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Rove beetles collected with carrion traps (Coleoptera: Staphylinidae) in *Quercus* forest of Cerro de García, Jalisco and *Quercus*, *Quercus*-pine, and pine forests in other jurisdictions of Mexico

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Abstract

We present the species diversity of rove beetles (Coleoptera: Staphylinidae) collected with carrion baited traps in *Quercus* forests of Cerro de García, Jalisco, and provide a compilation of published species records in *Quercus*, *Quercus*-pine and pine forests in other jurisdictions of Mexico. This work includes taxonomic notes, information on species phenology, distribution, and their occurrence in Cerro de García (if applicable), and other jurisdictions of Mexico. In Cerro de García, 75 species were collected in total, of which 16 are shared with other *Quercus* forests in different locations, and 9 species are provided with new habitat data. The remaining individuals were only determined to morphospecies. In Mexico, there are 77 known species of rove beetles collected with carrion traps (determined to species or near species) and recorded from *Quercus*, *Quercus*-pine and pine forests. These species belong to 30 genera, 11 tribes and 10 subfamilies. This study provides biological information on Mexican rove beetles captured with carrion traps and highlights the importance of rove beetles as indicator species of habitat change for conservation analysis, forestry, agronomy and forensic sciences studies.

Key words: Checklist, diversity, carrion traps, oak forest, rove beetles, Mexico

Introduction

The Staphylinidae or rove beetles represent one of the largest evolutionary radiations on earth with more than 63,495 described species in 3,762 genera worldwide (Newton, unpublished database, December 2017). The sustainable management of natural resources relies on baseline data to establish differences between reference (unaltered) and managed ecosystems under various degrees of resource extraction. The rove beetles have lately become a focus of attention as an indicator group in environmental conservation studies because these species occur in a wide variety of macro- and microhabitats (e.g., like leaf litter, river gravel, bark of trees, flowers), they belong to a wide range of trophic groups (predators, mycophages, saprophages), and are very sensitive to environmental changes (Buse & Good 1993; Spence *et al.* 1997; Boháč 1999; Yerson & Ashe 2000). They are found in different types of habitats, some species are unique to one type of habitat/microhabitat, and they are easy to capture and with the exception of some groups, can be determined to species (Boháč 1999; Yerson & Ashe 2000; Klimaszewski 2000).

Information on biodiversity is essential for the management of environmental conditions and requires the study of assemblages of species that provide information on the composition of the community and functional aspects of the ecosystem. The sustainable use of resources emerges as one of the solutions to preserve ecosystems. This approach helps to improve the understanding of a given ecosystem, including its biotic and abiotic components composition, and provides valuable information how these components react to the anthropogenic alteration (Klimaszewski 2000).

The expanded knowledge of the diversity of carrion rove beetles, will help to establish strategies for the

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selection of indicator species/groups. Their measurements and analysis will allow comparative studies of a particular community type, will help to determine the possible effects of fragmentation and other anthropogenic alterations, and will assist to monitor changes in the biodiversity and will help to develop predictive models of biodiversity (Halffter 2000, mentioned for other groups of beetles).

The objective of this research is to provide a baseline biodiversity data in the form of a compiled checklist of rove beetle species, collected with carrion traps, in a *Quercus* forest in Cerro de García, Jalisco, complemented with the species of rove beetles collected in carrion traps in other *Quercus*, *Quercus*-pine and pine forests throughout the Mexican Republic.

Materials and methods

Study area. Cerro de García is located southeast of Lake Chapala, between the municipalities of Teocuitatlán de Corona, Tuxcueca and Jocotepec of the state of Jalisco. It is located west of the Transverse Neovolcanic System (20°10'0.12" N 103°20'60.00" W). It has two types of climates: semi-warm and humid on the northern exposure, and semi-arid, semi-warm on the southern exposure (García 2004). The predominant vegetation at 2,000 to 2,780 m a.s.l. is *Quercus* forest.

Collection method. Four sites were chosen in an altitudinal gradient of 2,100–2,700 m a.s.l. The sites were separated by 200 m a.s.l. from each another (2,100 m, 2,300 m, 2,500 m and 2,700 m a.s.l.). Three carrion baited traps were used (modified NTP, Rodríguez & Navarrete-Heredia 2014) per site, each one separated by 100 m, for a total of 12. The rove beetles were collected monthly, from September 2013 to August 2014.

Taxonomic work. The rove beetles were determined using the keys of Navarrete-Heredia *et al.* (2002) and Chani-Posse (2014). For the determination of many groups to species, additional and more specialized publications were consulted (Sharp 1884, Sharp 1885, Sharp 1887, Newton 1973, Irmler 1982, Campbell 1991, Navarrete-Heredia 1995, Smetana 1995, Navarrete-Heredia 1998, Márquez-Luna *et al.* 2004, Chani-Posse 2006, Márquez-Luna & Asiain 2010, Cuccodoro 2011, and Rodríguez & Navarrete-Heredia 2015). The specimens (when available), were also compared with those housed in the Colección Entomológica del Centro de Estudios en Zoología de la Universidad de Guadalajara (CZUG). All specimens from our study (Cerro de García) were deposited in that collection (CZUG).

Checklist of species. Our checklist of species consists of two parts: species that were collected in the *Quercus* forest of Cerro de García, Jalisco, Mexico (Table 1); species of rove beetles collected with carrion traps and recorded in other works in *Quercus*, *Quercus-pine* and pine forests of the Mexican Republic (Table 2).

The phenology data (months of occurrence) (Tabla 4), distribution by states, altitudinal range (e.g., Cerro de García), habitats and taxonomic notes were generated from the present field work, and a review of published research was provided for rove beetles captured with carrion traps in *Quercus*, *Quercus*-pine and pine in other jurisdictions of Mexico (Table 3).

Results

In the *Quercus* forest of Cerro de García, 18,054 specimens were captured belonging to 75 species, 33 genera, nine subfamilies (Omaliinae, Osoriinae, Oxytelinae, Paederinae, Proteininae, Pselaphinae, Scaphidiinae, Staphylininae and Tachyporinae) and eleven tribes (Eleusinini, Mycetoporini, Omaliini, Oxytelini, Paederini, Pinophilini, Proteinini, Scaphisomatini, Staphylinini, Tachyporini and Xantholinini) (Table 1).

The most abundant species of rove beetles in Cerro de García were (Table 1): *Phloeonomus centralis* Blackwelder, 1944 (Omaliinae), *Anotylus* sp. 1 (Oxytelinae), *Rugilus* sp. 1 (Paederinae), *Tachinus mexicanus* Campbell, 1973 (Tachyporinae), *Megarthrus alatorreorum* Rodríguez & Navarrete-Heredia, 2016 (Proteininae), *Toxidium* sp. (Scaphidiinae), *Philonthus testaceipennis* Erichson, 1840 (Staphylininae), *Eleusis* sp. (Osoriinae) and *Pselaphinae* sp. (Pselaphinae).

In the general sampling in Cerro de García the most abundant species were *Philonthus testaceipennis* Erichson, 1840, *Chroaptomus mexicanus* Chani-Posse & Navarrete-Heredia, 2006 and *Philonthus* sp. 6 (5,959, 4,229, 2,254 specimens respectively) (Table 2).

TABLE 1. Rove beetles collected with carrion traps (Coleoptera: Staphylinidae) in *Quercus* forest in Cerro de García, Jalisco, Mexico.

