PROC. ENTOMOL. SOC. WASH.
115(4), 2013, pp. 358–368

THE DESCRIPTION OF *PARAMBLYNOTUS DELANEYI* (HYMENOPTERA: LIOPTERIDAE), A NEW SPECIES FROM JOSHUA TREE NATIONAL PARK

MATTHEW L. BUFFINGTON AND MICHAEL W. GATES

Systematic Entomology Lab, USDA, c/o Smithsonian NMNH, 10th & Constitution Ave NW, Washington DC 20013, USA. (e-mail: matt.buffington@ars.usda.gov; michael.gates@ars.usda.gov)

Abstract.—A **new species, *Paramblynotus delaneyi*,** is described and characters separating it from the Nearctic species *P. zonatus* Weld and *P. virginianus* Liu are discussed. A discussion of the insect biodiversity survey at Joshua Tree National Park is provided.

Key Words: Cynipoidea, *zonatus*, *virginianus*, *Kiefferiella*, desert

DOI: 10.4289/0013-8797.115.4.358

Joshua Tree National Park (JTNP) covers a land area of 790,636 acres and includes parts of two deserts, whose characteristics are determined primarily by elevation: the higher Mojave Desert and lower Colorado Desert below 3,000'. JTNP represents a diverse assemblage of desert ecosystems with their constituent flora and fauna, making it attractive to those interested in documenting the diversity of the arid lands of the Desert Southwest.

This malaise trap survey, from which the new *Paramblynotus* (Hymenoptera: Liopteridae) described herein, was collected as part of a proof-of-concept study on the insect biodiversity of a crown jewel (JTNP) of the National Park Service (NPS). With an initial emphasis on Hymenoptera, all insect material collected to date forms a growing knowledge base of the fauna. Very little has been published on the biodiversity of JTNP Hymenoptera specifically (Hampton 1968). Thus, this study will be one of the first of its kind. It will also be the first time that specimens collected on NPS property are deposited in the Smithsonian Institution as NPS's official repository. This is based on a Memorandum of Understanding signed in April 2012 by Eva Pell (Under Secretary for Science, National Museum of Natural History, Smithsonian Institution) and Jonathan Jarvis (Director, National Park Service).

The Liopteridae of North America are not a particularly diverse clade of Cynipoidea. The family is represented by two genera, namely *Kiefferiella* Ashmead and *Paramblynotus* Cameron. Ronquist (1995) provided the first clear understanding of the family, creating monophyletic subfamilies for all genera based on a morphological phylogenetic analysis. Of all genera, *Paramblynotus* is by far the most diverse, especially in the

urn:lsid:zoobank.org:pub:CB40FD32-ACB3-4935-B069-92F220B099AF

Afrotropical and Oriental Regions (Ronquist 1995, Liu et al. 2007, van Noort and Buffington 2013). Liu et al. (2007) revised the world *Paramblynotus*, and reported that two species of *Paramblynotus* exist in North America: *Paramblynotus virginianus* Liu, Ronquist and Nordlander, and *P. zonatus* Weld. *Paramblynotus virginianus* is known from the Shenandoah Mountains of eastern North America and southeastern Canada, while *P. zonatus* is only known from Brownsville, Texas. Liu et al. (2007) created species-groups to aid in the classification of *Paramblynotus*, and placed *P. virginianus* in its own monotypic group, while *P. zonatus* was placed in the *trisetosus* group.

While sorting raw Malaise trap samples from JTNP (Riverside/San Bernardino Counties, California), MG pulled a single liopterid specimen and brought it to MB for identification. The specimen was clearly a *Paramblynotus* (*Kiefferiella* has a distinct blade-like metasoma, and this specimen had a bulbous metasoma). The specimen was immediately mounted and labeled, and run through the *Paramblynotus* key of Liu et al. (2007), and came out in the first couplet of species-groups to *virginianus*. The specimen was then compared to the holotype and paratypes of *P. virginanus*, and was obvious after comparison that the species from JTNP was distinct from *P. virginianus*, both in morphology and distribution. While single specimen species descriptions are wisely avoided in parasitoid systematics, we feel this discovery is noteworthy, underscoring how little we know about the Hymenoptera diversity of the desert southwest, as well as a massive range extension for *Paramblynotus* in North America. Herewith, we provide a description of ***Paramblynotus delaneyi***, **new species**, included in the *virginianus* species-group (*sensu* Liu et al. 2007), and provide an overview of the joint project between the National Park Service (JTNP), the USDA (Systematic Entomology Laboratory) and the Smithsonian Institution.

