

Research Article

Rhopalocera (Lepidoptera) prey records of Asilidae (Diptera) in eastern New Mexico and western Texas, United States of America

Registros de Rhopalocera (Lepidoptera) como presas de Asilidae (Diptera) en el este de Nuevo México y el oeste de Texas, Estados Unidos de América

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Abstract. Robber flies with their prey were collected from 2014-2021 in several eastern New Mexico counties and one county in west Texas. A few were merely photographed in the same areas in 2022. One hundred and one asilid-butterfly pairs were collected representing 17 species of robber flies and 19 species of butterflies. Three pairs were photographed representing one robber fly species with two species of butterflies. The prey taxa consisted of five species of Hesperidae, three species of Pieridae, four species of Lycaenidae, and four species of Nymphalidae. *Efferia helena* (Bromley, 1951) was the most frequently collected asilid predator of butterflies, 33 individuals preying on 10 butterfly species followed by *Proctacanthus micans* Schiner, 1867, 15 individuals preying on seven butterfly species. *Nathalis iole* Boisduval, 1836 (Pieridae) was the most commonly collected butterfly prey with 21 specimens. However, at the species level, *Echinargus isola* (Reakirt, [1867]) (Lycaenidae) was found to be preyed upon by the most robber fly species, *i.e.*, seven, followed by *Atalopedes campestris* (Boisduval, 1852) (Hesperidae) and *Nathalis iole* (Pieridae), each by six robber fly species.

Key words: Behavior; butterflies; ecology; food chain; prey-predator; robber flies.

Introduction

Robber flies (Diptera: Asilidae), sometimes also known as assassin flies, are one of the apex predators among insects. Distributed worldwide (Hull 1962), there are 7,687 species of these flies described with 555 genera and 17 subfamilies making them the fourth largest group in the order Diptera (Catalogue of life checklist 2022). Around 1,000 extant species are native to North America (Finn 2004; Mitton 2020). It was initially believed that they preyed on vertebrates including mammals (Duncan 1882), but it has long been known that arthropods make the complete diet of adult robber flies, including some active predators such as dragonflies, tiger beetles as well as some arachnids (Bristowe 1924; Dennis *et al.* 2012; Lavigne 1972; Lavigne and Holland 1969; Musso 1978; Pollock and Davidson 2020). Some asilids are relatively prey-specific while most seem to be opportunists feeding on whatever arthropods they come across and can handle (Wood 1981). Scarbrough (1978) suggested that an asilid might chase after a prey much larger than its size but gives up right before or after capturing it. Their niche, flight period and

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habitat might vary among species (Cannings 1997; Dennis *et al.* 2008; Lavigne *et al.* 1978) but their feeding mechanism is more or less the same. The predator injects its saliva loaded with proteolytic and neurotoxic enzymes into its prey; these immobilize the prey while dissolving its tissue allowing the fly to feed on the liquified contents (Hayat 1997; Musso 1978; Wood 1981). The predatory larvae are usually subterranean or occur within similar substrates (*e.g.*, rotting wood) and search for their prey using chemicals released by the prey. Coleoptera larvae are the most common prey of asilid larvae (Castelo and Lazzari 2004).

Lepidoptera is the third largest insect order with 149,994 described species worldwide, of which 19,088 are butterflies (Catalogue of life checklist 2022). The prey-predator relationship between Asilidae and Lepidoptera has been reported by Dennis *et al.* (2009), Londt (1999), Nielsen (1977), and Price (1961). The asilid predator-prey database of Lavigne (2016) listed 14,388 records of Asilidae and their prey, of which 1,032 were Lepidoptera. This included 50 records of Hesperidae, 89 of Pieridae, 15 of Papilionidae, 103 of Lycaenidae, one of Riodinidae, and 70 of Nymphalidae as prey along with a few caterpillar prey records as well. It also listed instances of medium sized robber flies, such as *Triorla interrupta* (Macquart, 1834) and *Alcimus setifemoratus* Hobby, 1934, feeding on large species of butterflies such as those in the genus *Papilio* Linnaeus, 1758. Londt (1999) suggested that robber flies can apparently prey on any butterfly species, even the distasteful ones such as *Danaus chrysippus aegyptius* (Schreber, 1759), *Acraea caldarena caldarena* Hewitson, 1877, and *Acraea neobule neobule* Doubleday, [1847].

Robber flies are known to be most diverse in dry and sandy conditions (Finn 2004). New Mexico and Texas house around 180 and 220 species, respectively (Fisher and Wilcox 1997). Similarly, Texas is home to more than 400 species and New Mexico hosts more than 300 species of butterflies making them two of the richest states in the US in terms of butterfly diversity (Stanford and Opler 1993).

