

BULLETIN OF THE ALLYN MUSEUM

Published by
THE ALLYN MUSEUM OF ENTOMOLOGY
Sarasota, Florida

Number 10

10 May 1973

STUDIES ON NORTH AMERICAN PHILOTES (LYCAENIDAE)

I. Roosting behavior, tending ants, parasites, and predators

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The following observations are from my notes in connection with field work on western North American *Philotes*. This is the first of a series of papers to be published on the genus. All the identifications are done by viewing the male genitalia after soaking overnight in a dilute KOH solution and stripped with watchmakers forceps of surrounding non-chitinous material under the dissecting scope. The whole genitalia is stored in a plastic shell vial filled with glycerine and pinned to the specimen, along with the determination label. James L. Reveal of the University of Maryland kindly made the *Eriogonum* identifications (foodplant data to be fully documented and published later). I wish to thank the Allyn Museum of Entomology for largely sponsoring the extensive field work involved in this project, and John Burns of Harvard for additional funds from collecting *Colias* samples for esterase experiments. Other sources of financial aid came from Theodore J. Cohn, Charles L. Remington, Lloyd Martin, Charles Hogue, Roy Snelling, and Julian Donahue. Collector abbreviations: CH = Chris Henne, OS = Oakley Shields, JFE = John F. Emmel, SLE = Scott Ellis, MT = Mike Toliver, SKD = Stanley Dvorak, RW = Ralph Wells, JB = James Brock. The roosting behavior records are as follows:

(1) July 14, 1969, ca. 5-6 road mi. WSW of Calif.-Nevada border along Calif. State Hwy. 167, 6700', T.3N., R.28E., Mono Co., Calif., leg. JFE & OS. 14 *Philotes rita* ssp. (clinal between *pallascens* and *elvira*), from 3:30-4:30 pm PST, mostly settled on plants in a head-down position, on *Eriogonum kearneyi* var. *kearneyi*; some ♂♂ collected flitting and settling in the upper parts of sage bushes.

- (2) August 21, 1969, 10 road mi. S. of junction hwy. 53 & 216, along hiway 53, Duchesne Co., Utah, *leg.* JFE & OS. Collected from 6:00-6:45 pm MST, sun down, twilight. Located roosting *P. battoides* ssp. (new), 13, perched on uppermost part of *Artemisia* and *Chrysothamnus* bushes in gullies dissecting a ridge where *E. corymbosum* var. *corymbosum* plentiful. When disturbed, they flew out. Several bushes with five to six *Philotes*, each. Same locality, Aug. 22nd, early morning, air humid, cool, mackerel sky. From 6:30-7:10 am MST, collected 32 *P. battoides*, nearly all perched head-down along upper stems (at tips of dried branches) of a small sage (one plant with six but most with two or one), facing either N. or S. with wings shut (6:30-7:00). At 7:00-7:10, the sun broke through and some specimens perched horizontally; when these were approached, they took flight, whereas the 6:30-7:00 individuals were mostly torpid except a few which dropped into these bushes when disturbed. Mostly in small gullies, but some scattered over the slope.
- (3) August 24, 1969, 8 road mi. NW past turnoff to Dugout Ranch, along road to Canyonlands Nat. Park, via Indian Creek State Park, San Juan Co., Utah, *leg.* JFE & OS. Collected from 5:40-6:10 pm MST, took 13 *P. rita* ssp. (new) around *E. leptocladon* var. *leptocladon* blooms, mostly ♂♂ seeking roosting sites (flew around vegetation, mostly other than *Eriogonum*, and sat head-down).
- (4) August 26, 1969, summit of road to 1½ mi. E., of Little Flat Top, 5500', T.26S., R.13E., ca. 10-11 mi. SE of Utah hiway 24, Emery Co., Utah, *leg.* JFE & OS. In the late afternoon, many *P. rita* ssp. (new) noted hanging up for night, ventral side toward the W., head-down, in plants mostly other than *Eriogonum* (*smithii* and *leptocladon*), especially sage, mostly on E. side of plants.
- (5) September 20, 1969, South Fork of Big Rock Creek, 4500', San Gabriel Mts., Los Angeles Co., Calif., *leg.* JFE, OS, CH. Found four ♀, one ♂ *P. enoptes* near *enoptes* sitting on flower-heads of *E. nudum* var. *pauciflorum* between 2:30-3:00 pm PST, canyon mostly in shadow. *Eriogonum* common in wash just above campground. Henne said these usually roost on flower-heads of the *Eriogonum*; all these taken were doing so and flip-flopped about or sat in the net after being netted, indicating they were lethargic.
- (6) June 28, 1970, 12.1 road mi. E. of junction hiway 33 & 150, 6.1 road mi. NW of junction Hwy. 150 & 126 (N. of Santa Paula along Hwy. 150), Ventura Co., Calif., *leg.* SKD & OS. Took a few *P. enoptes* ssp. (somewhat intermediate between *smithii* and *tildeni*) roosting on *Eriogonum parvifolium* var. *paynei*. Very little sun left. One *Eriogonum* with flowers still in bud, along the creek, had seven adults roosting on terminal branches in a cluster, all oriented to the N. with their broadsides to the sun, just catching the sun's rays, 5:00-5:30 pm PST.
- (7) July 3, 1970, 3 road mi. SSE of Hull Mtn. Lookout, along Boardman Ridge, Mendocino Nat. For., Lake-Glenn Co. line, Calif., *leg.* SKD & OS. One ♂, one ♀ *P. enoptes* ssp. (near *enoptes*) sitting perpendicular to the sun's rays (sun below horizon) on flower-heads of *E. nudum* var. *nudum* at 7:05 pm PST.
- (8) August 9, 1970, hillside ca. 1 mi. W. of Park Point Fire Lookout, Mesa Verde Nat. Park, Montezuma Co., Colo., *leg.* SLE & OS. Noted one *P. rita spaldingi* [new combination] perched head-down on a bloom of *E. racemosum*, apparently for the night, in late afternoon.
- (9) August 17, 1970, 10.8 road mi. NE of Cerrillos, along Hwy. 10, Santa Fe Co., New Mexico, *leg.* SLE & OS. One ♂, one ♀ *P. rita* (clinal between *rita rita* and *r. coloradensis*) on *E. effusum* var. *effusum*, sitting torpid on the blooms, 8:15-8:30 am MST.
- (10) August 18, 1970, 8.0 road mi. SW of junction Hwy. 197 & 44 (SW of Cuba), along