Materials And Methods

List of Depositories

USNM – National Museum of Natural History, Washington, DC, USA.

Field collections.—We set up and maintained seven malaise traps (MT) (Fig. 13) in floristically/edaphically representative habitats, ranging from sandy arroyos and Joshua Tree woodlands to permanent springs, throughout JTNP in 2012 as part of sampling year one. It can be challenging to anticipate peak insect activity in response to highly localized rainfall, thus we operated MTs continuously over five months (May-October) to capture ephemeral emergence peaks.

We incorporated the principles of citizen science in obtaining a diverse pool of participants, ranging from students at Copper Mountain College (CMC; Joshua Tree, CA) to JTNP staff and volunteers (See Acknowledgments). These individuals received training in identification, collection, and curation techniques. Raw samples were, depending on number of specimens, either sorted by hand or fractionated (Buffington and Gates 2008), with the resultant residues shipped to the Smithsonian Institution for final processing and curation. All date and locality data associated with all MT fractions were entered into the Smithsonian's collections management database Electronic Museum (EMu, KE Software), which generated unique Internal Record Number (IRN) numbers for each residue. This system will allow for tracking residues and, ultimately, specimens as they are

processed and incorporated into the research stream.

Specimen illustration and observation.—The specimen was point mounted on black, acid-free Bristol board point for examination, using a Leica 205c stereomicroscope with fluorescent light sources. Color images were acquired using the EntoVision® multiple-focus imaging system. This system comprises a Leica® DMRB compound microscope with a GT-Vision Lw11057C-SCI digital camera attached that fed image data to a desktop computer. The program Cartograph® 5.6.0 was then used to merge an image series (representing typically 35–40 focal planes) into a single in-focus image. Lighting was achieved using techniques summarized in Buffington et al. (2005), Kerr et al. (2009) and Buffington and Gates (2009). Scanning electron images (SEM) were generated using a Hitachi TM3000, specimen uncoated, under 'charge-up reduction mode'. Resulting SEM and color images were editing using Adobe Creative Suite 4. All images are freely available from Morphbank (www.morphbank.com).

Descriptive format.—Morphological terms used in this description were matched to the Hymenoptera Anatomy Ontology (HAO, Yoder et al. 2010) (Table 1). Identifiers (URIs) in the format http://purl.obolibrary.org/obo/HAO_XXXXXXX represent anatomical concepts in HAO version http://purl.obolibrary.org/obo/hao/2011-05-18/hao.owl. They are provided to enable readers to confirm their understanding of the anatomical structures being referenced. To find out more about a given structure, including, images, references, and other metadata, use the identifier as a weblink, or use the HAO:XXXXXXX (note colon replaces underscore) as a search term at http://glossary.hymao.org. Diagnoses focus on easily recognized gross morphologies, and closely related species are distinguished. Terminology for all descriptive characters are defined in van Noort and Buffington (2013).

Systematic Treatment

Paramblynotus delaneyi Buffington and Gates, new species

urn:lsid:zoobank.org:act:833D529E-3C70-476E-92DE-F4F2DF93F1BC

http://usnmhymtypes.com/default.asp?Action=Show_Types&Single_Type=True&TypeID=7292

Diagnosis.—This species falls within the *virginianus* group of *Paramblynotus* circumscribed by Liu et al. (2007). *Paramblynotus delaneyi* appears to be a desert endemic and is not restricted to the deciduous forests of eastern North America as is *P. virginianus*; the forewings of *P. delaneyi* are entirely hyaline and glabrous, whereas *P. virginianus* have distinctly infuscate forewings and are entirely setose; *P. delaneyi* has a strongly keeled face between the toruli, whereas *P. virginianus* is weakly keeled; *P delaneyi* has a distinct pronotal crest, whereas *P. virginianus* lacks such a crest; *P. delaneyi* possesses stout (about as long as broad), nearly blunt, apical teeth on the metatibia, whereas *P. virginianus* has distinctly sharpened, elongate apical teeth (clearly longer than broad). A caveat to these differences is that *P. delaneyi* is only known from a single male, whereas *P. virginianus* is only known from females. The only other North American *Paramblynotus* this species could be confused with is *P. zonatus* Weld; however, *P. delaneyi* can be separated by having an entirely black body, whereas *P. zonatus* has a yellow head and pronotum; *P. delaneyi* has hyaline wings, whereas *P. zonatus* has two distinct infuscate patches in the forewing; *P. delaneyi* possesses a moderate keel