Taxon	Abundance				Total
	Altitudinal gradient (m)				
	2,100	2,300	2,500	2,700	
Omaliinae **Omaliini**					
Phloeonomus centralis Blackwelder, 1944	222	8	37	350	617
Phloeonomus sp.	12	1	2	49	64
Osoriinae **Eleusinini**					
Eleusis sp.	0	0	1	0	1
Oxytelinae **Oxytelini**					
Oxytelinae sp.	6	1	3	0	10
Anotylus sp. 1	3	17	123	103	246
Anotylus sp. 2	6	11	64	56	137
Anotylus sp. 3	0	1	0	0	1
Apocellus sp.	0	0	0	1	1
Oxytelus sp.	1	0	1	0	2
Paederinae **Paederini** **Medonina**					
Deroderus sp.	1	0	0	2	3
Stilicina					
Eustilicus sp. 1	0	0	1	0	1
Eustilicus sp. 2	0	0	0	1	1
Rugilus sp.	12	2	4	96	114
Pinophilini **Pinophilina**					
Pinophilus sp.	0	0	0	3	3
Procirrina					
Palaminus sp.	0	0	0	2	2
Proteininae **Proteinini**					
Megarthrus alatorreorum Rodríguez & Navarrete-Heredia, 2015	1	0	36	17	54
Proteinus sp.	1	1	0	2	4
Pselaphinae					
Pselaphinae sp.	0	0	1	1	2
Scaphidiinae **Scaphisomatini**					
Baeocera sp.	0	0	0	2	2
Scaphisoma sp. 1	0	0	1	0	1
Scaphisoma sp. 2	1	0	0	0	1
Toxidium sp.	1	0	1	6	8

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TABLE 1. (Continued)

Taxon	Abundance				Total
	Altitudinal gradient (m)				
	2,100	2,300	2,500	2,700	
Staphylininae					
Staphylinini					
Philonthina					
Belonuchus sp. nov. 1	23	43	91	104	261
Belonuchus aff. *apiciventris* sp. nov 2	2	2	1	8	13
Belonuchus aff. *apiciventris* sp. nov 3	8	10	10	15	43
Belonuchus sp. 4	0	1	2	0	3
Belonuchus sp. 5	1	0	5	3	9
B. basiventris (Sharp, 1885)	4	5	1	8	18
Belonuchus ephippiatus (Say, 1830)	1	1	0	0	2
Belonuchus oxyporinus (Sharp, 1885)	2	13	36	113	164
Belonuchus rufipennis (Fabricius, 1801)	15	26	4	0	45
Belonuchus rufiventris (Sharp, 1887)	0	4	0	27	31
Belonuchus trochanterinus (Sharp, 1885)	84	20	9	3	116
Belonuchus xanthomelas (Solsky, 1868)	3	4	0	6	13
Bisnius sp.	1	0	1	49	51
Chroaptomus mexicanus Chani-Posse & Navarrete-Heredia, 2006	166	230	666	3167	4229
Philonthus aff. *iris* Sharp, 1885	5	1	0	0	6
Philonthus aff. *mnemon* Smetana, 1995	0	0	8	7	15
Philonthus gentilis Horn, 1884	5	0	0	0	5
Philonthus hoegei Sharp, 1885	23	85	459	428	995
Philonthus sericans (Gravenhorst, 1802)	22	52	84	117	275
Philonthus sp. 1	0	0	0	1	1
Philonthus sp. 2	0	2	0	21	23
Philonthus sp. 3	1	0	0	0	1
Philonthus sp. 4	1	0	0	0	1
Philonthus sp. 5	8	8	5	51	72
Philonthus sp. 6	301	244	385	1324	2254
Philonthus testaceipennis Erichson, 1840	789	751	1274	3145	5959
Quediina					
Quedius sp. 1	1	0	0	0	1
Quedius sp. 2	0	1	0	0	1
Quedius sp. 3	0	0	0	2	2
Staphylinina					
Creophilus maxillosus villosus (Gravenhorst, 1802)	1	0	1	0	2
Platydracus sp. 1	222	213	406	262	1103
Platydracus sp. 2	66	44	11	4	125
Platydracus marcidus (Sharp, 1884)	3	8	12	3	26
Platydracus biseriatus (Sharp, 1884)	10	0	0	0	10

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TABLE 1. (Continued)

Taxon	Abundance				Total
	Altitudinal gradient (m)				
	2,100	2,300	2,500	2,700	
Platydracus mendicus (Sharp, 1884)	37	10	0	0	47
Platydracus phoenicurus (Nordmann, 1837)	1	9	30	2	42
Xanthopygina					
Oligotergus paederiformis (Sharp, 1884)	3	2	0	1	6
Styngetus adrianae Navarrete-Heredia, 1998	65	71	17	11	164
Xantholinini					
Neohypnus sp. 1	1	0	4	9	14
Neohypnus sp. 2	0	0	0	3	3
Neohypnus sp. 3	0	0	0	3	3
Tachyporinae **Mycetoporini**					
Bolitobius sp.	0	0	0	2	2
Bryoporus sp. 1	0	0	0	18	18
Bryoporus sp. 2	0	0	0	1	1
Bryoporus sp. 3	2	0	0	0	2
Bryoporus sp. 4	0	1	0	0	1
Ischnosoma arizonense Campbell, 1991	1	1	0	5	7
Tachyporini					
Coproporus sp.	0	0	0	1	1
Sepedophilus sp. 1	0	1	0	30	31
Sepedophilus sp. 2	1	2	0	5	8
Sepedophilus sp. 3	0	0	0	1	1
Sepedophilus sp. 4	0	0	0	3	3
Tachinus mexicanus Campbell, 1973	0	4	120	426	550
Total	2,146	1,911	3,917	2,250	18,054

The richness of 75 species in the *Quercus* forest of Cerro de García, was the highest in comparison to results from different sampling in other types of vegetation in Mexico (tropical forest, deciduous forest, low subcaducifolia forest, high perennifolia forest, pine-oak forest, pine forest, mountain mesophile forest, xerophite scrub, pasture and seasonal crops). In the latter, a range of 9 to 59 species, were recorded (Huacuja-Zamudio 1982; Ruíz-Lizárraga 1993; Delgadillo-Reyes *et al*. 1998; Morales *et al.* 1998; Jiménez-Sánchez *et al*. 2000a, 2000b, 2001, 2013; Caballero 2003, 2012; Caballero *et al*. 2003; Márquez-Luna *et al*. 2004; Acuña 2004; Cejudo & Deloya 2005; Flores 2009).

However, the species riches documented in Cerro de García was similar to 76 species captured in *Quercus*-pine forest, tropical deciduous forest, pine forest and crops (Márquez-Luna 2001), and to 81 species recorded from a *Quercus* forest and a mountain mesophile forest (Santiago 1999). The species riches in present study was only surpassed by that in a *Quercus* forest in Chiapas, with 142–181 species recorded (Caballero 2007, Caballero *et al.* 2009, and Caballero & León-Cortés 2012).

Sixteen recorded species of rove beetles collected with carrion traps in the *Quercus* forest in Mexico, were also recorded in Cerro de García; while 9 species constituted new records for this type of forest (Table 3). Three species were reported for the first time from the state of Jalisco: *Belonuchus ephippiatus* (Say, 1830), *Ischnosoma arizonense* Campbell, 1991 and *Belonuchus rufiventris* (Sharp, 1887).

Seventy seven species of rove beetles, determined to species or near species, belonging to 30 genera, 11 tribes and ten subfamilies, were collected with carrion traps in Mexico, in *Quercus, Quercus*-pine and pine forests, (Table

2). The following states, in which most species of rove beetles were collected with carrion traps, are listed in descending order of captured species: Morelos (27 spp.), Estado de México (26 spp.) and Jalisco (26 spp.), Hidalgo (21 spp.), Veracruz (21 spp.), Michoacán (12 spp.), Chiapas (2 spp.), Guerrero (1 sp.) and Oaxaca (1 sp.). The subfamily with the highest species diversity was Staphylininae (51 species in 13 genera), followed by Tachyporinae (8 species in five genera), Aleocharinae (5 species in three genera), Oxytelinae (4 species in one genus), Omaliinae (3 species in two genera), Scaphidiinae (2 species in two genera), and Paederinae, Proteininae, Osoriinae, Steninae with one species in one genus each.

The genera with the highest number of species were: *Belonuchus* (18 spp.), *Platydracus* (11 spp.), *Philonthus* (7 spp.), *Anotylus* (4 spp.), *Lordithon* (4 spp.) and *Oligotergus* (3 spp.). These species constitute 65.2% of the known rove beetles species collected with carrion traps in *Quercus*, *Quercus*-pine and pine forests in Mexico. Six genera were represented by two species, and 18 genera by one species each (excluding morphospecies).

The species most frequently recorded in *Quercus*, *Quercus*-pine and pine forests in Mexico were (Table 2): *Belonuchus trochanterinus* (Sharp), *B. rufipennis* (Fabricius), *B. apiciventris* (Sharp), *B. oxyporinus* (Sharp), *B. basiventris* (Sharp), *B. xanthomelas* Solsky, *Creophilus maxillosus villosus* (Gravenhorst), *Styngetus adrianae* Navarrete-Heredia and *Phloeonomus centralis* Blackwelder.