Hwy. 197, Sandoval Co., N.M., leg. SLE & OS. Collected from ca. 3:30-4:15 pm MST, took six *P. rita* (clinal between *rita rita* and *r. coloradensis*) alighting on *E. effusum* var. *effusum* mostly, for the night. A few on sage bushes along the road shoulder, especially between 4:00-4:15-♂♂ flying rapidly around sage along the hwy., probably seeking roost sites for the night. Also noted nine ♂ *Phyciodes campestris* perched on one sage bush right next to the hwy., at 4:15.

(11) August 19, 1970, 2.0 road mi. SW of junction of Hwy. 44 & 85, along Hwy. 85 (SW of Bernalillo), Sandoval Co., N.M., leg. SLE, OS, MT. Along the highway, found eight *P. rita* (clinal between *rita rita* and *r. coloradensis*) roosting on *E. effusum* var. *effusum* in gullies, from 5:20-5:40 pm MST.

(12) August 25, 1970, ca. 13-14 road mi. NE of Lordsburg, along Hwy. 90, Hidalgo Co., N.M., leg. SLE, OS, MT. Collected from 6:00-7:00 pm MST along road shoulder where the annual *E. polycladon* grew in dense stands in disturbed soil. Took 53 *P. rita rita* roosting, mostly on this *Eriogonum*. Roosting specimens perched with wing tips into the sun and at right angles to the sun's rays and could easily be spotted against the *Eriogonum*. Three *rita* specimens were taken roosting on *E. wrightii* var. *wrightii* plants along a gully.

(13) September 1, 1970, 7.7 to 8.1 road mi. ENE of Kayenta (from junction of Hwy. 464 & 164), Navajo Co., Arizona, leg. SLE & OS. Collected from ca. 6:15-7:30 pm MST, four ♂ *P. battoides* ssp. (new) roosting on bushes in gully within a pure stand of *E. corymbosum* var. *velutinum*. One ♀ *battoides* roosting on a mint, with *corymbosum* (rare) and *leptocladon* (common) in the area. Also three *P. rita* ssp. (new) roosting head-down in *E. leptocladon* var. *ramosissimum* in areas where no *corymbosum*. One ♀ *rita* roosting on an *Ephedra* sp. where *leptocladon* was common and *corymbosum* scarce. One ♂ *rita* found roosting on a *leptocladon* bush (6:35) in an area of *leptocladon* and *corymbosum* in a mixed stand.

(14) September 4, 1970, 1.5 road mi. SE of junction of Hwy. 128 & road to Castleton, along road to Castleton, Grand Co., Utah, leg. SLE & OS. Took five *P. battoides* ssp. (new) roosting on *E. corymbosum* var. *orbiculatum* plants or on *Atriplex* sp. in wash bottom during cool, overcast weather, midday.