Table 1. Correspondence between anatomical terms used and the Hymenoptera Anatomy Ontology.

Term	URL
F1	http://purl.obolibrary.org/obo/HAO_0001148
F2	http://purl.obolibrary.org/obo/HAO_0001883
T3	http://purl.obolibrary.org/obo/HAO_0001151
T6	http://purl.obolibrary.org/obo/HAO_0000059
T8	http://purl.obolibrary.org/obo/HAO_0000061
T7	http://purl.obolibrary.org/obo/HAO_0000060
abdominal petiole	http://purl.obolibrary.org/obo/HAO_0000020
antenna, antennae	http://purl.obolibrary.org/obo/HAO_0000101
antennal scrobe	http://purl.obolibrary.org/obo/HAO_0001432
anterior plate of pronotum	http://purl.obolibrary.org/obo/HAO_0002071
anterior tentorial pits	http://purl.obolibrary.org/obo/HAO_0000126
area	http://purl.obolibrary.org/obo/HAO_0000146
band	http://purl.obolibrary.org/obo/HAO_0000163
carina, carinae	http://purl.obolibrary.org/obo/HAO_0000188
clypeal margin	http://purl.obolibrary.org/obo/HAO_0001767
clypeus	http://purl.obolibrary.org/obo/HAO_0000212
costae	http://purl.obolibrary.org/obo/HAO_0000188
depression, depressions	http://purl.obolibrary.org/obo/HAO_0000241
dorsal pronotal area	http://purl.obolibrary.org/obo/HAO_0000267
dorsellum	http://purl.obolibrary.org/obo/HAO_0000625
eye, eyes	http://purl.obolibrary.org/obo/HAO_0000217
eye margin	http://purl.obolibrary.org/obo/HAO_0000672
face	http://purl.obolibrary.org/obo/HAO_0000316
flagellum	http://purl.obolibrary.org/obo/HAO_0000343
forewing	http://purl.obolibrary.org/obo/HAO_0000351
fovea, foveae	http://purl.obolibrary.org/obo/HAO_0000241
gena, genae	http://purl.obolibrary.org/obo/HAO_0000371
genal carina	http://purl.obolibrary.org/obo/HAO_0001755
head	http://purl.obolibrary.org/obo/HAO_0000397
inner spur	http://purl.obolibrary.org/obo/HAO_0002068
lateral ocelli	http://purl.obolibrary.org/obo/HAO_0000481
lateral pronotal carina	http://purl.obolibrary.org/obo/HAO_0001031
lateral propodeal carina	http://purl.obolibrary.org/obo/HAO_0001919
legs	http://purl.obolibrary.org/obo/HAO_0000494
lobe at the base of the tarsal claws	http://purl.obolibrary.org/obo/HAO_0001219
lower face	http://purl.obolibrary.org/obo/HAO_0000502
margin	http://purl.obolibrary.org/obo/HAO_0000510
margin	http://purl.obolibrary.org/obo/HAO_0001981
median longitudinal propodeal carina	http://purl.obolibrary.org/obo/HAO_0000529
median mesoscutal impression	http://purl.obolibrary.org/obo/HAO_0001951
median ocellus	http://purl.obolibrary.org/obo/HAO_0000526
medial carina	http://purl.obolibrary.org/obo/HAO_0001929
mesopleural triangle	http://purl.obolibrary.org/obo/HAO_0000562
mesopleuron	http://purl.obolibrary.org/obo/HAO_0000566
mesoscutum	http://purl.obolibrary.org/obo/HAO_0001490
mesosoma	http://purl.obolibrary.org/obo/HAO_0000576
mesotibial outer spur	http://purl.obolibrary.org/obo/HAO_0002069
metacoxa	http://purl.obolibrary.org/obo/HAO_0000587
metapectal propodeal complex	http://purl.obolibrary.org/obo/HAO_0000604
metasoma	http://purl.obolibrary.org/obo/HAO_0000626

Table 1. Continued.

