

An Inventory of the Carabidae of the Rincon Mountains

Jason Schaller, Wendy Moore, Jeff Eble & Wallace Meyers

Abstract: One hundred four specimens, representing 16 species, of ground beetles (family Carabidae) were collected in Saguaro National Park along elevation gradients in the Rincon mountains during the Summer and Fall of 2011. These specimens were collected using pitfall traps, Malaise traps, by searching under rocks, debris, and through leaf litter during the day and by headlamp searching at night when ground beetles are most active. Twenty additional species were found in the University of Arizona Insect Collection from the Rincon Mountains, but outside of park boundaries. In total, 36 carabid species are known from the Rincon Mountains. Analysis of distributions among the species collected shows a majority occurring at higher elevations in wooded and/or riparian areas and very few occurring in arid lower elevations. The total number of species was less than anticipated despite extensive collecting using pitfall traps and searching under rocks, debris, and through leaf litter along with night collecting. Low diversity is likely a result of insularization of the Rincon Mountains sky island.

Introduction

The ground beetles, family Carabidae, comprise one of the largest beetle families with nearly 40,000 described species worldwide and over 300 occurring in the Madrean Sky Islands region of southeastern Arizona. Their distribution here is remarkable: temperate species in the genus *Scaphinotus*, which can be found as far north as Alaska (Lindroth 1969), are found in the same mountain ranges as tropical species in the genus *Ozaena*, which is common in equatorial regions (Ball and Shpeley 1990). Ground beetles represent the apex predators of most soil arthropod communities and thus play an important ecological role in almost every terrestrial habitat. Because of this, they have been important subjects in ecological and climate change studies such as the Arizona Sky Island Arthropod Project (ASAP) and the National Ecological Observatory Network (NEON).

The Rincon Mountains represent one of the Madrean Sky Islands, a biologically diverse archipelago of high mountain ranges with isolated woodland habitats surrounded by a “sea” of desert and/or grassland (Warshall 1994). With the threat of global climate change, this region is in jeopardy as confined woodlands are driven upslope and continue to shrink in size, and endemic species face potential extinction (Kupfer et al. 2005). Because of this threat, it is essential that these unique habitats receive special attention for research, and inventorying ecologically important taxa such as the ground beetles is a vital part of such studies.

As part of the 2011 BioBlitz at Saguaro National Park, I inventoried the carabid species in the Rincon Mountains during four collecting trips conducted in the Summer and Fall of 2011. Malaise traps were set up during the first trip while pitfall traps were deployed during the second trip and recovered during the third trip. We hand collected during

these hikes as well. The last trip was a day trip to the Grass Shack campground and consisted of extensive hand collecting.

Methods

Three trips were made up the Manning Camp Trail starting at Madrona Ranger Station and one trip was made up the Miller Creek Trail on the east side of the park. The Miller Creek Trip was on August 10, 2011 and involved setting up two Malaise traps that were active until August 25, when the contents were collected. I hand collected along the hike by searching under rocks/debris and sifting through leaf litter. All collecting locations are shown below (Map 1, Table 1). Locations RINPIT01-10 were locations where pitfall traps were deployed, locations RIN01-RIN11 are locations where hand collecting was done, and location RINMAL01 is where Malaise traps were set.

Map 1: Collecting Locations in the Rincon Mountains

QuickTime™ and a
None decompressor
are needed to see this picture.

Table 1: Collection sites where carabids were collected (in order of elevation)