Records of coleopteran prey of Asilidae were provided by Pollock and Lavigne (2019) for eastern New Mexico and neighboring areas of western Texas. The current study uses the same collection data, which has been updated since then to 13,200 prey records, but solely focuses on butterfly prey. The main objective is to present new butterfly prey records for robber flies while also providing an idea of robber fly and butterfly diversity in the study areas.

Material and Methods

Robber flies with their prey were collected from various localities in eastern New Mexico and western Texas from 2014 to 2021. Chaves, Curry, Lea, Otero, Quay and Roosevelt counties in eastern New Mexico and Bailey County in western Texas were surveyed. The surveys were done opportunistically, mostly in the open dry areas (Figs. 1-4). Thirteen thousand and two hundred (13,200) prey-predator pairs were collected. Collection was done by hand using an aerial net of 12" hoop diameter. Predators with prey were either trapped inside the net while perched on the ground, were swept from vegetation or were caught in flight. Robber flies, along with their respective prey, were euthanized by transferring them into individual glass vials with several drops of ethyl acetate on lintless tissue paper. The GPS details of the collection locality were obtained using Google Earth. Lepidoptera specimens were mounted underneath their asilid predators on the same pin and then the wing(s) were spread. In 2022, a few robber flies were photographed with their butterfly prey by the first and third authors. Photographs were taken using Canon 7D Mark II with 100 mm f/2.8L Macro IS USM lens (Figs. 5-7). These pairs were not collected but the details are included herein as "photographs only".



Figure 1. New Mexico, Portales, nr. softball complex (28.viii.2021). / Nuevo México, Portales, cerca del complejo de softbol (28.viii.2021).



Figure 2. New Mexico, field just NE of Floyd (15.vii.2017). / Nuevo México, campo al NE de Floyd (15.vii.2017).



Figure 3. New Mexico, nr. jct. 480 and Roos. Rd. AG (20.v.2017). / Nuevo México, cerca jct. 480 y Roos. Calle AG (20.v.2017).



Figure 4. Texas, Bailey Co., Muleshoe Nat. Wildlife Refuge nr. Goose Lake (10.vii.2022). / Texas, Bailey Co., Muleshoe Nacional. Refugio de vida silvestre cerca del lago del Ganso (10.vii.2022).

Genitalia of cryptic butterfly species were extracted by clipping the last segments of their abdomen and boiling it in 10% KOH on a Corning PC-351 hot plate stirrer at power six for five to seven minutes. Genitalic parts were analyzed by placing them in glycerin and studying under Leica MZ9.5 stereoscope attached with a T-Q/FOI-1 150w Fiber Optic Illuminator. The genitalia were stored in glycerin inside genitalia vials and pinned alongside their respective specimens with appropriate labeling for future reference.

In this paper, prey records are organized alphabetically according to butterfly family, subfamily, genus, species, and state and county in which they were found. Those from same states and counties are listed chronologically. For each prey butterfly species, the asilid predators are listed in alphabetical order by genus and then species. Complete label data are given followed by sex of the asilid and butterfly (if the latter unknown, then indicated by “?”) in parentheses. Specimens were collected by the second author (DAP) unless otherwise noted, as follows: CBM = Colin B. Mackenzie; GWP = George W. Pollock; LAP = Louis A. Pollock; LAR = Lisa A. Reichert. Identification of the butterflies and their genitalia analysis was done by the first and third authors.

Abbreviations used. Co.: County; Coll.: Collector; Cyn.: Canyon; ENMU: Eastern New Mexico University; F: female; Hwy: Highway; Jct.: Junction; Lk.: Lake; M: male; Nat.: National; NM: New Mexico; nr.: near; Rd.: Road; Roos.: Roosevelt; TX: Texas.

Identification. The identification of the robber flies was done using the generic key in Wood (1981) and then species treatments in Barnes (2010), Hine (1911), Pritchard (1935), and Wilcox (1966). A broad concept of the genus *Efferia* (as in Fisher and Wilcox 1997) was used. Confirmations or original identifications were also provided by Dr. Eric Fisher. Butterflies were identified using Burns (1989, 1990, 1994), Elrod (1906), Heppner (2007, 2011), Mielke (1968), Minno and Sloten (2011), Opler and Warren (2002), Pittaway *et al.* (2006), Scott (1992), Shapiro (2000), Silberglied and Taylor (1978), Skinner and Williams, Jr. (1923), Stradomsky (2016), and online references including Alabama Butterfly Atlas (2022), Peecnature (2022), and Sandianet (2022).

