai Peninsula searching for water mites (Hydrachnidiae, in particular, the family Torrenticolidae), extended their field work into Denali; and Jessica Rykken (bioblitz coordinator), a former Researcher-in-Residence in Denali and an associate at the Museum of Comparative Zoology at Harvard University, collected pollinators (bees and flower flies).

Scientists and students were not reimbursed for travel expenses to the park, however, they were provided with room and board during the event. Lodging included two nights of car camping at Riley Creek campground and use of the MSLC yurt in the front country, and two nights at the MSLC Teklanika field camp.

To publicize various bioblitz activities to park visitors and local residents, the MSLC listed the event on its website, a press release was sent out a few days ahead of time, and event announcements were posted at the visitor centers and a few other sites.

We received one research permit for the bioblitz that covered all participating scientists. Because specimens would ultimately be deposited at different institutions, separate loan agreements were made with the University of Alaska Fairbanks and the University of Arkansas.

Public events on July 26, 2014

Outdoor events

Scientists met up with a group of park visitors (mostly local residents) at the MSLC at 10AM and broke into two groups: aquatic and terrestrial. The aquatic groups (mites and macro-invertebrates) headed north towards Horseshoe Creek and Lake (Fig. 1), the terrestrial groups (ground-dwelling arthropods and pollinators) headed south towards Hines Creek (Fig. 1). Three sets of pitfall traps and bee bowls had been set up the previous evening (see Collecting techniques below). Scientists spent two hours demonstrating their collecting methods and discussing their finds to visitors at the sites. Public participants collected a few pollinators with nets, but otherwise were not encouraged to collect specimens.

In the afternoon, we set up a one-hour “catch-and-release” bug collecting event for kids and their families. Park staff helped coordinate this well-attended event (Fig. 3) just outside of the MSLC.

Additional activities that were open to the public were a day-long dragonfly nymph survey at two lake sites (part of an ongoing service-wide citizen science project to monitor ecosystem health) and a park-wide photoblitz for moths and butterflies. The photoblitz was intended to appeal to visitors traveling throughout the park who could take photos of any moth or butterfly they saw and submit it to the bioblitz in person (at the MSLC), via e-mail, Facebook, or Flickr (see poster, Appendix C). One person was stationed at the MSLC for most of the day to receive photo submissions.

Indoor events

For two hours in the afternoon, scientists gathered at large tables in the classroom at the MSLC to showcase some of the aquatic and terrestrial specimens that had been collected in the morning (Fig. 3). Several microscopes were set up, aquatic arthropods were dumped out in white sorting trays, and a few terrestrial insects were pinned up or in small sorting dishes.

Later that evening at the MSLC, each of the four scientists/groups gave a 10-15 minute public presentation about their focal taxa, including taxonomy, natural history, ecology, and why these bugs are so cool!



Denali Bug Bio-Blitz!

**Open house
with researchers**

DROP IN!
Visit with Bio-Blitz
scientists and view
their morning's
collections up close
with microscopes.
Learn more about
Denali's amazing
invertebrate
biodiversity, including
pollinators, aquatic
insects, beetles,
spiders, and ants!

**Today!
2-4 PM**

The Denali Bug Bio-Blitz is a park-sponsored event with sessions open to the public throughout the day on July 26, 2014. To learn more, visit the Murie Science and Learning Center or <http://go.nps.gov/DenaliBioBlitz>.

Figure 3. Public-oriented activities at the Denali Bug Bioblitz. **Top left:** examining a specimen during the kids “catch and release” bug hunt. **Bottom left:** scientists and the public join together at the MSLC to look at the day’s catch up close. Photo credits: K. Thoresen.

Researcher-focused events on July 27-29, 2014

Because access to the backcountry is relatively challenging in Denali, we allotted three days for scientists to collect along the full extent of the park road. Nine bioblitz participants (seven scientists and students, two park staff) drove out to the MSLC Teklanika field camp at mile 29 of the road on July 27, in an MSLC van. Several stops were made along the way (sites 7-11; Fig. 2) to collect both aquatic and terrestrial arthropods (collecting techniques are described below). Tables at the MSLC field camp allowed the water mite researchers to set up their white sorting pans to extract mites in the evenings. July 28 was a full day of collecting for the mite team, who travelled all the way to Kantishna in the van, while the terrestrial team concentrated their efforts looking for rove beetles alongside steep, rocky streams and at the edges of lingering snow patches in the vicinity of Stony Dome, west of Highway Pass. Rainy, cold weather precluded any pollinator collecting. The teams split up again on the last day, with the terrestrial entomologists spending time at Tattler Creek and a tributary before making their way back to the MSLC on one of the Denali buses.