Term	URL
metasomal tergum/ metasomal terga	http://purl.obolibrary.org/obo/HAO_0001349
metatarsomere	http://purl.obolibrary.org/obo/HAO_0002070
metatibia	http://purl.obolibrary.org/obo/HAO_0000631
metatibial spur	http://purl.obolibrary.org/obo/HAO_0001121
metepisternum	http://purl.obolibrary.org/obo/HAO_0000634
notaulices	http://purl.obolibrary.org/obo/HAO_0000647
nucha	http://purl.obolibrary.org/obo/HAO_0000651
occipital carina	http://purl.obolibrary.org/obo/HAO_0000653
occiput	http://purl.obolibrary.org/obo/HAO_0000658
ocellar plate	http://purl.obolibrary.org/obo/HAO_0000430
ocellus, ocelli	http://purl.obolibrary.org/obo/HAO_0000661
patch, patches	http://purl.obolibrary.org/obo/HAO_0000704
pronotal crest	http://purl.obolibrary.org/obo/HAO_0001956
pronotum	http://purl.obolibrary.org/obo/HAO_0000853
punctures	http://purl.obolibrary.org/obo/HAO_0000885
rim	http://purl.obolibrary.org/obo/HAO_0000900
scrobe	http://purl.obolibrary.org/obo/HAO_0001432
sculpture	http://purl.obolibrary.org/obo/HAO_0000913
scutellar fovea	http://purl.obolibrary.org/obo/HAO_0000916
scutellum	http://purl.obolibrary.org/obo/HAO_0000572
setae	http://purl.obolibrary.org/obo/HAO_0000935
speculum	http://purl.obolibrary.org/obo/HAO_0000944
sternum 3	http://purl.obolibrary.org/obo/HAO_0000036
submedian pronotal depression	http://purl.obolibrary.org/obo/HAO_0001762
tentorial pits	http://purl.obolibrary.org/obo/HAO_0000999
torulus, toruli	http://purl.obolibrary.org/obo/HAO_0001022
vertex	http://purl.obolibrary.org/obo/HAO_0001077
wing, wings	http://purl.obolibrary.org/obo/HAO_0000351

between the toruli on the face, whereas *P. zonatus* has an enormous keel between the toruli. *Paramblynotus zonatus* was not illustrated in Liu et al. (2007), so we provide here images of the type specimen and labels (Figs. 9–12; USNM Matrix 00675698) and designate the following LSID for the species: urn:lsid:zoobank.org:act:B53ACCAF-DF08-4297-81D3-FA077FC9C8CE; the full record for the specimen can be found at: http://usnmhymtypes.com/default.asp?Action=Show_Types&Single_Type=True&TypeID=7290

Description.—MALE. Length 2.5 mm. Head, mesosoma and metasoma dark brown; antennae orange, and legs basally brown, apically light yellow; (Fig. 1). Wings transparent (Fig. 1). Entire head and mesosoma lightly pubescent (Fig. 2).

Head: Eyes prominent, bulbous, but not laterally extended much beyond outer margin of genae in anterior view (Fig. 5). Antenna with 13 flagellomeres; F1 0.95x length of F2; flagellum not widening toward apex. Vertex strigate, rows of longitudinal carinae present; ocellar plate raised; ocelli large, their diameter as great as distance between lateral and median ocellus (Fig. 4). Face punctate-rugose, bulging close to clypeal margin, protruding in lateral view; antennal scrobe entirely smooth. Strongly keeled median carina present between toruli extending toward median ocellus and ocellar plate (Fig. 5). Occiput concave in dorsal view,

Figs. 1–6. *Paramblynotus delaneyi*, male. 1, lateral habitus; 2, lateral head and mesosoma; 3, dorsolateral head and mesosoma; 4, dorsal head and mesosoma; 5, anterior face; 6, labels.

smooth without a carina. Lower face with strong excavations and vertical carinae defining upper clypeal margin, and containing anterior tentorial pits (Fig. 5). Clypeus strongly strigate. Genae with distinct foveae along eye margin, punctate-rugose and sparsely pubescent between these foveae and genal carina (Fig. 5).