Results

Among 13,200 records of robber flies with their prey, 627 (4.75%) were collected in association with Lepidoptera of which 101 (0.77%) represented nineteen butterfly (Rhopalocera) species (Tab. 1). More than 95% of our Asilidae-Rhopalocera prey-predator records were not found in the Lavigne (2016) database. Records that are also found in Lavigne (2016) are marked with an asterisk (*) in Tab. 1 where our results are summarized. Specifics regarding localities, dates, collectors and sexes of predator and prey are given in detail below.

Hesperiidae (Hesperiinae)

Amblyscirtes eos (W. H. Edwards, 1871)

Prey of *Proctacanthus micans* Schiner, 1867

NM: Roosevelt Co., nr. Jct. Hwy 480 & S. Roos. Rd. AG ca 15 mi. WSW Portales (34.12371, -103.58029), 20.vi.2019 (F, M)

Anatrytone logan (W.H. Edwards, 1863)

Prey of *Diogmites bilobatus* Barnes, 2010

NM: Roosevelt Co., Portales, N. Ave. Q, nr. ENMU soccer field (34.180862, -103.356217), 26.viii.2015 (F, M)

Prey of *Proctacanthus micans* Schiner, 1867

NM: Roosevelt Co., nr. Jct. Hwy 480 & S. Roos. Rd. AG ca 15 mi. WSW Portales (34.12371, -103.58029), 31.v.2020 (M, M); same locality, 10.vi.2020 (F, M); same locality, 16.vi.2020 (M, M)

Prey of *Proctacanthus nearno* Martin, 1962

NM: Roosevelt Co., near Jct. Hwy 480 & S. Roos. Rd. AG ca 15 mi. WSW, Portales (34.120912, -103.581585), 26.v.2017 (F, M); same locality, 14.vi.2017 (F, M)

***Atalopedes campestris* (Boisduval, 1852)**

Prey of *Diognites angustipennis* Loew, 1866

NM: Chaves Co., Mesalero Dunes Rec. Area ca. 38 mi. E. Roswell (33.398519, -103.863315), 14.ix.2019 (F, F)

Prey of *Efferia argentifrons* (Hine, 1911)

NM: Lea Co., 2.5 mi. E Hwy 206 on Co Rd 164 (Ranger Lake Rd.) (33.357022, -103.276657), 11.vi.2015 (M, F)

NM: Lea Co., Co. Rd. 165 (Price Rd.) ca. 0.7 mi. W Hwy 206 (33.410052, -103.342636), 31.vii.2015 (F, F; M, F; F, M)

Prey of *Efferia bicaudata* (Hine, 1919)

NM: Chaves Co., nr. Jct S. Roos. Rd. AU & AV 5.1 mi. NW Kenna (33.887951, -103.846912), 15.ix.2018, coll. DAP & GWP (M, F)

Prey of *Efferia helenae* (Bromley, 1951)

NM: Curry Co., Ned Houk Park ca. 7.5 mi. NNE Clovis 4260 ft. (34.5103, -103.172), 25.ix.2020, coll. GWP (M, F)

NM: Roosevelt Co., Portales nr. softball complex (34.17946, -103.37641), 7.x.2016 (F, M)

NM: Roosevelt Co., Portales nr. softball complex (34.179217, -103.375178), 24.ix.2019, coll. LAP (F, F)

Prey of *Proctacanthus milbertii* Macquart, 1838

TX: Bailey Co., Muleshoe Nat. Wildlife Refuge nr. Goose Lake, 3744 ft. (33.955034, -102.750128), 4.vii.2019 (F, M)

Prey of *Triorla interrupta* (Macquart, 1834)

NM: Roosevelt Co., Portales 173 Yucca Dr. (34.16442, -103.3427), 18.vii.2015, coll. GPW (M, F)

***Copaeodes aurantiaca* (Hewitson, 1868)**

Prey of *Efferia luna* Wilcox, 1966

NM: De Baca Co., Bosque Redondo Lk. Ca. 3 mi. SSE Ft. Sumner (34.424924, -104.222847), 13.vii.2016, coll. DAP & GWP (F, F)

Prey of *Efferia varipes* (Williston, 1885)

NM: Roosevelt Co., nr. Jct. Hwy 480 & S. Roos. Rd. AG ca 15 mi. WSW Portales (34.12371, -103.58029), 31.v.2020 (F, F)