Collecting techniques

Water mites (Fig. 4)—Water mites were sampled in streams, rivers, and ponds. In flowing water, a shovel was used to dig in the substrate just upstream of a net and mites were carried with the current into the net. The contents of the net were transferred to a jar which was swirled vigorously so that mites and light organic matter were suspended while heavier sand, rocks, etc. sank to the bottom. The suspended material was poured through a set of sieves (2 mm mesh, then 250 μm mesh); the mites and fine particulate matter collected in the smaller sieve were added to a jar with some river water and kept cool. Later, the contents of the jar were placed neatly in the center of a white photo tray. This set-up allowed mites that crawled out from the particulate matter to be easily spotted and collected with a pipette. Mites were then stored in ethanol for genetic work, or in GAW (a mixture of glycerol, acetic acid and distilled water) for morphological work.



Figure 4. Collecting techniques for water mites in Denali NPP (see description in Methods). Photo credits: (Top L) J. Rykken; (Top R) K. Thoresen; (Bottom L) S. McLane; (Bottom R) J. Rykken

Aquatic macroinvertebrates (Fig. 5)—Invertebrate taxa were collected from various aquatic habitats (streams, rivers, lakes, ponds) using a D-frame net with a 350 μm mesh. Organisms were picked from white sorting trays in the field and preserved in 70% ethanol.



Figure 5. Collecting techniques for aquatic macroinvertebrates in Denali NPP (see description in Methods). Photo credits: (Top) K. Thoresen; (Bottom) J. Rykken.

Ground-dwelling arthropods (Fig. 6)—Pitfall traps were used in the front country. These were 20 oz. plastic cups dug into the ground so that the lip of the cup was flush with the soil surface. A small plastic plate propped up with three nails served as a roof for each cup to keep rain and debris out. Pitfalls were left open for only one night (July 25), so water without preservative was used to trap insects in the cup. Five cups were installed at three sites between the MSLC and Hines Creek (sites 4,5,6; Table 1, Fig.1). Cups were open from approximately 9:30 PM July 25 until 1:30 PM July 26. Signs were posted near the transects to inform visitors what the traps were for and to discourage tampering (Appendix A). Trapped specimens were stored in 70% ethanol. Other ground-dwelling arthropods were collected by hand and with an aspirator by L. Mullen, primarily under rocks near small alpine streams, and at the edges of lingering snow patches.



Figure 6. Collecting techniques for beetles and other terrestrial ground-dwelling insects in Denali NPP. **Bottom left:** a pitfall trap. **Bottom right:** the roof over a pitfall trap (also see description in Methods). Photo credits: J. Rykken.

Insect pollinators (Fig. 7)—Bee bowls (or pan traps) were set up in the front country for several hours (~8:30 AM until 1:30 PM) on July 26. These are small (3.25 oz.) white plastic cups, some of which are painted fluorescent blue or yellow on the inside. Bowls were filled with water and a drop of dish soap to break the surface tension. Pollinators (e.g., bees, flies) are attracted to the color of the bowls, fly in, and drown. Thirty bowls, spaced 5 m apart, were set out along a transect (alternating the three colors) at three sites (sites 4,5,6; Table 1, Fig.1). Signs were posted near the transects to inform visitors what the traps were for and to discourage tampering (Appendix A). Combined contents from the bowls within a transect were strained through a small sieve and stored in 70% ethanol. An aerial net was also used to actively collect insects while in flight and from vegetation. Specimens collected with a net were transferred to a jar with ethyl acetate and pinned as immediately as possible.



Figure 7. Collecting techniques and one site for pollinators in Denali NPP. **Top right:** blue and yellow bee bowls. **Bottom right:** the trail between two visitor centers along which we set up a bee bowl transect (also see description in Methods). Photo credits: J. Rykken.

Specimen processing and deposition

Researchers took preserved specimens back to their respective institutions for processing, curation, and identification. Some funding was allocated to the Sikes lab at UAF to hire a student to sort and curate terrestrial ground-dwelling arthropods and to catalog these as well as all the aquatic macroinvertebrates. Approximately nine months were needed by the various labs to sort through material and get the bulk of the identifications made. All specimens were assigned accession and catalog numbers for entry into the NPS Interior Collections Management System (ICMS). Specimens were ultimately deposited in the collections at the University of Arkansas (water mites) and the University of Alaska Museum (all other arthropods).