Mesosoma: Overall weakly pubescent, with fine hairs along each horizontal ridge. Bi-lobed submedian pronotal depression present. Anterior plate of pronotum puberulous. Pronotum dorsomedially

with swollen rim with slight crest. Lateral carinae of pronotum strong, fading dorsomedially. Lateral surface of pronotum foveate (Fig. 2). Dorsal pronotal area smooth with minute punctures, each having a single seta. Mesoscutum deeply foveate, horizontal rows of cuticle present, lightly setose; notaulices complete, extending to anterior margin of mesocutum; median mesoscutal impression absent (Fig. 4). Scutellar foveae smooth, each with one subcarina creating two elongate subfoveae. Scutellum medially deeply areolate (Fig. 4). Posterior mesoscutum and scutellum contiguously rounded in lateral view. Mesopleural triangle defined by gentle ventrally curved carina, strongly pubescent dorsally, glabrous ventrally; entire surface dorsoventrally ribbed; median longitudinal impression percurrent with evenly spaced transverse carinae; speculum glabrous, smooth (Fig. 2). Lower mesopleuron with aerolate mesopleural impression which curves anteriorly and posteriorly, meeting at the mesosternum, largely glabrous save for few long hairs. Metapectal-propodeal complex strongly excavated, excavations bordered by strong carinae. Metepisternum dorsally excavated with pubescence, medially polished with indications of minor aerolate remnants, postero-ventrally pubescent. Dorsellum with two strong medial, polished foveae; laterally strongly excavated with fine pubescence in lateral depressions. Lateral propodeal carina present, gently curving medially along posterior 1/3 of length; median propodeal area crossed by wrinkled transverse and longitudinal carinae extending onto nucha.

Forewing: Hyaline throughout; Rs+M of forewing defined (Fig. 1). Marginal cell 2.5 times as long as wide. Abdominal petiole short, finely longitudinally striate, about as long as wide in dorsal and lateral view (Fig. 2).

Metasoma: Entirely glabrous. Posterior ventral margin of metasomal T7 curved downward (Fig. 8). T8 obscured by T7 (Fig. 8); T3–T7 micropunctate; T6–T7 with few scattered larger impressions. Ventral borders of terga distinctly flared out (presumably curatorial artifact), extending beyond ventral border of metasoma.

Legs: Sparsely punctate; fore/mid femora lightly pubescent, hind femora densely setose; fore/mid coxa lightly setose, hind coxa antero-laterally densely setose, posteriorly glabrous, smooth (Fig. 2-3). Mesotibial spurs subequal in length; metatibial spurs subequal in length; metatibial apical teeth short, stout, about as long as wide (Fig. 7). Ratio of first metatarsomere to the remaining 4 metatarsomeres combined: 0.60.

FEMALE. Unknown.

Distribution.—Known only from the type locality: Joshua Tree National Park, San Bernardino County, California, USA.

Biology.—Unknown.

Etymology.—Named in honor of Dr. Paul Delaney (Copper Mountain Community College, Joshua Tree, CA) for all his help in coordinating the fieldwork over 2012 necessary to begin our joint project with JTNP, SEL and the Smithsonian Institution.

Type material.—*Holotype* male. USA: California, San Bernardino Co. Joshua Tree National Park; Black Rock malaise trap, Little San Bernardino Mtns; Black Rock Canyon Campground; 15.VI-5. VII.2012, 34.071074° N -116.391839° W; F. Soffel, R. Zamorano; IRN 10325423. The holotype is point-mounted on black Bristol board. Deposited in USNM (USNM Matrix 0675699) (Fig. 6).