***Hesperia uncas* W.H. Edwards, 1863**

Prey of *Efferia argentifrons* (Hine, 1911)

NM: Roosevelt Co., 0.5 mi. S Hwy 70 ca. 7 mi. NE, Portales, just S old Greyhound Stadium, 4068 ft. (34.253841, -103.24477), 24.v.2020, coll. DAP & LAP (F, M)

Prey of *Efferia helenae* (Bromley, 1951)

NM: Roosevelt Co., nr. Jct. S. Roos. Rd. AU & AV 5.1 mi. NW Kenna (33.876494, -103.837416), 14.ix.2017 (F, M)

NM: Roosevelt Co., S. Roos. Rd. AU 4.1 mi. NW Kenna, 4410 ft. (33.87108, -103.83423), 15.ix.2018, coll. DAP & GWP (M, M)

Hesperiidae (Pyrginae)

Burnsius communis (Grote, 1872)

Prey of *Efferia helenae* (Bromley, 1951)

NM: Roosevelt Co., Portales, open field, SW of softball complex; 4013 ft. (34.17854, -103.37686), 1.x.2014 (F, F)

NM: Roosevelt Co., Portales, nr. softball complex (34.178383, -103.375918), 4.x.2018 (M, M)

Prey of *Triorla interrupta* (Macquart, 1834)

NM: Roosevelt Co., field on south side NM 480 b/n S. Roos. Rd. AF and AG; 4232 ft. (34.12419, -103.57179), 26.vii.2016 (F, M)

Pholisora catullus (Fabricius, 1793)

Prey of *Efferia albibarbis* (Macquart, 1838)

NM: Roosevelt Co., near Jct. Hwy 480 & S. Roos. Rd., AG ca 15 mi. WSW, Portales, (34.120912, -103.581585), 1.vi.2017 (M, M)

Prey of *Proctacanthus milbertii* Macquart, 1838

NM: Roosevelt Co., Portales nr. softball complex, (34.179217, -103.375178), 28.viii.2021 (F, M)

Prey of *Triorla interrupta* (Macquart, 1834)

NM: Roosevelt Co., Portales 173 Yucca Dr. (34.16442, -103.34270), 19.viii.2016, coll. GWP (F, M)

TX: Bailey Co., Hwy 746 nr. Jct. Co. Rd. 21 (34.092938, -103.009915), 13.vii. 2017 (M, M); same locality, 17.vii.2017 (F, F; F, M)

Pyrgus scriptura (Boisduval, 1852)

Prey of *Efferia helenae* (Bromley, 1951)

NM: Roosevelt Co., Portales nr. softball complex (34.178383, -103.375918), 6.ix.2018 (M, F)

Lycaenidae (Polyommatainae)

Brephidium exilis (Boisduval, 1852)

Prey of *Efferia bicaudata* (Hine, 1919)

NM: Lea Co., 2.5 mi. E Hwy 206 on Co Rd 164, 4008 ft. (Ranger Lake Rd.) (33.357022, -103.276657), 20.ix.2015 (M,?)

NM: Roosevelt Co., Portales, open field, SW of softball complex; 4013 ft. (34.17854, -103.37686), 23.x.2014 (F,?); same locality, 29.x.2014 (M,?)

NM: Roosevelt Co., Portales, nr. softball complex (34.178383, -103.375918), 13.ix.2018 (M,?); same locality, 20.ix.2018 (M, M)

Prey of *Efferia helenae* (Bromley, 1951)

NM: Curry Co., Ned Houk Park ca. 7.5 mi. NNE Clovis, 4260 ft. (34.520119, -103.170984), 5.ix.2018, coll. GWP (F, F)

NM: Quay Co., Hwy 278 ca. 13.8 mi., SW San Jon, Apache Cyn., 4600 ft. (34.934684, -103.460314), 19.ix.2015, coll. DAP, GPW & LAR (M,?)

NM: Roosevelt Co., Portales nr. softball complex (34.17946, -103.37641), 11.x.2016 (F,?)

TX: Bailey Co., Muleshoe Nat. Wildlife Refuge nr. Goose Lake, 3730 ft. (33.954818, -102.752485), 9.ix.2018, coll. DAP, GWP & LAR (M,?)