Determining new park and state records

New species, genus, or family records for the state of Alaska and/or Denali NPP were determined primarily by searching through the following available resources: Arctos (<http://arctos.database.museum>), an online database of Alaska arthropods managed by Derek Sikes at the University of Alaska Museum; NPSpecies and ICMS databases for Denali; a paper by Milner et al. (2006) documenting several genera of mayflies (Ephemeroptera) and stoneflies (Plecoptera) from Denali, and a USGS report (Brabet and Ourso 2013) that includes aquatic macroinvertebrates used to assess the health of streams in the Kantishna area. Status for all identified taxa is given in Appendix C.

Post-event publicity

Shortly after the bioblitz, we submitted brief summaries describing the event and preliminary results to a regional newsletter, High Latitude Highlights, and also to the service-wide online resource, InsideNPS.

RESULTS

Public events

Approximately 48 park visitors, including 18 children, attended one or more of the public events associated with the Denali Bug Bioblitz, many of these were residents of nearby communities. The best-attended events were the “catch-and-release” outdoor bug-collecting program aimed at younger children and their families, and the indoor microscope session at the MSLC which also drew in many children and their families. The moth and butterfly photoblitz did not attract any volunteers.

Researcher collections

A total of 1,002 arthropod specimens were collected and cataloged. These included 514 water mites, 322 aquatic insects, 17 bees, 57 syrphid flies, and 92 other terrestrial insects. Three taxonomic classes (Arachnida, Chilopoda, Insecta) were represented, including at least 10 orders, and more than 40 families. Of these, 547 specimens have been identified to family level or lower (Appendix C). Among the identified taxa collected during the bioblitz, there were 14 new state records for Alaska and 45 new records for the park.

Aquatic macroinvertebrate samples were very diverse overall, comprising more than half of the identified families: Coleoptera (beetles; 3 families), Diptera (flies; 6 families), Ephemeroptera (mayflies; 4 families), Hemiptera (true bugs, 1 family), Odonata (dragon/damselflies; 3 families), Plecoptera (stoneflies; 4 families), and Trichoptera (caddisflies; 1 family). Five species of dragonflies and one damselfly were documented in the kettle pond near Teklanika campground (site 10, Fig. 2), this was the only site where odonates were collected.

Eight of the 11 identified water mite genera (Fig. 8) were new records for the park and for Alaska. Taxonomy of water mites is extremely challenging and there remain 387 unidentified water mites. The U. of Arkansas researchers found no Torrenticolid water mites (their primary research focus in Alaska) at any of the sites in Denali.

In contrast, all of the seven species of bees collected at the blitz had been documented previously in the park (Rykken 2013), while 10 of the 19 identified syrphid fly species represented new park records.

Logan Mullen was successful in finding two individuals of a currently undescribed species of *Phlaeopterus* (Coleoptera: Staphylindiae) under rocks beside a small, steep tributary to Tattler Creek.



Figure 8. Images of 10 of the 11 water mite genera collected during the Denali Bug Bioblitz. **Top row** (L to R; v = ventral view, d = dorsal view): *Arrenurus* (d), *Atractides* (d), *Aturus* (d). **Second row:** *Forelia* (d), *Frontipoda* (v), *Hygrobates* (v). **Third row:** *Lebertia* (v), *Limnesia* (d), *Sperchon* (v); last row: *Sperchnopsis* (d). Photo credit: J. O'Neill.

DISCUSSION

Biodiversity discovery: the science

We limited the taxonomic scope of the Denali bioblitz to match the focal interests of invited researchers, thus the “grand totals” for numbers of specimens and species collected and identified is relatively low compared to other bioblitzes. However, this strategy also served to minimize arthropod bycatch, huge volumes of which typically remain unsorted and unidentified at the conclusion of many bioblitzes. Although we collected little more than one thousand specimens in all, there were many noteworthy taxa among them.

A new species of rove beetle

Two specimens of an undescribed species belonging to the rove beetle (family Staphylinidae) genus *Phlaeopterus* (Fig. 9) were found northeast of Sable Pass, under damp rocks next to a small, steep tributary to Tattler Creek at 1,219 m elevation. These beetles are predators and are typically found under rocks or moss alongside small alpine streams or lakes and at the edges of snowfields. They often feed on insects that blow onto the surface of the snow.