Site	Habitat	Elevation (ft)	Species	#
RIN01B	Desert Scrub	3,855	<i>C. prominens</i>	1
RINMAL01	Oak/Riparian	4,485	<i>C. sedecimpunctata</i>	2
			<i>Elaphropus</i> sp.1	1
RINPIT03	Grass/Riparian	5,296	<i>S. petersi</i>	2
			<i>C. gregarius</i>	2
			<i>S. dubius</i>	2
			<i>Rhadine</i> sp1	1
RIN08	Grass/Oak/ Riparian	5,320	<i>N. mexicana</i>	1
			<i>B. elongatulus</i>	3
			<i>C. brunnea</i>	1
RINPIT02	Grass/Riparian	5,408	<i>S. petersi</i>	2
RINPIT04	Grass/Oak	5,512	<i>S. petersi</i>	1
RIN02	Oak/Pinyon	5,546	<i>N. mexicana</i>	1
RIN01	Oak	5,561		
RINPIT05	Juniper/Pinyon	6,564	<i>S. petersi</i>	1
			<i>Rhadine</i> sp1	1
RIN09	Pine	7,515		
RINPIT06	Pine/Riparian	7,708	<i>S. dubius</i>	2
RIN03	Pine	7,945	<i>S. petersi</i>	1
			<i>C. gregarius</i>	3
			<i>B. sp2</i>	3
			<i>B. sp3</i>	20
			<i>Harpalini</i> sp1	1
			<i>Platynini</i> sp1	1
			<i>S. dubius</i>	9
			<i>Rhadine</i> sp1	1
RINPIT07	Pine	7,963	<i>S. dubius</i>	1
			<i>C. gregarius</i>	1
RIN11	Pine	8,019	<i>S. dubius</i>	5
			<i>Rhadine</i> sp1	3
RINPIT08	Pine/Douglas Fir	8,060	<i>S. petersi</i>	2
			<i>S. dubius</i>	5
			<i>C. gregarius</i>	4
RIN04	Pine/Douglas Fir	8,090	<i>H. laevipes</i>	1
RINPIT10	Pine/Douglas Fir	8,130	<i>C. gregarius</i>	1
			<i>Rhadine</i> sp1	1
RIN10	Pine/Riparian	8,238	<i>B. sp1</i>	12
RIN06	Pine/Douglas Fir	8,346	<i>S. petersi</i>	1
			<i>S. dubius</i>	1
			<i>C. gregarius</i>	1
RIN07	Pine	8,624	<i>S. dubius</i>	2

The first of the Manning Camp trips began on August 27, 2011. The first day involved hiking to Manning Camp, deploying pitfall traps along the way. The pitfalls consisted of 50mL centrifuge tubes approximated 4" by 1.5" that were dug into the ground, filled with about 20mL of propylene glycol, and covered with a halved 3" segment of PVC pipe. The next day, we hiked the North Slope Trail, where we deployed more pitfall traps. On the third day, we hiked back down, deploying the last of our pitfalls. A total of 100 pitfalls were set at 10 different sites ranging from about 5,000 feet elevation in grasslands to 8,624 feet in the pine/Douglas fir zone. Extensive hand collecting was done throughout the hike and around Manning Camp, supplying a significant portion of the specimens.

The second trip began on September 18, 2011, following the same route during which we collected the pitfall traps. Two nights were spent again at Manning Camp, and extensive hand collecting was done throughout the trip.

The third trip occurred on September 25, 2011 and only covered lower elevations. We hiked about 1 mile past Grass Shack and hand collected throughout the hike.

During the earlier trips, pitfalls were not set in lower elevations because carabids are generally not abundant in arid areas and the soil was difficult to dig through. However, extensive hand collecting was done at all elevations.

Specimens collected were identified to species using the available literature (Lindroth 1969, Erwin 1970) and by comparing the specimens to identified material in the University of Arizona Insect Collection (UAIC). Each individual was examined closely under a microscope to analyze the morphological details used to determine the species.

To add to the species inventory, the UAIC was searched for all Rincon Mountain carabid specimens.

Results

One hundred four carabid specimens were collected, representing 16 species (Table 1). The majority of specimens and species occurred at elevations in wooded or riparian areas (Figures 1 & 2). The most abundant species were *Synuchus dubius* (22 specimens), *Bembidion sp.2* (20 specimens), *Bembidion sp.1* (12 specimens), *Calathus gregarious* (12 specimens), and *Scaphinotus petersi* (10 specimens). The rest of the species were low in abundance with most being represented by only a single specimen.

Of the five most commonly encountered species, all (except the two more abundant *Bembidion sp.1* and *sp.2*) occurred at a wide range of elevations and habitats (Table 1). All three *Bembidion* species were collected at only two locations in pine and pine/riparian habitats near 8,000 feet.