Echinargus isola (Reakirt, [1867])

Prey of *Efferia albibarbis* (Macquart, 1838)

NM: Roosevelt Co., nr. Jct. Hwy 480 & S. Roos. Rd. AG ca 15 mi. WSW Portales (34.12371,

- 103.58029), 12.vi. 2020 (F, M)
Prey of *Efferia argyrosoma* (Hine, 1911)
NM: Quay Co., Hwy 278 ca. 13.8 mi., SW San Jon, Apache Cyn., 4600 ft. (34.934684, -103.460314), 8.vi.2016, coll. DAP & GWP (F, M)
Prey of *Efferia bicaudata* (Hine, 1919)
NM: Roosevelt Co., Portales nr. softball complex (34.179217, -103.375178), 11.ix.2019, coll. LAP (F, F)
Prey of *Efferia helenae* (Bromley, 1951)
NM: Quay Co., Hwy 278 ca. 13.8 mi., SW San Jon, Apache Cyn., 4600 ft. (34.910459, -103.448931), 25.ix.2016, coll. DAP & GWP (F, M)
NM: Roosevelt Co., field just NE of Floyd, 4145 ft. (34.218165, -103.565243), 9.ix.2017 (M, M)
NM: Roosevelt Co., nr. Jct. Hwy 480 & S. Roos. Rd. AG ca 15 mi. WSW Portales (34.12371, -103.58029), 8.ix.2018 (M, M) coll. DAP, GWP & LAP; same locality, 28.viii.2021 (F, M)
Prey of *Proctacanthus micans* Schiner, 1867
NM: Roosevelt Co., nr. Jct. Hwy 480 & S. Roos. Rd. AG ca 15 mi. WSW Portales (34.12371, -103.58029), 7.vi.2020 (M, F)
Prey of *Promachus oklahomensis* James, 1935
TX: Bailey Co., Muleshoe Nat. Wildlife Refuge nr. Goose Lake, 3730 ft. (33.954818, -102.752485), 9.vii.2018, coll. DAP & GWP (F, F)

***Icaricia acmon* (Westwood, [1851])**

- Prey of *Proctacanthus nearno* Martin, 1962
NM: Roosevelt Co., nr. Jct. Hwy 480 & S. Roos. Rd. AG ca 15 mi. WSW Portales (34.12371, -103.58029), 15.vi.2019 (F, F)

Lycaenidae (Theclinae)

***Strymon melinus* (Hübner, 1818)**

- Prey of *Efferia argentifrons* (Hine, 1911)
NM: Lea Co., Co. Rd. 165 (Price Rd.) ca. 0.7 mi. W Hwy 206 (33.410052, -103.342636), 10.vii. 2016 (F, M)
Prey of *Efferia helenae* (Bromley, 1951)
NM: Quay Co., Hwy 278 ca. 13.8 mi., SW San Jon, Apache Cyn., 4600 ft. (34.934684, -103.460314), 1.x.2016 (M, M)
NM: Roosevelt Co., Portales nr. softball complex (34.17946, -103.37641), 7.x.2016 (F, M)
NM: Roosevelt Co., Portales nr. softball complex (34.179217, -103.375178), 11.ix.2019, coll. LAP (M, F)

Nymphalidae (Nymphalinae)

***Chlosyne gorgone* (Hübner, 1810)**

- Prey of *Proctacanthus micans* Schiner, 1867
NM: Roosevelt Co., near Jct. Hwy 480 & south Roosevelt Road AG ca 15 mi. WSW, Portales (34.120912, -103.581585), 30.v.2017 (M,?)

***Euptoieta claudia* (Cramer, 1775)**

- Prey of *Efferia argentifrons* (Hine, 1911)
NM: Roosevelt Co., 0.5 mi. S Hwy 70 ca. 7 mi. NE, Portales, just S old Greyhound Stadium, 4068 ft. (34.253841, -103.24477), 24.v.2020, coll. DAP & LAP (F,?)
NM: Roosevelt Co., field just NE of Floyd, 4146 ft. (34.218384, -103.563225), 27.v.2020 (F, M)

Prey of *Efferia auripila* (Hine, 1916)

TX: Bailey Co., Muleshoe Nat. Wildlife Refuge nr. Goose Lake, 3744 ft. (33.955034, -102.750128), 7.vi.2019, coll. DAP, GWP & CBM (M,?)

Prey of *Efferia helenae* (Bromley, 1951)

NM: Roosevelt Co., Portales nr. softball complex (34.181335, -103.379171), 7.x.2017 (F,?)

Prey of *Proctacanthus micans* Schiner, 1867

NM: Roosevelt Co., nr. Jct. Hwy 480 & S. Roos. Rd. AG ca 15 mi. WSW Portales (34.12371, -103.58029), 15.vi.2019 (M,?); same locality, 23.vi.2019, coll. DAP, GWP & LAP (M,?)