The highest catch of rove beetles occurred in August, September and October, while the lowest catch occurred in January to April (Fig. 1). The following species occurred throughout of the year: *Philonthus testaceipennis* Erichson, *P. sericans* (Gravenhorst), *B. apiciventris* (Sharp), *B. rufipennis* (Fabricius) and *Phloeonomus centralis* Blackwelder. The genera with greatest number of species and greatest presence throughout the year were: *Belonuchus* and *Philonthus* (Table 4).

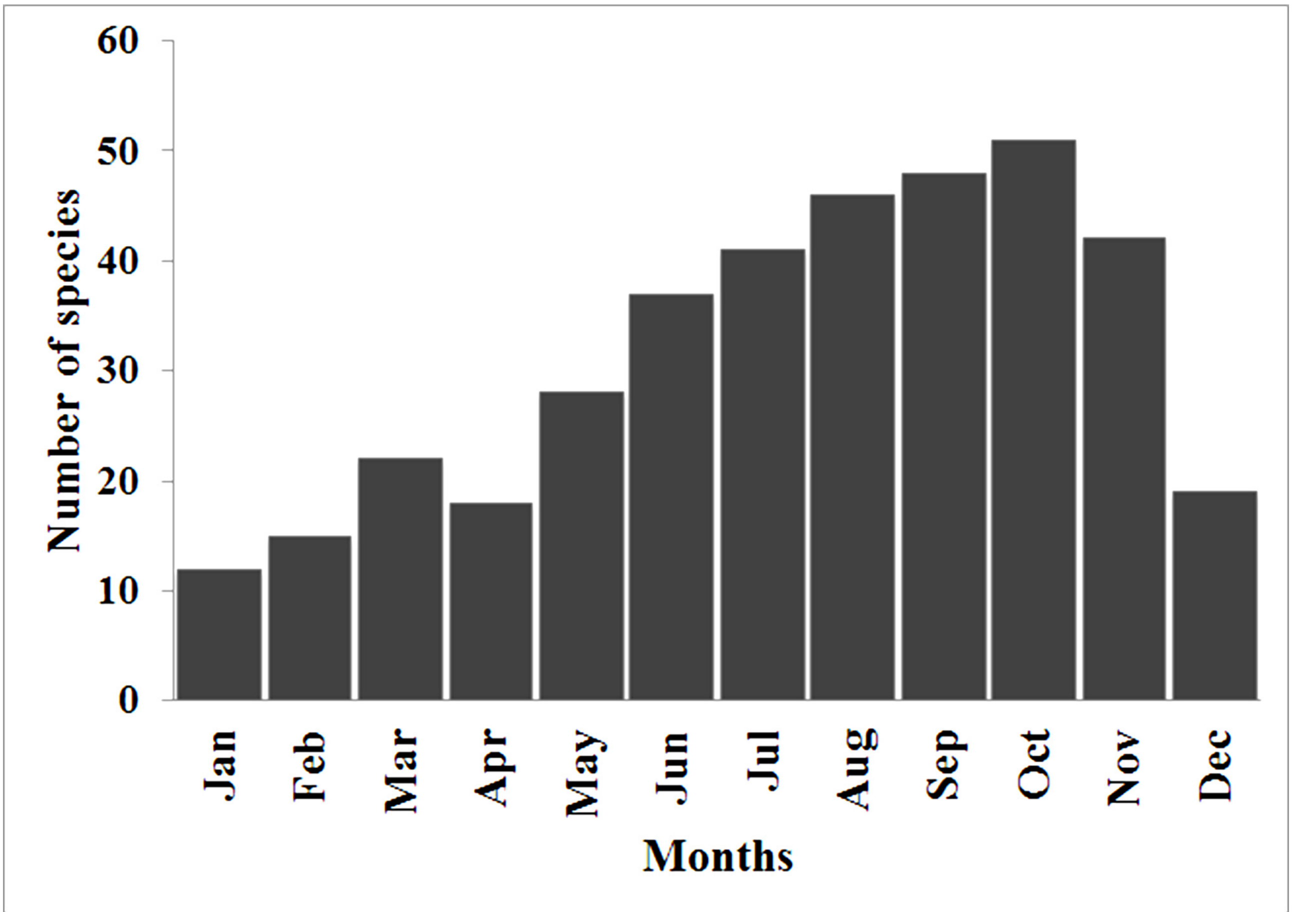

FIGURE 1. Richness of rove beetles collected with carrion traps in *Quercus*, *Quercus-pine* and pine forests in Mexico.

TABLE 2. Rove beetles collected with carrion traps (Coleoptera: Staphylinidae) in *Quercus*, and *Quercus*-pine and pine forests in Mexico. Abbreviations of states: **AGS:** Aguascalientes, **BCN:** Baja California, **BCS:** Baja California Sur, **CAMP:** Campeche, **CHIH:** Chihuahua. **CHIS:** Chiapas, **COAH:** Coahuila, **COL:** Colima, **DF:** Distrito Federal, **GRO:** Guerrero, **GTO:** Guanajuato, **JAL:** Jalisco, **OAX:** Oaxaca, **MEX:** Estado de México, **MOR:** Morelos, **NAY:** Nayarit, **NL:** Nuevo León, **PUE:** Puebla, **VER:** Veracruz, **MICH:** Michoacán, **HGO:** Hidalgo, **QRO:** Querétaro, **QROO:** Quintana Roo **SIN:** Sinaloa, **SLP:** San Luis Potosí, **SON:** Sonora, **TAB:** Tabasco, **TAMPS:** Tamaulipas, **TLAX:** Tlaxcala, **YUC:** Yucatán, **ZAC:** Zacatecas.
Abbreviations of habitats: **AG:** Agave cultivation, **AV:** Aquatic vegetation, **CM:** Cloud montane forest, **CP:** Coffee plantation, **DSU:** Dune with low forest subperennifolia, **ES:** Espartal, **GF:** Gallery forest, **GR:** Grass, **HE:** High evergreen forest, **LDE:** Lowland deciduous forest, **MA:** Mangrove, **MD:** Madroño, **NA:** Nursery area, **NO**: Nopalera, **P:** Pine forest, **PH:** *Pinus hartwegii* forest, **PL:** *Pinus lawsoniii* forest **Q:** *Quercus* forest, **QP:** *Quercus-pine* forest, **QPA:** *Quercus*-pine-*Arbutus*, **QPJ:** *Quercus*-Pine-*Juniperus,* **RA:** Ravine**, SN:** Stones near streams, **TC:** Temporary crops, **TD:** Tropical dry forest, **TDE:** Tropical deciduous forest, **TS:** Tropical semi-deciduous forest, **XS:** Xeric shrublands.
The data containing the superscript '**CTP**' indicate that specimens have been collected with carrion traps, and those with '**CTP***' indicate that they represent new records.

Taxon	**Distribution by states:**	**Altitudinal range (m)**	**Habitats**	**References**
Omaliinae				
Omaliini				
Phloeonomus centralis Blackwelder, 1944	COL, JAL^{CTP}, OAX, MEX^{CTP} PUE^{CTP}, MOR^{CTP}, GRO, CHIS, VER, MICH^{CTP} HGO^{CTP}	600–2,850	CM, GR, P, Q, QP, TC, TD, TDE, TS, XS.	Huacuja-Zamudio 1982; Ruíz-Lizárraga 1993; Delgadillo-Reyes *et al.* 1998; Jiménez-Sánchez & Padilla-Ramírez 1999; Jiménez-Sánchez 1998; Jiménez-Sánchez *et al.* 2000b; Jiménez-Sánchez *et al.* 2001; Márquez-Luna 2001; Caballero 2003; Quezada *et al.* 2003; Cejudo & Deloya 2005; Jiménez-Sánchez *et al.* 2011; Jiménez-Sánchez *et al.* 2013.
Phloeonomus pumilo Sharp, 1887	HGO^{CTP}, CHIS, VER	1,800	CM with in associations of P, QP	Huacuja-Zamudio 1982; Navarrete-Heredia *et al.* 2002.
Omalium meximontanum Thayer, 2003	HGO^{CTP}, CHIS, DGO, JAL, MEX, MOR, NL, PUE, OAX.	1,800	CM with in associations of P, QP	Huacuja-Zamudio 1982 Navarrete-Heredia *et al.* 2002
Paederinae				
Paederini				
Paederina				
Paederus aff. *currax* Sharp, 1886	VER, HGO^{CTP}	1,800	CM with in associations of P, QP	Huacuja-Zamudio 1982; Navarrete-Heredia *et al.* 2002
Proteininae				
Proteinini				
Megarthrus alatorreorum Rodríguez & Navarrete-Heredia, 2015	JAL^{CTP}	2,100–2,800^{CTP}*	Q ^{CTP}*	Rodríguez & Navarrete-Heredia 2015.
Scaphidiinae				
Scaphisomatini				
Toxidium punctatum Matthews, 1888	MOR^{CTP} MEX	1,783–1,930	CM with in associations of P, QP	Navarrete-Heredia 1996; Márquez-Luna 2001; Navarrete-Heredia *et al.* 2002.