This undescribed species had never before been collected in Denali National Park, and had previously only been collected at two sites in Alaska (Antimony Creek in the Alaska Range west of Denali, and Summit Lake/Hatcher Pass in the Talkeetna Mountains), and in British Columbia and Alberta. Historical (1978) and recent (2014) collection records from these two Alaskan sites, coupled with the Denali NPP collection records suggest the possibility of an upwards shift in the altitudinal distribution of these beetles from 1978 to the present, a documented response of many alpine taxa to climate change. DNA from these two specimens was extracted and sequenced, and is being incorporated into a phylogenetic analysis of evolutionary relationships of the species of this genus as part of the MS thesis project of Logan Mullen. Preliminary results of the analysis of this genetic data confirm the hypothesis that these specimens belong to a new species in the genus *Phlaeopterus*.



Figure 9. *Phlaeopterus* n.sp., an undescribed species collected by L. Mullen near Sable Pass during the Denali bioblitz. Photo credit: L. Mullen.

Aquatic macroinvertebrates

Aquatic macroinvertebrates are a diverse group of insects that typically include beetles, flies, true bugs, dragon and damselflies, mayflies, caddisflies, and stoneflies. These insects live in lentic or lotic habitats as larvae, nymphs, and/or adults. Other taxa such as worms, mites, clams, and crustaceans also comprise some fraction of the aquatic community. Macroinvertebrates are often used as biological indicators of water quality in streams and rivers, and this has also been the case in Denali. For example, Milner et al. (2006) studied the macroinvertebrates of six streams in Denali between 1994 and 2002 to assess the persistence and stability of aquatic communities. Brabets and Ourso (2013) used macroinvertebrates to assess the effects of mining on streams in the Kantishna area. Nevertheless, one stonefly genus, *Ostrocerca*, and two nonbiting midge genera (*Pseudokiefferiella* and *Syndiamesa*) collected during the bioblitz appear to be new records for both the park and state.

Hydrachnidia, the water mites

Water mites are extremely diverse and have interesting life histories. The larvae are parasitic on aquatic insects (and use their hosts as a means of dispersal), while nymphs and adults are predators. Water mites live in both lentic and lotic waterbodies and can be among the most abundant and diverse benthic arthropods in these habitats. In part, no doubt, because of their small size, there is far less known about the biodiversity and natural history of water mites compared to their macroinvertebrate hosts, but it is likely that they are also excellent indicators of aquatic habitat quality. Extensive field collections and improved taxonomy will help define their role in biological monitoring. It is not surprising that 8 of the 11 genera collected and identified during the bioblitz were new records for both the park and the state (Table 1).

Also of interest is what was *not* found during the bioblitz. The Dowling lab at the U. of Arkansas is focused primarily on one family of water mites, the Torrenticolidae, which are a diverse and abundant group found in swift-flowing waters. In addition to their bioblitz survey in Denali, the research team was also searching for torrenticolids on the Kenai Peninsula. Surprisingly, they found no torrenticolids in either place, even though there were high densities of what are presumed to be their larval hosts, nonbiting midges (Family Chironomidae), and also other families of water mites. It may be that torrenticolid mites have been particularly slow to recolonize Alaska after the last glaciation, we hope to hear more hypotheses from the graduate students as their research progresses.

The researchers also observed that among the water mite families collected from Denali, abundances were much lower than expected. As an example, during previous water mite surveys in the Rocky Mountains, a typical stream sample yielded thousands of water mites, while in Denali they collected 514 mites across 13 sites (and no water mites were collected at four sites). Clearly, there is a lot more research needed to explain patterns of water mite diversity and abundance in Denali and Alaska.

Pollinators

Previous surveys of insect pollinators along the length of the park road in 2012 documented 20 species of bees and 42 species of syrphid flies, including one species new to science (Rykken 2013). While the bioblitz added no new bee species to the database, 10 of the 19 species of syrphid flies we collected were new park records, and two of these represented new state records:

Eupeodes flukei and *Platycheirus coerulescens* (the former was collected by J. Rykken two days after the official end of the bioblitz on Primrose Ridge, see Appendix C.) This suggests that there are many more pollinators to discover in Denali as well as in Alaska.