(15) June 20, 1971, S. end of Stillwater Range, along Hwy. 50, 28-29 road mi. SE of Fallon, Churchill Co., Nev., leg. JB, OS, RW. In a dry wash a few *P. battoides* ssp. (near *martini* and *bernardino*) roosting on *E. heermanni* var. *humilius* in early am, bright, clear, calm, warm day. One ♂ was sitting on *heermanni* at 7:40 am PST, upper terminal branch on sun side of plant at the wash edge next to a hill with lots of *heermanni* scattered, mostly not in bloom. One ♀ roosted on a bush next to a *heermanni* (in a spot only just out of shadow). At 8:20 am PST tapped a fresh male *P. speciosa* from a *heermanni* plant in a draw with *Oxytheca perfoliata* plants fairly nearby. Area had recent rains and many annuals out. Same locality, July 3rd, found two worn ♂ *battoides* sitting head-down on terminal branch ends of small *heermanni* plants between 8:15-8:30 am PST. When one was disturbed, it flew about sluggishly and perched up on vegetation at the upper end 6-8X, as they do when choosing the night roost (very skittish). Also, one worn ♀ was flitting about and perching up at 9:00 am in the mouth of the draw where there was much sun (it seemed not yet "fully flighty").

(16) June 27, 1971, South Fork of Silver Creek, ca. 1 mi. E. (upstream) of Chicken Hawk Spring, ca 4 mi. W. of Ice House Store, 5000', El Dorado Co., Calif., leg. OS & RW. Coolish, partly cloudy. Nine ♀, 12 ♂ *P. enoptes enoptes* (missed two others) sitting on terminal branches of *E. nudum* var. *deductum* (almost all head-down, two or three head-up, all with wings tightly closed together and feet firmly grasping buds, perpendicular and broadside to the sun's rays, along roadside, between 9:05-10:07

am PST (only one was definitely on wing, though not fully active, at 10:12). Several flipped about lethargically in the net after capture, one started to fly when approached. Nearly all were fresh. Perhaps these *enoptes* withstood the major storm with heavy downpours yesterday, in this roost position. One ♀ roosting on a *Ceanothus* tip next to *nudum* at 9:05 am PST.

The only report of possible tending ants on *Philotes* larvae I have been able to find is that of Opler (1968) for *Iridomyrmex humilis* Mayr on *Philotes enoptes bayensis*. However, he states that the relationship may have been fortuitous since they were only observed in close proximity to each other and not in direct contact. Below are some records obtained during the course of field work on the genus *Philotes*. All were collected by John F. Emmel and O. Shields unless otherwise noted. Roy R. Snelling identified the ant species and the coccinellids; these are deposited at the Los Angeles County Museum (Natural History). (According to Snelling, ants are best preserved in 70-75% ethanol.) The *Philotes* material is currently in the Shields' Study Collection, later to go to the Allyn Museum Collection.

The tending ant records are as follows:

- (1) May 6, 1969, vicinity of Briceburg, Mariposa Co., Calif., leg. N. La Due & O. Shields. Numerous *Philotes sonorensis* larvae (ca. 50) were found mining the succulent leaves of *Dudleya cymosa*, ranging from second to fifth instars. Tending ants, *Tapinoma sessile* (Say), were commonly crawling over *Dudleya* plants and on the larger larvae inside the leaves. Newcomer (1912) implied that certain species such as *Philotes sonorensis* that feed within thick leaves may not be tended by ants, but these observations do not support this.
- (2) July 8, 1969, 5 road mi. W. of Five Mile Spring, on U.S. Hwy. 6, 6400', at S. end of Monitor Range, NW ¼ of T.3N., R.47E., Nye Co., Nevada. Many larvae of *Philotes enoptes* near *ancilla* (none reared successfully, but this is the common species on *E. umbellatum* to the north in the Toiyabe Range) were taken on flowers of *Eriogonum umbellatum* var. *umbellatum*. Two species of ants, *Crematogaster mormonum* Emery and *Formica neogagates* Emery, were helpful in locating larvae on the plants. These ants also attended aphids and mealy bugs on the flowers. The tending ants "stroked" the larvae with their antennae and kept returning to the larvae.
- (3) July 14, 1969, Cottonwood Canyon, 7300', S. of Bodie, Mono Co., Calif. Many *Philotes battoides glaucon* larvae (ca. 25-30), third to fifth instar, taken on flowers of *E. umbellatum* var. *umbellatum*, with a small black ant, *Tapinoma sessile* (Say), "tending" the larvae (antennal stroking, walking over larva). No adults reared, but *P. b. glaucon* flies abundantly here on the *umbellatum* about a month earlier.
- (4) July 29, 1969, sand dunes 1 miles S. of Blind Spring, 5800', SE end of Baking Powder Flat, W. of Snake Range, T.11N., R.67E., White Pine Co., Nevada. Eight *Philotes battoides* ssp. (new) larvae found on *Eriogonum shockleyi* ssp. *longilobum* flowers; all were fifth instar although unusually small for *Philotes*. Three tending ants, *Formica obtusopilosa* Emery, were noted; these ants also commonly fed on the flowers. One adult *Philotes* male was dissected from the pupa and genitally determined.
- (5) August 2, 1969, NW corner of T.9N., R.58E., sand flats, 7 road mi. S. of Current, 5000', on dirt road to Nyala, Railroad Valley, NE corner of Nye Co., Nevada. Many *Philotes rita pallescens* larvae collected on *Eriogonum kearneyi* var. *kearneyi* flowers, ca. third to fifth instars, initially found by watching the tending ants! Three species of ants were involved, *Dorymyrmex pyramicus* (Roger), *Camponotus nearcticus* Emery, and *Myrmecocystus kennedyi* Cole. These ants walked up and down the *Eriogonum* stems and also fed in the flowers (only one mealy bug and one