Key to species of *Paramblynotus* of North America

1. A. Head and pronotum yellow-orange (Figs. 9-10). Wings with two distinct infuscations

(Fig. 9) Facial keel, between toruli, massive, with a distinct hump dorsally . . . . . .P. *zonatus*

B. Head and pronotum black to very dark brown (Fig. 2). Wings either hyaline or with a single infuscation coincidental with the marginal cell (Fig. 1). Facial keel present but reduced a single small ridge 2

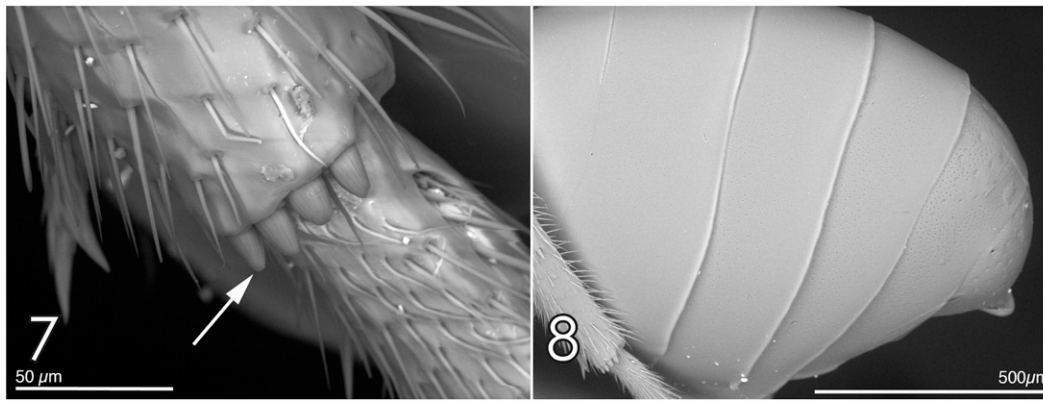
2. A. Wings entirely hyaline, with no infuscation (Fig. 1). Pronotal ridge (viewed in profile) present (Fig. 2). Metatibial apical teeth stout, about as long as broad (Fig. 7). . . . . .P. *delaneyi*

B. Wings with a distinct infuscation coincidental with marginal cell. Pronotal ridge absent. Metatibial apical teeth clearly longer than broad . . . . . P. *virginianus.*

Discussion

Throughout 2012, seven Malaise traps were run nearly year round in Joshua Tree NP (JTNP) or nearby areas. The locations of each trap, as well as habitat images, are summarized in Fig. 13. Our goals are to compare and contrast insect diversity at disparate microhabitats within JTNP. This project is primarily exploratory and directed toward species discovery, but could lead to a longer-term study addressing specific research questions. Further, having JTNP biodiversity identified and quantified can provide information pertinent for management decisions made by JTNP staff. Specimens collected in JTNP can be used to further our understanding in piecing together the distribution of desert taxa, especially when compared with the results of our collecting efforts throughout the Desert Southwest (SE Arizona, SW New Mexico, Nevada, Southern California, etc.)

The following cynipoids have thus far been recorded from JTNP: Liopteridae: *Paramblynotus delaneyi*; Cynipidae: *Synergus* sp. (Synergini); Figitidae: *Anacharis* sp. (Anacharitinae); *Banacuniculus utilis* (Beardsley); *Hexacola* sp.; *Ganaspis* sp.; *Sinatra pacifica* (Yoshimoto) (Eucoilinae); *Melanips* sp. (Aspicerinae). Most of these genera and/or species are not particularly surprising to find in the desert southwest (Buffington, pers. obsv.). A *Kiefferiella rugosa* Weld has been taken at Swarthout Canyon (San Bernardino Co) in CA (through C. Weirauch and D. Yanega UC Riverside), and it appears this species is adapted for more mesic-arid habitats; this species may eventually be taken at JTNP. Cynipid diversity in the desert southwest is patchy, and coincides with clutches of oaks on so-called 'sky islands'



Figs. 7–8. *Paramblynotus delaneyi*, male. 7, metatibial teeth; 8, lateral metasoma.

Figs. 9–12. *Paramblynotus zonatus*, female, holotype. 9, lateral habitus; 10, dorsal head and mesosoma; 11, lateral metasoma; 12, labels.

throughout AZ, NM and CA (Z. Liu, pers. comm.). Malaise trapping is not the most efficient way of sampling the cynipid fauna, aside from the fact that host plant data is impossible to obtain without direct collection of galls.