Biodiversity discovery: public outreach

Connecting scientists with park visitors in the process of biodiversity discovery is an essential component of any bioblitz. At the Denali Bug Bioblitz, public participation was limited to one day. Our main goals were to demonstrate the process of scientific sampling to park visitors and to encourage observation of arthropods, rather than have citizen scientists actively collecting specimens themselves. Observation was encouraged via “catch and release” techniques with children, by asking for contributions to the butterfly photoblitz, and at the well-attended microscope session at the MSLC, where kids and adults could get a good look at specimens under microscopes and engage directly with the scientists.

The logistics for arranging public events in Denali were challenging. Most visitors are at the park for a limited period of time, and spend much of it on buses traveling into the backcountry to see majestic landscapes and charismatic megafauna. And because visitors are on the move for much of the time, it is difficult to catch their attention with posters or announcements, or to lure them into “extra-curricular” activities. For instance, the butterfly photoblitz, which we hoped would encourage visitors anywhere in the park to contribute biodiversity data to the bioblitz, was unsuccessful in attracting any participants, likely because of insufficient advertising. In the event, most of the park visitors who attended our bioblitz events were local residents and families. This turned out to be an ideal group for outreach as it allowed people from surrounding communities to discover fauna from their own landscapes, however, the overall number of participants was relatively small compared to a bioblitz in a more accessible park.

The Denali bioblitz model

On a national scale, bioblitzes have varied in their goals and structure from park to park, with some being more focused on public participation and others on scientific research. While the Denali Bug Bioblitz prioritized having scientists and their research accessible to the public for one day on the “front end,” it also provided scientists with several additional days to focus on taxa directly related to their own research. This model resulted in fewer specimens/species being collected overall, and also in a much higher likelihood that collected specimens would be prioritized for identification and databasing in the researchers’ own labs. Additionally, funding set aside in the budget to hire a student at UAF (the ultimate repository for all specimens but the water mites) to help sort, prepare, and database specimens after the event, significantly reduced the overwhelming bioblitz backlog that is all too common to most bioblitzes. These considerations for the “back end” of the Denali Bug Bioblitz represent a novel contribution to the bioblitz model.

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APPENDIX A. Signs posted near pitfall traps (top) and bee bowls (bottom) to educate visitors.

Denali Bug Bio-Blitz: ground-dwellers



Rove beetle



Wolf spider



Ant

As part of the Denali Bug Bio-Blitz, we are surveying ground-dwelling beetles, ants, and spiders, which play important ecological roles as predators, scavengers, and herbivores in many habitats.

What are these plastic cups and plates?



Pitfall traps are small plastic cups half-filled with water that are dug into the ground so that the lip of the cup is flush with the ground surface. Unwary insects and spiders fall into the cups as they are walking around. The red plate serves as a roof to keep out rain and debris.

Please leave the traps in place!

The Denali Bug Bio-Blitz is a park-sponsored event with sessions open to the public throughout the day on July 26, 2014. To learn more, visit the Murie Science and Learning Center or <http://go.nps.gov/DenaliBioBlitz>.

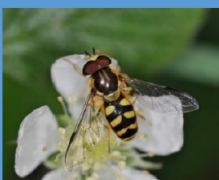
Denali Bug Bio-Blitz: pollinators



Bumble bee



Mining bee



Flower fly

As part of the Denali Bug Bio-Blitz, we are surveying bees and flower flies, two abundant and diverse groups of pollinating insects in the park.

What are these colored bowls?



Bee bowls are painted blue, yellow, and white to resemble flowers and attract pollinators. They are laid out in transects of 15-30 bowls on warm, sunny days, when bees and flies are active. After a few hours, the bowls are collected and the insects are removed from the water.

The Denali Bug Bio-Blitz is a park-sponsored event with sessions open to the public throughout the day on July 26, 2014. To learn more, visit the Murie Science and Learning Center or <http://go.nps.gov/DenaliBioBlitz>.

APPENDIX B. Poster advertising the moth and butterfly photoblitz, with instructions for submitting images.



Denali Needs You

on Saturday, July 26, 2014

for the Butterfly and Moth Photo-Blitz



Help scientists collect data on Denali pollinator diversity from wherever you are in the park on July 26.

HERE'S HOW:

1. Take one or more photos of butterflies or moths with your camera or smartphone.
2. Note the location (e.g., nearest road milepost #, or nearest landmark) of each insect you photograph.
3. Share your photos with us in one of three easy ways:
 - Stop by the Murie Science and Learning Center with your camera to transfer your photos
 - Email your photos to denali_info@nps.gov
 - Send us a message with your photos on Facebook or Flickr. Search for DenaliNPS on either of those two social media sites to find us.