Table 2: Species and Locations

Species	Lowest Elevation (ft)	Highest Elevation (ft)	Total Number	Habitats
<i>Bembidion lacunarium</i>	7,945	7,945	3	Pine
<i>Bembidion sp.1</i>	8,238	8,238	12	Pine/Riparian
<i>Bembidion sp.2</i>	7,945	7,945	20	Pine
<i>Brachinus elongatulus</i>	5,320	5,320	3	Grass/Oak/Riparian
<i>Calathus gregarius</i>	5,296	8,346	12	Grass/Riparian, Pine, Pine/Douglas Fir
<i>Calosoma prominens</i>	3,855	3,855	1	Desert Scrub
<i>Cicindela sedecimpunctata</i>	4,485	4,485	2	Oak/Riparian
<i>Coptodera brunnea</i>	5,320	5,320	1	Grass/Oak/Riparian
<i>Elaphropus sp.1</i>	4,485	4,485	1	Oak/Riparian
Harpalini, sp.1	7,945	7,945	1	Pine
<i>Harpalus laevipes</i>	8,090	8,090	1	Pine/Douglas Fir
<i>Notiobia mexicana</i>	5,320	5,546	2	Grass/Oak/Riparian, Oak/Pinyon
Platynini, sp.1	7,945	7,945	1	Pine
<i>Rhadine sp.1</i>	5,296	8,130	7	Grass/Riparian, Juniper/Pinyon, Pine
<i>Scaphinotus petersi</i>	5,296	8,346	10	Grass/Riparian, Grass/Oak, Juniper/Pinyon, Pine, Pine/Douglas Fir
<i>Synuchus dubius</i>	5,296	8,624	27	Grass/Riparian, Pine/Riparian, Pine, Pine/Douglas Fir

Figure 1:

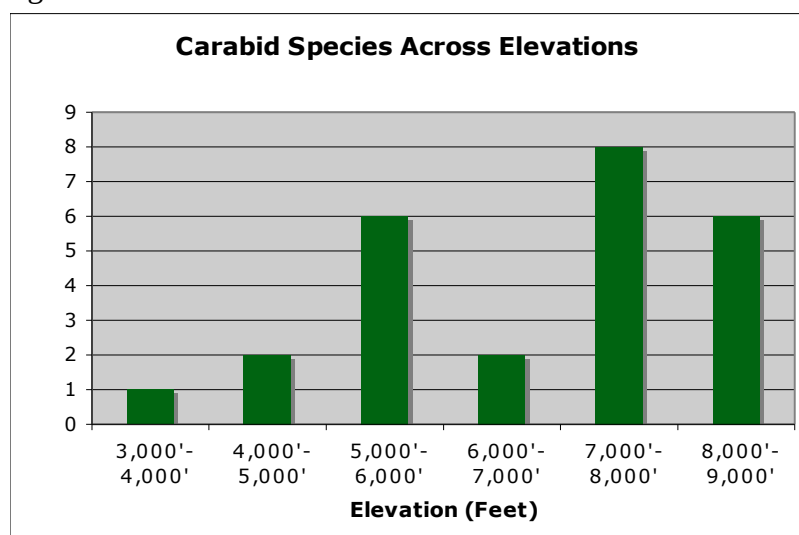
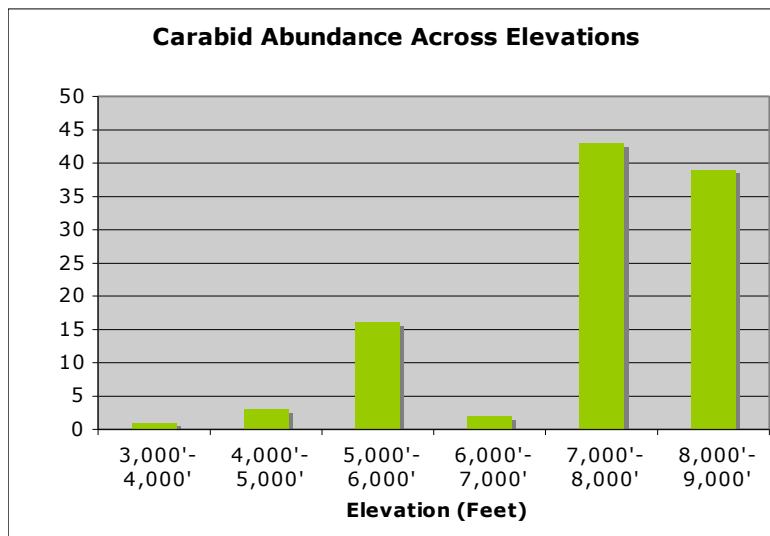