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TABLE 2. (Continued)

Taxon	**Distribution by states:**	**Altitudinal range (m)**	**Habitats**	**References**
Cypariini				
Cyparium aff. *terminale* Matthews, 1888	MOR^{CTP}, JAL, MEX, OAX, VER, MICH	1,721–1,874	CM, PL, QP	Navarrete-Heredia 1996; Márquez-Luna 2001; Navarrete-Heredia *et al.* 2002; Márquez 2006.
Staphylininae				
Staphylinini				
Philonthina.				
Belonuchus basiventris (Sharp, 1885)	MICH^{CTP}, MOR^{CTP}, MEX^{CTP}, JAL^{CTP}*, OAX, PUE, VER, GRO	1,000–2,700^{CTP}*	CM, GR, P, Q, QP, TD, TDE	Jiménez-Sánchez 1998; Jiménez-Sánchez *et al.* 2000b; Jiménez-Sánchez *et al.* 2001; Márquez-Luna 2001; Navarrete-Heredia *et al.* 2002; Caballero 2003; Jiménez-Sánchez *et al.* 2011.
Belonuchus ephippiatus (Say, 1830)	BCS, MEX, GRO, HGO, MICH, MOR, OAX, PUE, QRO, VER, ZAC, JAL ^{CTP}*.	1,450–2,300^{CTP}*	NO, Q^{CTP}*, XS	Jiménez-Sánchez & Padilla-Ramírez 1999; Márquez 2004; Jiménez-Sánchez *et al.* 2013; CZUG.
Belonuchus oxyporinus (Sharp, 1885)	MICH^{CTP}, MOR^{CTP}, MEX^{CTP} JAL^{CTP}, GRO, VER, OAX	1,200–2,700^{CTP}*	CM, GR, P, Q, QP, TC, TDE	Jiménez-Sánchez 1998; Santiago-Jiménez 1999; Jiménez-Sánchez *et al.* 2000a; Jiménez-Sánchez *et al.* 2001; Márquez-Luna 2001; Navarrete-Heredia *et al.* 2002; Jiménez-Sánchez *et al.* 2011.
Belonuchus rufipennis (Fabricius, 1801)	MOR^{CTP}, MEX^{CTP}, VER^{CTP} HGO^{CTP}, JAL^{CTP}, CHIS, GRO, MICH, NL, OAX, PUE, SLP, TAB, TAMPS, NL^{CTP}, ZAC, COAH	10–2,500^{CTP}*	AG, AV, CM, DSU, ES, GF, GR, P, Q, QP, TC, TD, TDE, TS, XS	Ruíz-Lizárraga 1993; Márquez-Luna 1994; Márquez-Luna & Navarrete-Heredia 1994; Navarrete-Heredia 1996; Jiménez-Sánchez 1998; Morales *et al.* 1998; Jiménez-Sánchez & Padilla-Ramírez 1999; Santiago-Jiménez 1999; Jiménez-Sánchez *et al.* 2001; Márquez-Luna 2001; Caballero 2003; Márquez-Luna *et al.* 2004; Márquez 2006; Asiain *et al.* 2011, Jiménez-Sánchez *et al.* 2011; Jiménez-Sánchez *et al.* 2013; CZUG.
Belonuchus rufiventris (Sharp, 1887)	MOR, JAL CTP*	2,300–2,700	Q ^{CTP}*	Herman 2001b
Belonuchus trochanterinus (Sharp, 1885)	MOR^{CTP}, MEX^{CTP}, HGO^{CTP}, VER^{CTP}, JAL^{CTP}.	864–2,700^{CTP}*	CM, P, Q, QP, TD	Márquez-Luna 2001; Márquez-Luna *et al.* 2004; Asiain *et al.* 2011; Jiménez-Sánchez *et al.* 2011.
Belonuchus xanthomelas (Solsky, 1868)	MOR^{CTP} HGO^{CTP} MEX^{CTP}, JAL^{CTP}, BCS, MICH, OAX, PUE, VER, GRO.	750–2,700	CM, HE, P, Q, QP, TDE, TS	Huacuja-Zamudio 1982; Ruíz-Lizárraga 1993; Jiménez-Sánchez *et al.* 1997; Jiménez-Sánchez 1998; Márquez-Luna 2001; Delgado-Castillo 2004; Márquez 2006.
Belonuchus aff. *pictipennis* Sharp, 1885	HGO^{CTP}	1,800	CM with associations of P, QP	Huacuja-Zamudio 1982
Belonuchus zunilensis (Sharp, 1885)	VER, MEX, HGO^{CTP}	1,250–2,444	CM, Q, QP, TDE	Santiago-Jiménez 1999; Navarrete-Heredia *et al.* 2002; Asiain *et al.* 2011; Jiménez-Sánchez *et al.* 2011.
Belonuchus alternans (Sharp, 1885)	VER^{CTP}, HGO^{CTP}, CHIS, OAX, PUE.	380–2,850	CM, CP, GR, HE, NA, Q, QP	Santiago-Jiménez 1999; Quezada et al. 2003; Acuña 2004; Delgado-Castillo 2004; Márquez-Luna et al. 2004; Márquez 2006; Asiain et al. 2011.
Belonuchus bidens Sharp, 1885	VER^{CTP}, CHIS, OAX, PUE, MEX	380–2,340	CM, CP, GR, HE, NA, Q, XS	Delgadillo-Reyes *et al.* 1998; Acuña 2004; Márquez-Luna *et al.* 2004.

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TABLE 2. (Continued)