***Phyciodes picta* (W. H. Edwards, 1865)**

Prey of *Proctacanthus nearno* Martin, 1962

NM: De Baca Co., Bosque Redondo Lk. ca. 3 mi. SSE Ft. Sumner, 3976 ft. (34.423868, -104.222936) 22.vii.2018, coll. DAP & GWP (F,?)

***Vanessa cardui* (Linnaeus, 1758)**

Prey of *Proctacanthus milbertii* Macquart, 1838

NM: Roosevelt Co., field just NE of Floyd, 4145 ft. (34.218165, -103.565243), 24.vii.2017 (M,?); same locality, 26.vii.2017 (F,?; F,?); same locality, 9.viii.2017 (F,?); same locality, 31.viii.2017(F,?); same locality, 3.ix.2017 (F,?)

Pieridae (Coliadinae)

***Colias eurytheme* Boisduval, 1852**

Prey of *Diogmites bilobatus* Barnes, 2010

NM: Roosevelt Co., ENMU campus field just S. of baseball pk. (34.17709, -103.357817), 26.viii.2014 (F, M)

Prey of *Proctacanthus milbertii* Macquart, 1838

NM: Roosevelt Co., field just NE of Floyd, 4145 ft. (34.218165, -103.565243), 21.vii.2017 (F, F)

NM: Roosevelt Co., nr. Jct. Hwy 480 & S. Roos. Rd. AG ca 15 mi. WSW Portales (34.12371, -103.58029), 26.vii.2019 (M, M)

***Nathalis iole* Boisduval, 1836**

Prey of *Efferia bicaudata* (Hine, 1919)

NM: Roosevelt Co., Portales, open field, SW of softball complex; 4013 ft. (34.17854, -103.37686), 8.ix.2014 (F, F)

Prey of *Efferia helenae* (Bromley, 1951)

NM: Chaves Co., Mescalero Dunes Rec. Area ca. 38 mi. E. Roswell (33.39852, -103.8633), 5.ix.2021, coll. DAP, GWP & LAR (M, F)

NM: Curry Co., Ned Houk Park ca. 7.5 mi. NNE Clovis, 4260 ft. (34.520119, -103.170984), 30.ix.2018, coll. DAP & GWP (M, M)

NM: Roosevelt Co., Portales, open field, SW of softball complex; 4013 ft. (34.17854, -103.37686), 26.ix.2014 (F, F); same locality, 1.x.2014 (F, F)

NM: Roosevelt Co., Portales, N. Ave. Q, nr. ENMU soccer field (34.180862, -103.356217), 10.ix.2015 (M, M)

NM: Roosevelt Co., field just NE of Floyd, 4145 ft. (34.218165, -103.565243), 25.x.2017 (M, M; F, M)

NM: Roosevelt Co., Portales, nr. softball complex (34.178383, -103.375918), 27.ix.2018 (F, F); same locality, 28.ix.2018, coll. GWP (F, M)

NM: Roosevelt Co., nr. Jct. Hwy 480 & S. Roos. Rd. AG ca 15 mi. WSW Portales (34.12371, -103.58029), 25.ix.2021 (M, M)

NM: Roosevelt Co., Portales nr. softball complex (34.179217, -103.375178), 3.x.2021 (M, M)
TX: Bailey Co., Hwy 746 nr. Jct. Co. Rd. 21, 3926 ft. (34.091109, -103.01537), 9.ix.2019, coll. DAP, GWP & LAR (M, M)

Prey of *Machimus* Loew 1849 sp.

NM: Roosevelt Co., Portales open field SW of softball complex, 4013 ft. (34.175228, -103.379101), 19.vi.2015 (F, M)

Prey of *Proctacanthus micans* Schiner, 1867

NM: Roosevelt Co., nr. Jct. Hwy 480 & S. Roos. Rd. AG ca 15 mi. WSW Portales (34.12371, -103.58029), 12.vi.2019 (M, M); same locality, 27.vi.2019 (F, M; F, M); same locality, 4.vi.2020 (F, M); same locality, 27.vi.2020 (F, M)

Prey of *Proctacanthus nearno* Martin, 1962

NM: De Baca Co., Bosque Redondo Lk. Ca. 3 mi. SSE Ft. Sumner, 3976 ft. (34.423868, -104.222936), 25.v.2018, coll. DAP & GWP (F, M)

Prey of Stenopogoninae genus nr. *Eucyrtopogon* sp.