Please be sure to tell us the location where you took each photo

Please note that photos donated to us as part of this BioBlitz become public domain, meaning anyone may reuse them for any purpose. If you are not comfortable with your submission entering the public domain, please do not give us your photos.

APPENDIX C. List of arthropod taxa identified to family level or below, collected during the Denali Bug Bioblitz, 2014. Habit column: A = aquatic; T = terrestrial. Status column: S = state record; P = park record. Site numbers correspond to sites in Table 1; numbers in spreadsheet represent specimen abundance. Terrestrial arthropods that were identified only to order level or higher do not appear in this list, but are in the ICMS database.

			Sampling sites																								
Taxon list	Habit	Status	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	# sites	
CLASS ARACHNIDA																											
ORDER TROMBIDIFORMES (SOME MITES)																											
Unidentified taxa	A			6	3				35					250		3	3				80		1	3	3		10
Family Arrenuridae																											
Arrenurus	A	S,P																					3			1	
Family Aturidae																											
Aturus	A	S,P																						5		1	
Family Hydriphantidae																											
Wandesia	A	S,P												3												1	
Family Hygrobatidae																											
Atractides	A	S,P																						2		1	
Hygrobates	A																					2				1	
Family Lebertiidae																											
Lebertia	A				2						2			3								1		8		5	
Family Limnesiidae																											
Limnesia	A	S,P		25																						1	
Family Oxidae																											
Frontipoda	A	S,P																				1				1	
Family Pionidae																											
Forelia	A	S,P																				20				1	
Family Sperchontidae																											
Sperchon	A				3															4				33		3	
Sperchonopsis	A	S,P							2		2			1						4			1			5	
CLASS INSECTA																											
ORDER COLEOPTERA (BEETLES)																											
Family Carabidae	T						1																			1	
Family Cerambycidae	T						1																			1	
Family Dytiscidae																											
Agabus	A	P		2								2														2	
Family Haliplidae																											
Haliplus	A	P		1																						1	
Family Staphylinidae												2														1	
Phlaeopterus n. sp.	T	P													2											1	

Taxon list	Habit	Status	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
ORDER DIPTERA (FLIES)																									
Family Chaoboridae																									
<i>Chaoborus</i>	A	P										1													1
Family Chironomidae																									
<i>Corynoneura</i>	A									1															1
<i>Cricotopus/Orthocladius</i>	A														2										1
<i>Diamesa</i>	A			2	2				4	1	2				4										6
<i>Eukiefferiella brehmi group</i>	A	S,P								1	1														2
<i>Eukiefferiella claripennis group</i>	A		4		1				2	1															4
<i>Heterotrissocladius</i>	A	P							2																1
<i>Orthocladius</i>	A								1																1
<i>Orthocladius (Mesorthocladius)</i>	A	P								4															1
<i>Orthocladius (Symposiocladius)</i>	A	P									9														1
<i>Psectrocladius limbatellus group</i>	A	P										1													1
<i>Pseudodiamesa</i>	A				1																				1
<i>Pseudokiefferiella</i>	A	S,P								35															1
<i>Rheocricotopus</i>	A														1										1
<i>Syndiamesa</i>	A	S,P		1																					1
<i>Synorthocladius</i>	A	P									1														1
<i>Trichotanypus</i>	A	P								13															1
<i>Tvetenia</i>	A								1		9				1										3
Family Dixidae																									
<i>Dixella</i>	A	P										2													1
Family Empididae																									
<i>Metachela/Chelifera</i>	A														1										1
<i>Oreogeton</i>	A														1										1
Family Faniidae	T	S,P					13																		1
Family Heleomyzidae	T	P					1																		1
Family Phoridae	T	P					2																		1
Family Scathophagidae	T						3																		1
Family Sciaridae	T	P					1																		1
Family Simuliidae																									
<i>Gymnopsis</i>	A								8	3															2
<i>Metacnephia</i>	A	P									1				2										2
<i>Prosimulium</i>	A								1	7					8										3
<i>Simulium</i>	A		20																						1