Taxon	Distribution by states:	Altitudinal range (m)	Habitats	References
Belonuchus colon (Sharp, 1885)	HGO^{CTP}, VER	1,250–2,444	Q, QP, CM	Santiago-Jiménez 1999; Navarrete-Heredia *et al.* 2002; Asiain *et al.* 2011.
Belonuchus dichrous Erichson, 1840	VER^{CTP}, HGO, OAX, PUE	864	Q	Márquez-Luna *et al.* 2004.
Belonuchus erichsoni Bernhauer, 1917	QRO, HGO ^{CTP}	2,444	QP	Navarrete-Heredia *et al.* 2002; Asiain *et al.* 2011.
Belonuchus pollens Sharp, 1885	MOR^{CTP}, MEX^{CTP}, GRO, JAL, OAX.	750–1,940	CM, GR, P, QP, TC, TD, TDE, TS	Ruíz-Lizárraga 1993; Jiménez-Sánchez 1998; Jiménez-Sánchez *et al.* 2001; Márquez-Luna 2001; Navarrete-Heredia *et al.* 2002; Caballero 2003; Jiménez-Sánchez *et al.* 2011
Belonuchus aff. *flavipennis* Solsky, 1870	HGO^{CTP}, OAX, VER	1,892–2,444	Q, QP	Navarrete-Heredia *et al.* 2002; Asiain *et al.* 2011.
Belonuchus viridipennis Baudi, 1848	VER, MOR, HGO^{CTP}	1,783–1,800	CM, QP	Huacuja-Zamudio 1982; Márquez-Luna 2001; Navarrete-Heredia *et al.* 2002.
Chroaptomus flagrans (Erichson, 1840)	MOR^{CTP}, MEX^{CTP}, VER^{CTP}, CHIS, HGO, OAX, QRO, DF, MICH, PUE, GRO	380–2,340	CM, CP, GR, HE, NA, P, Q, QP, TDE,	Navarrete-Heredia 1996; Delgadillo-Reyes *et al.* 1998; Jiménez-Sánchez 1998; Santiago-Jiménez 1999; Jiménez-Sánchez *et al.* 2000b; Jiménez-Sánchez *et al.* 2001; Márquez-Luna 2001; Acuña 2004; Márquez-Luna *et al.* 2004; Márquez 2006; Jiménez-Sánchez *et al.* 2011.
Chroaptomus mexicanus Chani-Posse & Navarrete-Heredia, 2006	JAL^{VTP}, CHIS, COL, DGO, MOR, GRO, VER, HGO, MEX, OAX, QRO	1,300–2,700^{CTP}*	MD, P, Q, SN	Navarrete-Heredia *et al.* 2002; Chani-Posse 2006
Philonthus aff. *iris* Sharp, 1885	MOR^{CTP}, VER^{CTP}, JAL^{CTP}*, DF, OAX, PUE	1,634–2,300^{CTP}*	LDE, Q^{CTP}*, TC	Santiago-Jiménez 1999; Márquez-Luna 2001; Márquez-Luna *et al.* 2004.
Philonthus aff. *mnemon* Smetana, 1995	MICH, JAL	2,500 - 2,700^{CTP}	Q ^{CTP}*.	Navarrete-Heredia *et al.* 2002
Philonthus gentilis Horn, 1884	DGO, GTO, JAL^{CTP}, SON	2,100	Q ^{CTP}*.	Navarrete-Heredia *et al.* 2002
Philonthus hoegei Sharp, 1885	MICH^{CTP}, HGO^{CTP}, JAL^{CTP}, DF, MEX, OAX, TLAX, VER	2,100^{CTP}*-2,825	Q^{CTP}*, QP	Jiménez-Sánchez *et al.* 2000b; Márquez 2004; Márquez 2006; Asiain *et al.* 2011
Philonthus sericans (Gravenhorst, 1802)	MOR^{CTP}, VER^{CTP}, JAL^{CTP}*, DGO, HGO, PUE, SLP	750–2,700^{CTP}*	CM, Q, QP, TD	Santiago-Jiménez 1999; Márquez-Luna 2001; Márquez-Luna *et al.* 2004
Paederomimus angularius (Erichson, 1840)	MOR^{CTP}, MEX^{CTP}, PUE, VER, GRO	750–1,874	CM, GR, QP, TD, TS	Ruíz-Lizárraga 1993; Navarrete-Heredia 1996; Jiménez-Sánchez 1998; Jiménez-Sánchez *et al.* 2001; Márquez-Luna 2001; Navarrete-Heredia *et al.* 2002; Jiménez-Sánchez *et al.* 2011.
Paederomimus gentilis Sharp, 1885	MEX^{CTP}, JAL, VER, MOR, GRO.	1,200–2,100	QP, TD, TDE	Jiménez-Sánchez 1998; Jiménez-Sánchez *et al.* 2001; Márquez-Luna 2001; Navarrete-Heredia *et al.* 2002.
Philonthus apheles Solsky, 1868	VER, MOR^{CTP}	1,874	QP	Márquez-Luna 2001; Navarrete-Heredia *et al.* 2002.
Philonthus piceatus Nordman, 1837	MOR^{CTP}, DF, DGO, GRO, GTO, HGO, JAL, MEX, OAX, PUE, QROO, VER	1,534–1,930	CM, P, QP, TD	Márquez-Luna 2001; Navarrete-Heredia *et al.* 2002

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TABLE 2. (Continued)

Taxon	Distribution by states:	Altitudinal range (m)	Habitats	References
Philonthus testaceipennis Erichson, 1840	MOR^{CTP}, HGO^{CTP}, JAL^{CTP}*, DF, MEX, NL, OAX, QRO, TAMPS, VER	1,750–2,700^{CTP}*	CM , Q, QP	Huacuja-Zamudio 1982; Navarrete-Heredia 1996; Santiago-Jiménez 1999; Márquez-Luna 2001; Márquez 2006; Asiain *et al.* 2011
Ambylopinina				
Heterothops tenuicornis Sharp, 1884	MOR^{CTP}, GRO, VER	1,634–1,874	QP, TDE	Márquez-Luna 2001; Navarrete-Heredia *et al.* 2002.
Staphylinina				
Creophilus maxillosus villosus (Gravenhorst, 1802)	MICH^{CTP}, HGO^{CTP}, MEX^{CTP}, BCN^{CTP}, JAL^{CTP}, BCS, CHIS, COAH, COL, DF, DGO, GTO, MOR, NAY, NL, OAX, PUE, QRO, SLP, SON, VER, ZAC, AGS	587–2,884	CM, GF, GR, P, Q, QPJ, TC, TD, TDE, XS	Huacuja-Zamudio 1982; Jiménez-Sánchez & Padilla-Ramírez 1999; Jiménez-Sánchez *et al.* 2000b; Márquez-Luna 2001; Jiménez-Sánchez *et al.* 2001; Navarrete-Heredia *et al.* 2002; Quezada *et al.* 2003; Martínez-Ruvalcaba *et al.* 2007; Flores 2009; Jiménez-Sánchez *et al.* 2013; CZUG
Leistotrophus versicolor (Gravenhorst, 1806)	VER^{CTP}, CHIS, HGO, OAX, PUE, SLP, TAB, TAMPS	864	Q	Márquez-Luna *et al.* 2004.
Platydracus marcidus (Sharp, 1884)	MICH^{CTP}, MOR^{CTP}, VER, CHIS, GRO, JAL^{CTP}.	244–2,700^{CTP}*	CM, GR, P, Q, QP, TC, TD	Newton 1973; Jiménez-Sánchez *et al.* 2000b; Jiménez-Sánchez *et al.* 2001; Márquez-Luna 2001; Quezada *et al.* 2003
Platydracus biseriatus (Sharp, 1884)	MEX^{CTP}, JAL^{CTP}, MOR, GRO, CHIS, CHIH, COL, DGO, MICH, NAY, OAX, SIN, SON	700–2,300	GR, P, Q, TC, TD, TDE, TS	Ruíz-Lizárraga 1993; Jiménez-Sánchez 1998; Jiménez-Sánchez *et al.* 2001; Márquez-Luna 2001; Navarrete-Heredia *et al.* 2002; Caballero 2003; Jiménez-Sánchez *et al.* 2011.
Platydracus mendicus (Sharp, 1884)	MICH^{CTP}, MEX^{CTP}, CHIS, COL, GRO, JAL^{CTP}, MOR, NAY, OAX	600–2,850	CM, GR, Q, QP, TC, TD, TDE, TS	Ruíz-Lizárraga 1993; Jiménez-Sánchez 1998; Jiménez-Sánchez *et al.* 2000b; Jiménez-Sánchez *et al.* 2001; Márquez-Luna 2001; Navarrete-Heredia *et al.* 2002; Caballero 2003; Quezada *et al.* 2003; Jiménez-Sánchez *et al.* 2011
Platydracus phoenicurus (Nordmann, 1837)	CHIS, CHIH, COAH, COL, DF, DGO, GTO, Hidalgo, JAL^{CTP}*, MEX, MICH, NL, PUE, SIN, SON, TAMPS, TLAX, VER, ZAC	2,100–2,700	Q^{CTP}*, QP	Márquez-Luna & Asiain 2006; Asiain *et al.* 2011.
Platydracus castaneus (Nordmann, 1837)	MEX^{CTP}, CHIH, DF, DGO, HGO, JAL, MICH, MOR, NAY, OAX, PUE, VER	1,790	QP	Jiménez-Sánchez 1998; Márquez 2006.
Platydracus femoratus (Fabricius, 1801)	VER^{CTP}, CAMP, CHIS, HGO, OAX, PUE, QROO, SLP, VER	750–864	Q	Santiago-Jiménez 1999; Márquez-Luna *et al.* 2004; Márquez 2006.
Platydracus ferox (Nordmann, 1837)	VER^{CTP}, CAMP, CHIS, HGO, MOR, OAX, PUE, QRO, QROO	380–1,226	CM, CP, GR, HE, NA, Q	Acuña 2004; Márquez-Luna *et al.* 2004; Márquez 2006.
Platydracus fervidus (Sharp, 1884)	VER^{CTP}, MEX^{CTP}, OAX	864–1,790	CM, Q, QP, TDE	Jiménez-Sánchez 1998; Santiago-Jiménez 1999; Navarrete-Heredia *et al.* 2002; Márquez-Luna *et al.* 2004.
Platydracus fuscomaculatus (Laporte, 1835)	VER^{CTP}, GTO, HGO, PUE, QRO, SLP, TAMPS	864–1,970	CM, Q, QP	Santiago-Jiménez 1999; Márquez-Luna *et al.* 2004; Márquez 2006; Asiain *et al.* 2011.
Platydracus optatus (Sharp, 1884)	VER^{CTP}, CHIS, HGO, SLP	750–1,250	CM, Q	Santiago-Jiménez 1999; Márquez-Luna *et al.* 2004; Márquez 2006.