NM: Roosevelt Co., nr. Jct. Hwy 480 & S. Roos. Rd. AG ca 15 mi. WSW Portales (34.12371, -103.58029), 11.xi.2020 (F, M)

Pieridae (Pierinae)

Pontia protodice (Boisduval & LeConte, [1830])

Prey of *Efferia argentifrons* (Hine, 1911)

NM: Lea Co., 2.5 mi. E Hwy 206 on Co Rd 164 (Ranger Lake Rd.) (33.357022, -103.276657), 4.vi.2015, coll. DAP & GWP (F, M; F, F)

NM: Lea Co., 2.4 mi. E Hwy 206 on Co. Rd. 164 (Ranger Lake Rd.) (33.356708, -103.275159), 28.v.2016 (M, M)

NM: Roosevelt Co., field just NE of Floyd, 4146 ft. (34.218384, -103.563225), 27.v.2020 (F, M)

Prey of *Efferia helenae* (Bromley, 1951)

NM: Roosevelt Co., Melrose trap (34.433292, -103.79976), 31.viii.2014 (M, M)

Prey of *Proctacanthus micans* Schiner, 1867

NM: Roosevelt Co., nr. Jct. Hwy 480 & S. Roos. Rd. AG ca 15 mi. WSW Portales (34.12371, -103.58029), 5.vii.2019 (M, M)

TX: Bailey Co., Hwy 746 nr. Jct. Co. Rd. 21, 3926 ft. (34.092229, -103.009466), 7.vi.2019, coll. DAP, GWP & CBM (M, M)

Photographic records

Lycaenidae (Polyommatainae)

Echinargus isola (Reakirt, [1867])

Prey of *Triorla interrupta* (Macquart, 1834)

Fig. 5- NM: Roosevelt Co., tennis court, S Ave L, Portales, Eastern New Mexico University, 4012 ft. (34.174537, -103.349274), 31.vii.2022 (M, ?)

Nymphalidae (Nymphalinae)

Phyciodes picta (W. H. Edwards, 1865)

Prey of *Triorla interrupta* (Macquart, 1834)

Figs. 6, 7- TX: Bailey Co., Muleshoe Nat. Wildlife Refuge nr. 1931 Bomar Ave, Fort Worth, 3655 ft. (33.950143, -102.764817), 10.vii.2022 (M, ?; M, ?)

Table 1. Predator-prey list of collected specimens. / Lista depredador-presa de especímenes recolectados.

	<i>Diogmites angustipennis</i>	<i>Diogmites bilobatus</i>	<i>Efferia albibarbis</i>	<i>Efferia argentifrons</i>	<i>Efferia argyrosoma</i>	<i>Efferia auripila</i>	<i>Efferia bicaudata</i>	<i>Efferia heleneae</i>	<i>Efferia luna</i>
Hesperiidae									
<i>Amblyscirtes eos</i> (W.H. Edwards, 1871)									
<i>Anatrytone logan</i> (W.H. Edwards, 1863)	1								
<i>Atalopedes campestris</i> (Boisduval, 1852)*	1			4			1	3	
<i>Burnsius communis</i> (Grote, 1872)*								2	
<i>Copaodes aurantiaca</i> (Hewitson, 1868)									1
<i>Hesperia uncas</i> W.H. Edwards, 1863*				1				2	
<i>Pholisora catullus</i> (Fabricius, 1793)*			1						
<i>Pyrgus scriptura</i> (Boisduval, 1852)								1	
Lycaenidae									
<i>Brephidium exilis</i> (Boisduval, 1852)							5	4	
<i>Echinargus isola</i> (Reakirt, [1867])*			1		1		1	4	
<i>Icaricia acmon</i> (Westwood, [1851])									
<i>Strymon melinus</i> (Hübner, 1818)				1				3	
Nymphalidae									
<i>Chlosyne gorgone</i> (Hübner, 1810)									
<i>Euptoieta claudia</i> (Cramer, 1775)				2		1		1	
<i>Phycodes picta</i> (W.H. Edwards, 1865)									
<i>Vanessa cardui</i> (Linnaeus, 1758)*									
Pieridae									
<i>Colias eurytheme</i> Boisduval, 1852*		1							
<i>Nathalis iole</i> Boisduval, 1836*							1	12	
<i>Pontia protodice</i> (Boisduval & LeConte, [1830])*				4				1	
Total	1	2	2	12	1	1	8	33	1

Prey already recorded in Lavigne (2016). "" next to a number indicates that prey-predator pair was already recorded in Lavigne (2016).

Table 1 (Continuation). Predator-prey list of collected specimens. / Lista depredador-presa de especímenes recolectados.