aphid colony noted). The ants tended even the small *rita* larvae. Adult *rita* were common here on this date and about a month earlier, and several were reared from the larvae.

(6) September 8, 1969, corner of Binder & Whiting Streets, El Segundo, Los Angeles Co., Calif. Larvae of *Philotes battoides* ssp. (new) on flowers of *Eriogonum parvifolium* var. *parvifolium* were commonly tended by *Iridomyrmex humilis* (Andre). Several adult *Philotes* reared.

A parasite was obtained from *Philotes sonorensis* larvae and determined by E. E. Grissell, UC Davis, as *Euderus*, a species near *lividus* (Ashmead) (Hymenoptera: Eulophidae). Nine specimens were obtained, three are with K. Yoshimoto (Canadian Dept. Agr.), and six are in the UC Davis entomology collection. The localities were: Briceburg, Mariposa Co., Calif., from larvae of *sonorensis* collected on May 6, 1969; parasites emerged from a 4th instar *sonorensis* larva on May 7 and pupated ca. May 10; another batch emerged from a shriveled larva on ca. May 14. 4 mi. N. of Placerville, South Fork of American River, on road to Georgetown, El Dorado Co., Calif., larvae of *sonorensis* collected May 4, 1969, leg. R. F. Denno & O. Shields; parasite ex dead *sonorensis* larva, noted as pupa on May 14, noted as adult on May 25, one specimen. "The biological records of the Nearctic *Euderus* indicate that most species are host specific on pupae of leaf tying, leaf mining, twig and fruit boring Lepidoptera, stem boring Coleoptera, and gall making Hymenoptera. Others show hyperparasitism on other Hymenoptera and have a diversity in host preference" (Yoshimoto, 1971: 542).

Rarely adult *Philotes* have square chips out of the wing edge, sometimes on both sides, or a line across the wing with no scales (in line with a chip), perhaps indicative of bird and/or lizard predation. Old wings of a *Philotes enoptes* near *ancilla* were found in a spider web on *Eriogonum umbellatum* var. *umbellatum*, July 11, 1969, south & west facing slopes of Victorine Canyon, 8000-10,000', S. side of Bunker Hill, Toiyabe Range, Lander Co., Nevada. On February 20, 1972, ca. 3 mi. NE of Auburn, Placer Co., Calif., leg. O. Shields, J. Mori, S. Sims, & R. Wells, we found a *sonorensis* adult caught in a small web by the tip of the wing. It fluttered for about two hours before finally breaking loose, then sat resting on a weed head for 15 minutes. The spider in the web was an orb weaver, *Cyclosa* sp. (Araneidae), determined by L. Vincent and K. Yeargan, UC Davis. One ♀ *P. enoptes dammersi* was found floating on the surface of a small pool, September 10, 1969, ½ mi. S. of Cove Spring, Granite Mts., SW of Providence Mts., San Bernardino Co., Calif. On August 8, 1969, W. end of Dana Plateau, above Tioga Pass, 11,000-11,400', Mono Co., Calif., a dead *Philotes battoides battoides* female was dragged across the ground by an ant, *Formica* sp., *fusca* group. (Snelling's notes say, "Specimen is broken and I cannot give a name with certainty. Seems nearest *F. fusca* Linné.") A possible predator of the *P. rita pallescens* larvae from the Aug. 2, 1969, Currant, Nevada, locality are two species of coccinellids, *Hippodamia convergens* Guerin and *H. quinquesignata* Kirby; a few larvae and adults of these beetles were noticed crawling over the *Eriogonum kearneyi* stems.

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