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TABLE 2. (Continued)

Taxon	Distribution by states:	Altitudinal range (m)	Habitats	References
Platydracus salvinianus (Sharp, 1884)	VER^{CTP}, CAMP, CHIS, HGO, OAX, PUE, QROO, SLP, TAMPS	750	Q	Santiago-Jiménez 1999; Márquez 2006.
Xanthopygina				
Oligotergus paederiformis (Sharp, 1884)	MEX^{CTP}, JAL^{CTP}, COL, GRO, MICH, MOR	1,292–2,700^{CTP}*	GR, Q^{CTP}*, TDE	Navarrete-Heredia *et al.* 2002; Jiménez-Sánchez *et al.* 2011
Oligotergus fasciatus (Nordmann, 1837)	CHIS, OAX, TAB, TAMPS, VER^{CTP}, MEX	864–1,292	Q, TDE	Márquez-Luna *et al.* 2004; Jiménez-Sánchez *et al.* 2011.
Oligotergus subtilis (Sharp, 1884)	MEX^{CTP}, GRO, MOR, OAX, VER	2,300	QP	Navarrete-Heredia *et al.* 2002; Jiménez-Sánchez *et al.* 2011.
Styngetus adrianae Navarrete-Heredia, 1998	MICH^{CTP}, MOR^{CTP}, MEX^{CTP}, JAL^{CTP}*, DF, GRO, OAX	1,100–2,700^{CTP}*	CM, GR, Q, QP, TC, TD, TDE	Jiménez-Sánchez 1998; Jiménez-Sánchez *et al.* 2000b; Jiménez-Sánchez *et al.* 2001; Márquez-Luna 2001; Márquez 2006; Jiménez-Sánchez *et al.* 2011.
Styngetus deyrollei (Solsky, 1866)	VER^{CTP}, HGO^{CTP}, CHIS, OAX, PUE, QRO, SLP, TAMPS	214–1,959	CM, CP, GR, HE, NA, Q, QP	Huacuja-Zamudio 1982; Jiménez-Sánchez *et al.* 1997; Navarrete-Heredia 1998; Santiago-Jiménez 1999; Acuña 2004; Márquez-Luna *et al.* 2004; Asiain *et al.* 2011.
Gastrisus newtonorum Navarrete-Heredia & Márquez, 1998	MEX^{CTP}, GRO, JAL, MOR^{CTP}, OAX	750–1,783	Q	Jiménez-Sánchez *et al.* 2000a; Navarrete-Heredia *et al.* 2002.
Xenopygus analis (Erichson, 1840)	VER^{CTP}, MEX^{CTP}, CAMP, CHIS, DGO, GRO, HGO, JAL, MOR, OAX, QRO, SLP, TAMPS, YUC, PUE	10–1,790	AV, CM, CP, ES, GR, HE, MA, NA, Q, TC, TDE, TS	Ruíz-Lizárraga 1993; Navarrete-Heredia 1996; Jiménez-Sánchez 1998; Morales *et al.* 1998; Santiago-Jiménez 1999; Jiménez-Sánchez *et al.* 2001; Caballero 2003; Acuña 2004; Márquez-Luna *et al.* 2004; Márquez 2006; Jiménez-Sánchez *et al.* 2011.
Xantholinini				
Eulissus chalybaeus Mannerheim, 1830	VER^{CTP}, CHIS, GRO, JAL, NAY, OAX, PUE, SIN, YUC	750–864	Q	Santiago-Jiménez 1999; Márquez-Luna *et al.* 2004.
Thyreocephalus puncticeps Sharp, 1885	MEX^{CTP}, COL, GRO, JAL, MICH, MOR, NAY, OAX, SON, ZAC	1,253–2,300	CM, GR, QP, TD, TDE, TC	Navarrete-Heredia 1996; Jiménez-Sánchez 1998; Jiménez-Sánchez *et al.* 2001; Márquez-Luna 2001; Jiménez-Sánchez *et al.* 2011; Márquez-Luna & Asiain 2016.
Tachyporinae				
Mycetoporini				
Ischnosoma arizonense Campbell, 1991	SON, JAL^{CTP}*	2,100–2,700	Q ^{CTP}*.	Rodríguez & Navarrete-Heredia 2013
Lordithon nubicola Campbell, 1982	JAL, MEX, OAX, HGO, TLAX, MICH^{CTP}	2,580–3,352	Q	Jiménez-Sánchez *et al.* 2000b; Navarrete-Heredia *et al.* 2002; Márquez 2006.
Lordithon antennatus Campbell, 1982	MOR^{CTP}, HGO, OAX, PUE, VER.	1,500–1,874	CM, P	Navarrete-Heredia 1996; Márquez-Luna 2001; Navarrete-Heredia *et al.* 2002; Delgado-Castillo 2004.
Lordithon howdeni Campbell, 1982	MOR, PUE, MEX^{CTP}	1,751–3,628	CM, PH, QP	Navarrete-Heredia 1996; Márquez-Luna 2001; Navarrete-Heredia *et al.* 2002; Cejudo & Deloya 2005.

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TABLE 2. (Continued)

Taxon	Distribution by states:	Altitudinal range (m)	Habitats	References
Lordithon aff. *obliquus* (Sharp, 1884)	CHIS, OAX, VER, HGO^{CTP}, NL^{CTP}	1,892–2,444	P, QP, QPA	Navarrete-Heredia *et al.* 2002; Asiain *et al.* 2011; CZUG.
Tachyporini				
Coproporus hepaticus Erichson, 1839	MOR^{CTP} VER^{CTP}, MEX^{CTP}, CAMP, CHIS, DF, GRO, JAL, NAY, NL, OAX, PUE, SON, TAB	750–1,900	CM, P, Q, QP, TC, TDE	Ruíz-Lizárraga 1993; Márquez-Luna 1994; Márquez-Luna & Navarrete-Heredia 1994; Navarrete-Heredia 1996; Jiménez-Sánchez 1998; Santiago-Jiménez 1999; Jiménez-Sánchez *et al.* 2001; Márquez-Luna 2001; Navarrete-Heredia *et al.* 2002; Caballero 2003; Jiménez-Sánchez *et al.* 2009.
Tachinomorphus grandis (Solsky, 1868)	MICH^{CTP}, CHIS, DF, DGO, HGO, JAL, MEX, MOR, OAX, PUE, QRO, SLP, VER	914–1,524	CM, Q	Jiménez-Sánchez *et al.* 2000b; Márquez-Luna 2001; Navarrete-Heredia *et al.* 2002.
Tachinus mexicanus Campbell, 1973	MICH^{CTP}, MEX^{CTP}, JAL^{CTP}, COL, DGO, HGO, MOR, OAX, PUE, SLP, SIN, DF, TAMPS, TLAX, VER	2,300^{CTP}–3,628	PH, Q, QP	Jiménez-Sánchez *et al.* 2000b; Navarrete-Heredia *et al.* 2002; Cejudo & Deloya 2005; Márquez 2006; Asiain *et al.* 2011
Aleocharinae				
Aleochara mexicana Sharp, 1883	HGO^{CTP}, CHIS, OAX, PUE, VER, MOR	1,800	CM with in associations of P, QP TD	Huacuja-Zamudio 1982; Navarrete-Heredia *et al.* 2002; Caballero *et al.* 2003.
Aleochara oxypodia Sharp, 1883	CHIS^{CTP}, MOR	830–900	Q, TD	Caballero *et al.* 2003; Caballero & León-Cortés 2012
Aleochara caviceps (Casey, 1893)	CHIS^{CTP}	2,500	Q	Caballero & León-Cortés 2012.
Hoplandria aff. *centralis* Sharp, 1883	HGO^{CTP}	1,800	CM with in associations of P, QP	Huacuja-Zamudio 1982
Hoplandria peltata (Erichson, 1839)	MEX, HGO^{CTP}, CHIS	830–1,800	CM with in associations of P, QP, RA, TDE	Huacuja-Zamudio 1982; Navarrete-Heredia *et al.* 2002; Caballero & León-Cortés 2012.
Oxytelinae				
Anotylus aff. *fragilis* (Sharp, 1887)	VER, MOR^{CTP}	1,534–1,930	CM, P, QP, TDE	Márquez-Luna 2001; Navarrete-Heredia *et al.* 2002.
Anotylus aff. *nanus* (Erichson, 1840)	MOR^{CTP}	1,783–1,930	CM, P, QP	Márquez-Luna 2001.
Anotylus aff. *spinifrons* (Sharp, 1887)	GRO, MEX^{CTP}	700–1,790	P, QP, TDE, TS	Ruíz-Lizárraga 1993; Jiménez-Sánchez *et al.* 2000; Navarrete-Heredia *et al.* 2002.
Anotylus vilis (Sharp, 1887)	VER^{CTP}, DGO, GRO, OAX, HGO	750–1,800	CM, Q, TS	Huacuja-Zamudio 1982; Ruíz-Lizárraga 1993; Santiago-Jiménez 1999; Navarrete-Heredia 1996; Navarrete-Heredia *et al.* 2002.
Steninae				
Stenus aff. *popocatepetlensis* Puthz, 1974	DF, MEX, MICH, MOR^{CTP}	1,874	QP	Márquez-Luna 2001; Navarrete-Heredia *et al.* 2002.