Figure 2:



The third collecting trip on September 25 did not yield any carabids despite extensive searching. However, the UAIC provided additional Rincon Mountain species that were collected outside of Saguaro National Park. A total of 20 species were found, and are listed below.

<i>Apristus tuckeri</i>	<i>Lebia guttula</i>
<i>Bembidion striola</i>	<i>Lebia viridis</i>
<i>Cicindela lemniscata</i>	<i>Notiophilus semiopacus</i>
<i>Cymindis arizonensis</i>	<i>Pasimachus californicus</i>
<i>Cymindis punctiger</i>	<i>Pasimachus duplicatus</i>
<i>Disocderus pinguis</i>	<i>Pelmatellus obtusus</i>
<i>Discoderus robustus</i>	<i>Pelophila sp.</i>
<i>Helluomorphoides ferrugineus</i>	<i>Platynus cohni</i>
<i>Helluomorphoides latitarsis</i>	<i>Platynus lyratus</i>
<i>Lachnophorus elegantulus</i>	<i>Selenophorus otiosus</i>

Exact locations of these UAIC specimens is not given, as most of them are old specimens.

Conclusions

Of the 300 or so species of Carabidae found in southern Arizona, 36 of these (just over 10%) are known from the Rincon Mountains. A thorough inventory of the Rincon Mountain carabids would require regular collecting trips throughout the year.

It comes to little surprise that the majority of species and specimens occurred in wooded and riparian areas, as carabids are generally known to be moisture loving. Because most carabids are generalist predators, we were not surprised to find species occurring over a wide range of elevations and in multiple habitats.

What is interesting is that the carabid fauna in the high elevations is dominated by so few species, particularly *Synuchus dubius*, *Calathus gregarius*, and *Scaphinotus petersi*. This may be a result of insularization, as the Rincons have a relatively small, isolated patch of montane woodland. According to the theory of island biogeography, the amount of diversity an island can sustain is dependent on size and remoteness (MacArthur & Wilson 1967). It would thus be reasonable to hypothesize that the relatively small Rincon Mountains “island” would hold fewer species than a larger range such as the Santa Catalina Mountains, or an even larger area of woodland such as the Colorado Plateau. If the Rincons do indeed represent a small island, then the high elevation woodland may be at higher risk of local extinctions, thus proving to be an important candidate for conservation efforts.

While this inventory suggests a seemingly low carabid diversity within the Rincon Mountains, more research is necessary to thoroughly understand the species content of this range. Collecting would need to be done in all seasons and would need to cover a wider variety of microhabitats throughout the range. Other collecting methods, such as Malaise traps and blacklight bucket traps, would most likely be ineffective, as the majority of carabid species rarely fly. However, using larger pitfalls or even baited pitfalls may potentially prove useful. Additionally, inventories in other mountain ranges and larger tracts of high elevation woodland (i.e. the Colorado Plateau) would provide a comparison to assess the carabid diversity of the Rincons.

The ASAP project, mentioned earlier, will eventually conduct sampling in the other Madrean Sky Islands, and the data provided from this inventory of the Rincon Mountains will ultimately be useful for the analysis of soil arthropod diversity of the region.

Acknowledgements

I would like to thank Wendy Moore, Richard Brusca, and my colleagues from the Moore lab (Jeff Eble, Wallace Meyer, and Garret Hughes) at the University of Arizona, who participated in setting pitfalls and hand collecting in the Rincons. I would also like to thank Mike Irwin for setting the Malaise traps and recovering the specimens from them.