			Sampling sites																							
Taxon list	Habit	Status	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	
Family Syrphidae																										
<i>Cheilosia bigelowi</i>	T														1											1
<i>Cheilosia laevis*</i>	T																								na	
<i>Cheilosia latrans</i>	T					5	23	2																		3
<i>Cheilosia</i>	T														1											1
<i>Chrysotoxum ventricosum</i>	T	P					1																			1
<i>Eristalis interrupta</i>	T	P				1	1	1																		3
<i>Eristalis rupium</i>	T	P				1		1																		2
<i>Eupeodes curtus</i>	T												1													1
<i>Eupeodes flukei*</i>	T	S,P																							na	
<i>Eupeodes perplexus</i>	T	P						1																		1
<i>Helophilus neoaffinis</i>	T	P						1																		1
<i>Melanostoma mellinum</i>	T					1	1																			2
<i>Parasyrphus tarsatus*</i>	T																								na	
<i>Pipiza macrofemoralis</i>	T							1																		1
<i>Platycheirus coerulescens</i>	T	S,P										1														1
<i>Platycheirus holarcticus</i>	T	P													1											1
<i>Platycheirus</i>	T												1													1
<i>Sphaerophoria abbreviata/asymmetrica/philanthus</i>	T							1																		1
<i>Syrphus attenuatus*</i>	T																									0
<i>Syrphus ribesii</i>	T						5	1																		2
<i>Syrphus torvus*</i>	T	P																							na	
<i>Xylota subfasciata</i>	T	P				2		1																		2
*Additional species collected on Primrose Ridge by J. Rykken two days after the event (7/31/2014).																										
Family Tipulidae																										
<i>Limonia</i>	A	P		2																						1
<i>Tipula</i>	A													2												1
ORDER EPHEMEROPTERA (MAYFLIES)																										
Family Ameletidae																										
<i>Ameletus</i>	A				13				7					4												3
Family Baetidae																										
<i>Acentrella turbida</i>	A										2															1
<i>Baetis bicaudatus</i>	A								12		7			4												3
<i>Procloeon</i>	A	P										6														1
Family Ephemerellidae																										
<i>Drunella doddsi</i>	A										1															1
Family Heptageniidae																										
<i>Cinygmula</i>	A								6		5			5												3
<i>Epeorus</i>	A													2												1

			Sampling sites																								
Taxon list	Habit	Status	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	# sites	
ORDER HEMIPTERA (TRUE BUGS & OTHERS)																											
Family Gerridae																											
<i>Limnopus</i>	A	P										1														1	
Family Miridae	T						1																			1	
ORDER HYMENOPTERA (BEES & OTHERS)																											
Family Andrenidae																											
<i>Panurginus ?ineptus</i>	T						1																			1	
Family Apidae																											
<i>Bombus cryptarum</i>	T							2	1																	2	
<i>Bombus flavifrons</i>	T					2	2								1											3	
<i>Bombus frigidus</i>	T						1					2		1												3	
<i>Bombus mixtus</i>	T					1	1					1														3	
<i>Bombus sylvicola</i>	T												1													1	
ORDER ODONATA (DRAGON/DAMSELFLIES)																											
Family Aeshnidae																											
<i>Aeshna interrupta</i>	A	P										1														1	
<i>Aeshna juncea</i>	A	P										1														1	
<i>Aeshna septentrionalis</i>	A	P										1														1	
<i>Aeshna sitchensis</i>	A	P										1														1	
Family Coenagrionidae																											
<i>Coenagrion/Enallagma</i>	A											1														1	
Family Libellulidae																											
<i>Leucorrhinia</i>	A	P										1														1	
ORDER PLECOPTERA (STONEFLIES)																											
Family Capniidae																											
<i>Mesocapnia</i>	A									1				13												2	
Family Chloroperlidae																											
<i>Plumiperla</i>	A								1		1			1												3	
<i>Suwallia</i>	A													5												1	
Family Nemouridae																											
<i>Nemoura</i>	A													2												1	
<i>Ostrocerca</i>	A	S,P								9																1	
<i>Podmosta</i>	A								1	3				8												3	
<i>Prostoia besametsa</i>	A								2																	1	
<i>Zapada haysi/oregonensis</i>	A								17					1												2	
Family Perlodidae																											
<i>Isoperla petersoni</i>	A										2															1	
ORDER TRICHOPTERA (CADDISFLIES)																											
Family Limnephilidae																											
<i>Limnephilus</i>	A	P		2																						1	
Total # taxa per site:				2	8	7	7	17	10	16	12	14	15	3	24	5	1	1	0	0	2	1	4	3	5	1	