TABLE 3. Rove beetle species collected in carrion traps in *Quercus* forest of Cerro de García and shared with other localities with *Quercus* forest.

Species
Belonuchus basiventris (Sharp, 1885)
Belonuchus oxyporinus (Sharp, 1885)
Belonuchus rufipennis (Fabricius, 1801)
Belonuchus trochanterinus (Sharp, 1885)
Belonuchus xanthomelas Solsky, 1868
Chroaptomus mexicanus Chani-Posse & Navarrete-Heredia, 2006
Creophilus maxillosus villosus (Gravenhorst, 1802)
Platydracus biseriatus (Sharp, 1884)
Philonthus hoegei Sharp, 1885
Platydracus marcidus (Sharp, 1884)
Platydracus mendicus (Sharp, 1884)
Philonthus sericans (Gravenhorst, 1806)
Philonthus testaceipennis Erichson, 1840
Phloeonomus centralis Blackwelder, 1944
Styngetus adrianae Navarrete-Heredia, 1998
Tachinus mexicanus Campbell, 1973

Taxonomic notes

Some species in the checklist (Tables 1–2), have been recorded with the follow taxonomic notes: *Aleochara mexicana* Sharp, 1883 was recorded by Huacuja-Zamudio (1982) as *Aleochara* aff. *miradoris* Sharp, 1883. *A. miradoris* is a synonym of *A. mexicana. Anotylus* aff. *fragilis* (Sharp, 1887): it is necessary to compare the specimens from Morelos (Márquez-Luna 2001) with the type material of this species for positive identification. *Anotylus* aff. *nanus* (Erichson, 1840): this is tentative identification. *A. nanus*, has not been before recorded from Mexico and it is necessary to verify the identification of the specimens by comparing them with the type series (Márquez-Luna 2001). *Belonuchus* aff. *pictipennis* Sharp, 1885: this is tentative identification. Confirmation of the determination is required because there is only one disjunct record of this species from Panama (Herman 2001a). *Belonuchus trochanterinus* (Sharp, 1885): according to Márquez *et al*. (2004), the type material of *B. trochanterinus* should be examined to clarify the identity of the Morelos species (Tlayacapan). *Hoplandria* aff. *centralis* Sharp, 1883: this is tentative identification. Confirmation of the determination is required. This species was also recorded in Guatemala (Hanley 2003). *Omalium meximontanum* Thayer, 2002: this specie was recorded by Huacuja-Zamudio (1982) as *Omalium* aff. *incultum* Sharp, 1887, it is likely to be *Omalium meximontanum* Thayer, 2002 (Navarrete-Heredia *et al.* 2002). *Paederomimus angularius* (Erichson, 1840): in the original description "*angularius*" was used, but "*angularis*" was used in the later work (Navarrete-Heredia *et al.* 2002). *Philonthus apheles* Solsky, 1868: Márquez-Luna (2001) recommended that the identification of the specimens from Morelos be confirmed by the examination of the median lobe of the aedeagus. *Phloeonomus pumilo* Sharp, 1887: this is tentative identification. This species was previously reported by Huacuja-Zamudio (1982) as *Omalium tristis* Sharp, 1887 and it is likely a misidentification of *Phloeonomus pumilo* Sharp, 1887 (Navarrete-Heredia *et al*. 2002). Confirmation of this determination is required (Thayer 2003). *Platydracus fervidus* (Sharp, 1884): this is tentative identification. The taxonomic differences between the subspecies, *P. fervidus fervidus* and *P. fervidus memnonius*, are not clear (Márquez-Luna *et al.* 2004). *Stenus* aff. *popocatepetlensis* Puthz, 1974: this is tentative identification. Confirmation of the determination of the specimens from Morelos is required (Márquez-Luna 2001). *Styngetus deyrollei* (Solsky, 1866): this is tentative identification. Huacuja-Zamudio (1982), recorded *Xanthopygus* aff. *sapphirinus* Erichson, 1839, from Hidalgo. However, this may be a misidentification of *Styngetus deyrollei* (Solsky, 1866) (Navarrete-Heredia 1998).

Importance of rove beetles collected with carrion traps in forests

Carrion is a nutrient-rich resource for a large variety of facultative and obligate scavengers and predators. It can also affect soils, microbes and plants. Carrion can therefore have direct and indirect effects on many ecological communities, and contribute to the dynamics of species diversity and nutrient cycling. However, it is an underestimated resource in ecosystems and little studied in an ecological perspective to understand the role of carrion in supporting biodiversity and various food webs (Barton *et al*. 2013).

The dispersal of nutrients away from carrion, is largely driven by the activity of arthropod and vertebrate detritivores and scavengers, and their predators (Barton *et al*. 2013). Many species of rove beetles (Coleoptera: Staphylinidae), are predators that can be generalist feeders on a variety of insects or other invertebrates co-occurring with them, or are more specialized feeders on a particular small subset of these organisms, including a variety of Diptera larvae and adults, Coleoptera, Lepidoptera larvae, Acarina, Araneae, Collembola, Oligochaeta, Nematoda, and at least occasionally Diplopoda (Thayer 2005, Castillo Miralbes 2002, Centeno *et al.* 2002, Watson & Carlton 2003)

The rove beetles present other feeding habits, particularly mycophagy and saprophagy. In most cases, adults and larvae of rove beetle species occur in the same microhabitats and consume the same foods, although in some genera the larvae are predaceous and the adults saprophagous or pollen-feeders. Some species combine mycophagy (some Tachyporinae) or saprophagy (Oxytelinae) with predaceous habits, either within a life stage or between life stages (Thayer 2005), and may occasionally be present in carrion as recorded in this research project. Considering the above, not all the species collected in carrion traps are strictly associated with carrion and their capture can be accidental (Rodríguez & Navarrete-Heredia 2014).

Therefore, it is important to do a systematic inventory with carrion traps in *Quercus* forests to analyze the diversity of the staphylinid assemblages and the distinct effects that this resource may have on ecological communities and to provide the theoretical foundation for many studies of carrion ecology, such as testing the temporal succession theory (Schoenly & Reid 1987), and the spatial aggregation and coexistence theory (Ives 1991). There are key conceptual parallels between carrion resources and other spatially discrete and ephemeral resources, such as dung (Huacuja-Zamudio 1982; Quezada *et al.* 2003; Márquez-Luna *et al.* 2004; Asiain *et al.* 2011; Caballero & León-Cortés 2012), fungi (Huacuja-Zamudio 1982; Navarrete-Heredia 1995; Delgado-Castillo 2004; Márquez-Luna *et al.* 2004; Asiain *et al.* 2011) and fruits (Huacuja-Zamudio 1982; Márquez-Luna *et al.* 2004). There exists a broader empirical basis to develop further the theory surrounding carrion ecology.

Conclusions

The rove beetle species richness, including morphospecies, in Cerro de García site (Table 1), was similar to that of 76 species captured in *Quercus*-pine, tropical deciduous, pine forests, and agriculture crops by Márquez-Luna (2001); and to that of 81 species found in *Quercus* and cloud mountain forests (Santiago-Jiménez 1999). The species richness in the present study, was only exceeded in *Quercus* forest in the state of Chiapas with 142–181 species (Caballero & León-Cortes 2012, and Caballero *et al.* 2009).