References

- Ball, G.E., and D. Shpeley. 1990. Synopsis of the Neotropical genus *Ozaena* Olivier: Classification and reconstructed evolutionary history (Coleoptera: Carabidae: Ozaenini). *The Canadian Entomologist*, 122:779-815.
- Kupfer, J.A., Balmat, J., Smith, J.L., 2005. Shifts in the potential distribution of sky island plant communities in response to climate change. USDA Forest Service Proceedings RMRS-P-36.
- Lindroth, Carl H., 1961-1969: The Ground-Beetles (Carabidae, excl. Cicindelinae) of Canada and Alaska, Parts 1-6. *Opuscula Entomologica, Supplementa* XX, XXIV, XXIX, XXIII, XXXIV, XXXV; Lund, Sweden: Entomogiska Sällskapet; XLVIII + 1192 pp.
- MacArthur, R. H. and Wilson, E. O. 1967. *The Theory of Island Biogeography*. Princeton, N.J.: Princeton University Press.
- Warshall, P. 1994. The Madrean Sky Island Archipelago: A planetary overview. In L. F. DeBano, G. J. Gottfried, R. H. Hamre, C. B. Edminster, P. F. Ffolliott & A. Ortega-Rubio. (Eds.), *The Sky Islands of Southwestern United States and Northwestern Mexico*. pp. 6-18. USDA Forest Service: General Technical Report RM-GTR-264.

Carabid Species List for the Rincon Mountains

Apristus tuckeri
Bembidion lacunarium
Bembidion striola
Bembidion sp.1
Bembidion sp.2
Brachinus elongatulus
Calathus gregarius
Calosoma prominens
Cicindela lemniscata
Cicindela sedecimpunctata
Coptodera brunnea
Cymindis arizonensis
Cymindis punctiger
Disocderus pinguis
Discoderus robustus
Elaphropus sp.
Harpalus laevipes
Harpalini sp.1
Helluomorphoides ferrugineus
Helluomorphoides latitarsis
Lachnophorus elegantulus
Lebia guttula
Lebia viridis
Notiobia mexicana
Notiophilus semiopacus
Pasimachus californicus
Pasimachus duplicatus
Pelmatellus obtusus
Pelophila sp.
Platynini sp. 1
Platynus cohni
Platynus lyratus
Rhadine sp.1
Scaphinotus petersi
Selenophorus otiosus
Synuchus dubius

Santa Catalina Mountains Carabidae Species List (Total 61 species)

Amara californica
Amblycheila baroni
Anisodactylus anthracinus
Apristus tuckeri
Bembidion flavopictum
Bembidion mexicanum
Bembidion rapidum
Bembidion striola
Bembidion subangustatum
Brachinus costipennis
Brachinus elongatulus
Brachinus lateralis
Brachinus mexicanus
Bradycellus rupestris
Calathus gregarius
Calosoma peregrinator
Calosoma prominens
Chlaenius cumatilis
Chlaenius leucoscelis
Chlaenius obsoletus
Chlaenius ruficauda
Cicindela lemniscata
Cicindela ocellata
Cicindela sedecimpunctata
Clivina ferrea
Colpodes longiceps
Cymindis arizonensis
Cymindis punctiger
Discoderus congruens
Discoderus pinguis
Elaphropus nebulosus
Galerita atripes
Galerita mexicana
Harpalus fraternus
Harpalus laevipes
Helluomorphoides latitarsis

Lachnophorus elegantulus
Lebia abdita
Lebia histrionica
Lebia pimalis
Lebia pulchella
Lebia scapula
Lebia tuckeri
Lebia viridis
Notiobia mexicana
Notiophilus semiopacus
Pasimachus viridans
Pericompsus laetulus
Platynus brunneomarginatus
Platynus lyratus
Platynus megalops
Platynus rufiventris
Pterostichus adstrictus
Rhadine anthicoides
Scaphinotus petersi catalinae
Schizogenius falli
Schizogenius pygmaeus
Selenophorus otiosus
Synuchus dubius
Tachyta nana
Tetragonoderus fasciatus