Remarkably, while running only seven traps, and using volunteers and interns to run the traps, sort, mount and label, we have made some rather startling discoveries within Cynipoidea. The cynipoid fauna encompasses lineage diversity that spans several hundred-million years (Buffington et al. 2012), and includes feeding guilds such as inquillines (*Synergus*), chrysopid parasitoids (*Anacharis*), agromyzid parasitoids (*Banacuniculus utiliz*; *Sinatra pacifica*), chamaemyiid parasitoids (*Melanips*), drosophilid parasitoids (*Ganaspis*), and ephedrid parasitoids (*Hexacola*) (see table 1, Buffington et al. 2012). Ergo, by sampling this rather moderately diverse superfamily of parasitic Hymenoptera, we have learned about the diversity of two additional orders, and five families, of insects. Unfortunately, science still has not revealed the host of *Paramblynotus* species (van Noort and Buffington 2013).

Future sampling within JTNP should focus on different habitats than previously sampled, possibly locations that coincide with plant phenology and mammal ecology studies; this would improve the logisitics of maintaining the traps. Additional

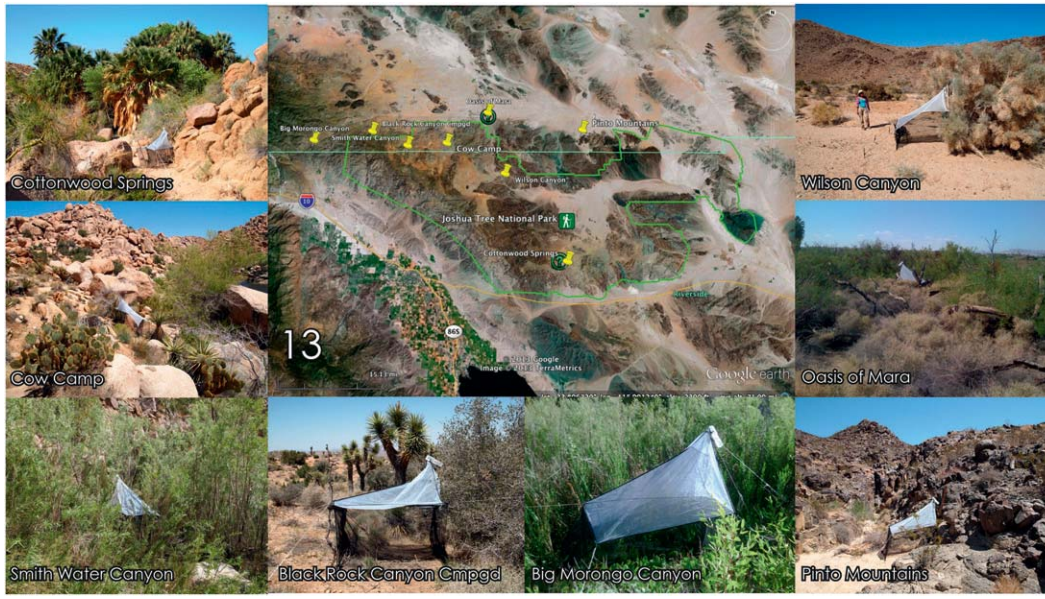


Fig. 13. Map of malaise trap locations with trap images. Cottonwood Springs, California fan palm oasis; Cow Camp, manmade impoundment in juniper scrub; Smith Water Canyon, riparian; Black Rock Canyon Campground, Joshua Tree woodland; Big Morongo Canyon, riparian; Pinto Mountains, creosote bush scrub; Oasis of Mara, mesquite/palm oasis; Wilson Canyon, transition between Mojavean and Sonoran zones, Shanteal Nazario pictured.

collecting methods would ideally be employed, such as yellow-pan trapping, sweeping, vacuuming, and direct rearing (especially of Cynipidae). Malaise traps are attractive for these types of biodiversity studies, but many groups of insects, especially brachypterous groups, can be missed by even the best placed Malaise trap (Buffington and Gates, pers. obs.; Masner, pers. comm.). Yellow-pan traps sample just at the interface of ground and plants, and can often be used to sample micro-habitats near shrubs. Sweeping and vacuuming can target certain shrub species for Hymenoptera, so at the very least, circumstantial host-plant associations can be recorded. Direct rearing, by far the most labor intensive, yields the greatest amount of reliable biological data, revealing the food-web dynamics of hosts, parasitoids, and host plants. However, for this latter method, not only do the hosts need to be located, but also they need to be isolated and reared under controlled conditions.