The number of species of rove beetles collected with carrion traps and recorded from *Quercus*, *Quercus*-pine and pine forests of Mexico (Table 2) was 77 species representing 4.5% of the 1,678 rove beetle species that have been reported in Mexico (Navarrete-Heredia & Newton, 2013). Work on carrion rove beetles was conducted only in 9 (Morelos, Hidalgo, Jalisco, Michoacán, Estado de México, Veracruz, Guerrero, Oaxaca and Chiapas), of the 31 states of Mexico in which *Quercus* forests occur (Rzedowski 2006; Valencia 2004). Therefore, this work should be regarded as a preliminary attempt to provide a checklist of species occurring in the studied habitats. Undoubtedly, there are many more species to be discovered, including endemic ones, in this diverse plant ecosystem.

In the existing reviewed literature, there are high number of morphospecies that were not included in this checklist (Table 2). This situation reflects poor taxonomic knowledge of many groups of Staphylinidae. It implies that the additional extensive work needs to be conducted in Mexico for improving the knowledge of the rove beetle fauna. Taxonomic revisions and ecological studies are particularly needed in the following genera: *Belonuchus* (*rufipennis* Group), *Philonthus* and *Phloeonomus*. These groups have a high affinity to decomposing organic matter, and occur throughout the year in *Quercus*, *Quercus*-pine and pine forests in Mexico. The species of these genera may be used in biodiversity, conservation, forensic and agricultural entomology studies.

TABLE 4. Months of occurrence of the carrion rove beetles in *Quercus*, *Quercus*-pine and pine forests in Mexico. []: Without data of month/s of occurrence. (*): Presence.

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Phloeonomus centralis Blackwelder, 1944	*	*	*	*	*	*	*	*	*	*	*	*
P. pumilo Sharp, 1887				*								
Omalium meximontanum Thayer, 2003			*		*							
Lordithon nubicola Campbell, 1982 []												
L. antennatus Campbell, 1982										*		
L. howdeni Campbell, 1982	*					*	*	*	*	*	*	
L. aff. *obliquus* (Sharp, 1884)							*	*	*	*	*	
Coproporus hepaticus Erichson, 1839	*	*						*	*	*	*	
Tachinus mexicanus Campbell, 1973					*	*	*	*	*	*	*	*
Tachinomorphus grandis (Solsky, 1868)			*									
Ischnosoma arizonense Campbell, 1991		*	*	*		*				*		*
Megarthrus alatorreorum Rodríguez & Navarrete-Heredia, 2015					*	*	*	*		*		*
Belonuchus alternans (Sharp, 1885)			*			*	*	*	*	*	*	
B. apiciventris (Sharp, 1885)	*	*	*	*	*	*	*	*	*	*	*	*
B. bidens Sharp, 1885			*	*								
B. colon (Sharp, 1885)							*	*	*	*	*	
B. dichrous Erichson, 1840				*								
B. erichsoni Bernhauer, 1917						*	*	*	*	*	*	
B. aff. flavipennis Solsky, 1870						*	*	*	*	*	*	
B. rufipennis (Fabricius, 1801)	*	*	*	*	*	*	*	*	*	*	*	*
B. trochanterinus (Sharp, 1885)		*	*		*			*	*	*	*	
B. basiventris (Sharp, 1885)	*			*	*	*	*	*	*	*	*	*
B. oxyporinus (Sharp, 1885)					*	*	*	*	*	*	*	*
B. xanthomelas Solsky, 1868	*	*	*	*			*	*	*	*		*
B. pollens Sharp, 1885				*	*		*			*	*	*
B. aff. *pictipennis* Sharp, 1885						*	*	*	*	*	*	
B. ephippiatus (Say, 1830)	*	*	*	*	*							
B. rufiventris (Sharp, 1887)			*	*		*	*	*	*	*	*	

......*continued on the next page*

TABLE 4. (Continued)

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
B. zunilensis (Sharp, 1885)						*	*	*		*	*	
B. viridipennis Baudi, 1848							*					
Chroaptomus flagrans (Erichson, 1840)		*	*					*		*	*	*
C. mexicanus Chani-Posse & Navarrete-Heredia, 2006					*	*	*	*	*	*	*	*
Creophilus maxillosus villosus (Gravenhorst, 1802)	*		*		*				*		*	
Paederomimus angularius (Erichson, 1840)									*	*	*	*
P. gentilis Sharp, 1885										*	*	
P. apheles Solsky, 1868								*				
P. hoegei Sharp, 1885		*		*	*	*	*	*	*	*	*	
P. testaceipennis Erichson, 1840	*	*	*	*	*	*	*	*	*	*	*	*
P. sericans (Gravenhorst, 1806)	*	*	*	*	*	*	*	*	*	*	*	*
P. iris Sharp, 1885								*	*	*	*	
P. aff. *mnemon* Smetana, 1995					*	*		*		*		
P. gentilis Horn, 1884									*		*	
P. piceatus Nordman, 1837							*	*	*	*		
Leistotrophus versicolor (Gravenhorst, 1806)			*									
Platydracus castaneus (Nordmann, 1837)							*					
P. femoratus (Fabricius, 1801)			*	*	*							
P. ferox (Nordmann, 1837)						*						
P. fervidus (Sharp, 1884)					*	*				*	*	
P. fuscomaculatus (Laporte, 1835)					*	*						
P. mendicus (Sharp, 1884)					*	*	*	*	*	*	*	
P. optatus (Sharp, 1884)						*	*	*	*			
P. phoenicurus (Nordmann, 1837)					*	*	*	*		*	*	
P. marcidus (Sharp, 1884)					*	*			*	*	*	*
P. biseriatus (Sharp, 1884)						*	*	*	*	*	*	
P. salvinianus (Sharp, 1884)						*	*	*	*			
Gastrisus newtonorum Navarrete-Heredia & Márquez, 1998					*	*	*	*	*	*	*	

......continued on the next page

TABLE 4. (Continued)

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Oligotergus fasciatus (Nordmann, 1837)									*	*		
O. subtilis (Sharp, 1884)		*			*	*	*	*	*	*	*	
O. paederiformis (Sharp, 1884)		*			*		*	*	*	*		
Styngetus adrianae Navarrete-Heredia, 1998				*	*	*	*	*	*	*	*	*
S. deyrollei (Solsky, 1866)		*	*				*	*	*			
Xenopygus analis (Erichson, 1840)						*		*	*			
Eulissus chalybaeus Mannerheim, 1830						*		*	*	*		
Thyreocephalus puncticeps Sharp, 1885					*	*	*	*	*	*		
Heterothops tenuicornis Sharp, 1884				*								
Aleochara mexicana Sharp, 1883						*			*	*	*	
A. oxypodia Sharp, 1883			*								*	
A. caviceps (Casey, 1893) [ ]												
Hoplandria aff. centralis Sharp, 1883						*	*	*	*			
H. peltata (Erichson, 1839)			*				*		*	*		
Anotylus aff. *fragilis* (Sharp, 1887)	*					*	*	*	*	*	*	*
A. aff. *nanus* (Erichson, 1840)							*	*	*	*	*	
A. aff. *spinifrons* (Sharp, 1887)							*	*	*			
A. vilis (Sharp, 1887)											*	
Paederus aff. *currax* Sharp, 1886			*	*	*					*	*	
Cyparium aff. *terminale* Matthews, 1888									*	*		
Toxidium punctatum Matthews, 1888								*	*	*	*	
Stenus popocatepetlensis Puthz, 1974									*			

Most of the studied rove beetles species collected with carrion traps belong to the subfamily Staphylininae, and they are abundant and diverse, in decomposing organic matter. However, it is important to note that most of the published works have excluded the large subfamily Aleocharinae, due to the taxonomic difficulty that this group presents. It is likely, that this species rich subfamily, when better known taxonomically, will exceed the number of species that have been reported in the other subfamilies of Staphylinidae.

A large number of species of *Belonuchus*, *Philonthus* and *Phloeonomus* occur throughout the year in the coniferous forests, while the species of the other 27 recorded genera occur only in a certain season of the year (Table 4). Therefore, it is important that future biodiversity studies take into consideration larger zoogeographic areas of Mexico with this particular forest type, and that collecting is conducted during a representative period of time, and considering main changes in temperature, precipitation or humidity throughout the year to examine community heterogeneity amongst carrion-visiting rove beetles (Rodríguez & Navarrete-Heredia 2014).

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