	<i>Efferia varipes</i>	nr. <i>Eucyrtopogon</i> sp.	<i>Machimus</i> sp.	<i>Proct. micans</i>	<i>Proct. milbertii</i>	<i>Proct. nearno</i>	<i>Promachus oklahomensis</i>	<i>Triortia interrupta</i>	Total
Hesperiidae									
<i>Amblyscirtes eos</i> (W.H. Edwards, 1871)				1					1
<i>Anatrytone logan</i> (W.H. Edwards, 1863)				3		2			6
<i>Atalopedes campestris</i> (Boisduval, 1852)*					1*			1	11
<i>Burrusius communis</i> (Grote, 1872)*								1	3
<i>Copaeodes aurantiaca</i> (Hewitson, 1868)	1								2
<i>Hesperia unca</i> W.H. Edwards, 1863*									3
<i>Pholisora catullus</i> (Fabricius, 1793)*					1			4	6
<i>Pyrgus scriptura</i> (Boisduval, 1852)									1
Lycaenidae									
<i>Brephidium exilis</i> (Boisduval, 1852)									9
<i>Echinargus isola</i> (Reakirt, [1867])*				1			1		9
<i>Icaricia acron</i> (Westwood, [1851])						1			1
<i>Strymon melinus</i> (Hübner, 1818)									4
Nymphalidae									
<i>Chlosyne gorgone</i> (Hübner, 1810)				1					1
<i>Euptoieta claudia</i> (Cramer, 1775)				2					6
<i>Phycodes picta</i> (W.H. Edwards, 1865)						1			1
<i>Vanessa cardui</i> (Linnaeus, 1758)*					6*				6
Pieridae									
<i>Colias eurytheme</i> Boisduval, 1852*					2*				3
<i>Nathalis iole</i> (Boisduval, 1836)*		1	1	5		1			21
<i>Pontia protodice</i> (Boisduval & LeConte, [1830])*				2					7
Total	1	1	1	15	10	5	1	6	101

*Prey already recorded in Lavigne (2016). “**” next to a number indicates that prey-predator pair was already recorded in Lavigne (2016).



Figure 5. *Triorla interrupta* male feeding on *Echinargus isola*. / *Triorla interrupta* macho alimentándose de *Echinargus isola*.



Figure 6-7. *Triorla interrupta* male feeding on *Phyciodes picta*. / *Triorla interrupta* macho alimentándose de *Phyciodes picta*.

Discussion

It has been noted in previous studies that Lepidoptera are not the first preference of adult robber flies as prey (Cole and Lovett 1921; Dennis *et al.* 2009; Hobby 1931; Lavigne 2016). Instead, robber flies seem to prefer hymenopteran, dipteran, and hemipteran insects, as evident in Brues (1946), Dennis *et al.* (1986), Hayat (1997), Hobby (1931), Lavigne and Holland (1969), Poulton (1906), and Scarbrough (1978). The fact that asilids mostly prefer species of Diptera, Hymenoptera or Hemiptera could be attributed to these insects' soft and relatively small bodies. Lepidoptera, while they also have soft and relatively small bodies, typically bear large wings that make them look larger than most insects (Dennis *et al.* 2009). In addition, they have different defense mechanisms to avoid

predation. Some species are distasteful/poisonous and show aposematism while some show Batesian mimicry and automimicry, and some can camouflage remarkably well in their environment all of which can help butterflies evade robber flies. Even though Londt (1999) suggested that asilids can feed on any species of butterflies including the distasteful/poisonous ones and gives some good examples, the toxicity/distaste of such species varies depending on which host plants they consume during their larval stages (Dimarco and Fordyce 2017), *i.e.*, if they feed on less poisonous host plants, they could indeed be palatable to some predators. It should also be noted that the same species of butterfly could have different host plants (with different toxicity) depending on the specific locality within its geographic range. Butterflies also show very skilled flight, and their slippery, scaly wings increase their survival chance even if they are captured by their predators (Saunders 2009).

Research has shown that robber flies feed more on moths than butterflies (Dennis *et al.* 2009; Lavigne 2016). Even in our collection, out of 627 lepidopteran prey, 526 specimens were moths while only 101 were butterflies. This could be associated with the fact that there are more species of moths than butterflies and that moth abundance is higher as pointed out by Dennis *et al.* (2009). Around 150,000 species of Lepidoptera are described out of which around 87% are moths (Catalogue of life checklist 2022). Most moths are nocturnal, but some species exhibit diurnal activity patterns as well, with much slower or clumsier flight than that of butterflies. This certainly makes it much easier for robber flies to capture them.

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