The circumscription of the *Paramblynotus virginianus* species-group needs to be slightly revised following the inclusion of *P. delaneyi*. Most notable are the following characters: pronotal crest either extended dorsally (*P. delaneyi*) or continuous with mesoscutum (*P. virginianus*); wings ranging from slightly infuscate (*P. virginianus*) to entirely hyaline (*P. delaneyi*); mesotibial apical teeth ranging from sharp and elongate (*P. virginianus*) to stout, as wide as long (*P. delaneyi*). It should also be noted that the *virginianus* species-group was formerly composed of only a single species known exclusively from females; being that *P. delaneyi* is known only from males, as more specimens of *P. delaneyi* are discovered in the desert southwest of North

America, the circumscription of the species-group may continue to be revised. It should also be noted that in the legend of figures 22–29 in Liu et al. (2007), *P. virginianus* is misspelled "*P. virginiatus*", resulting in the latter being unavailable.

Acknowledgments

We offer our deepest thanks to those citizen scientists who are the "boots on the ground" for this project: Alexander Boice, Sharlene Braginton, Aaron Cohen, Erin Farr, Deena Garrett, Cindy Haiston, Jeff Jones, Jessica Maciel, Tawnisha Martinez, Shanteal Nazario, Jack Roland, Misty Roland, Ronesta Zamorano, Tara Cambon, Jonathan Cambon, Fawn Cambon, Farrah Soffel, and their coordinator, Dr. Paul Delaney (CMC). For useful discussions and interactions we thank Kipp Callahan, Michael Vamstad, Andrea Compton, Victoria Chang (all NPS). Dave Furth (Smithsonian) provided merchandise return labels for shipping samples. Lynn Kimsey (University of California – Davis), James Pitts (Utah State University), Jon Gelhaus (Drexel University), and Norman Johnson (Ohio State University) provided malaise traps to the project. Finally, we would like to thank Erik Oberg (NPS) for assisting in the early developmental stages of this project; without Erik's hard work and dedication, this project would not have been possible.

Literature Cited

Buffington, M. L. and M. W. Gates. 2008. The Fractionator: a simple tool for mining 'Black Gold'. Skaphion 2(24): 1–4.

Buffington, M. L. and M. W. Gates. 2009. Advanced imaging techniques II: using a compound microscope for photographing point-mount specimens. American Entomologist 54: 222–224.

Buffington, M. L., R. Burks, and L. McNeil. 2005. Advanced techniques for imaging microhymenoptera. American Entomologist 51: 50–54.

Buffington, M. L., S. Brady, S. Morita, and S. van Noort. 2012. Divergence estimates and early evolutionary history of Figitidae (Hymenoptera: Cynipoidea). Systematic Entomology 37: 287–304. doi:10.1111/j.1365-3113.2012.00617.x

Hampton, R. 1968. The Ecological Distribution of the Ants of Joshua Tree National Monument (Hymenoptera: Formicidae). Thesis, California State College, Long Beach.

Kerr, P. H., E. M. Fisher, and M. L. Buffington. 2008. Dome lighting for insect imaging under a microscope. American Entomologist 54: 198–200.

Liu, Z., F. Ronquist, and G. Nordlander. 2007. The cynipoid genus *Paramblynotus*: revision, phylogeny, and historical biogeography (Hymenoptera, Liopteridae). Bulletin of the American Museum of Natural History 304: 1–151. doi:10.1206/0003-0090(2007)304[1:TCGPRP]2.0.CO;2

Ronquist, F. 1995. Phylogeny and classification of the Liopteridae, an archaic group of cynipoid wasps (Hymenoptera). Entomologica Scandinavica Supplement 46: 1–74.

van Noort, S. and M. L. Buffington. 2013. Revision of the Afrotropical Mayrellinae (Cynipoidea, Liopteridae), with the first record of *Paramblynotus* from Madagascar. ZooKeys 64: 1–64.

Yoder, M. J., I. Mikó, K. Seltmann, M. A. Bertone, and A. R. Deans. 2010. A gross anatomy ontology for Hymenoptera. PLoS ONE 5 (12): e15991 (i) (ii) (iii) (Figure Captions). doi:10.1371/journal.pone.0015991