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STUDIES ON NORTH AMERICAN PHILOTES (LYCAENIDAE)

III. Generic reassignments and the biology of *speciosa*

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GENERIC REASSIGNMENTS

Based on male genitalia, a heterogenous group of species exist within the Nearctic genus "*Philotes*". New generic assignments are hereby proposed. The most current opinion (Brown, 1972) that *Philotes* Scudder should be placed in the western Palearctic genus *Pseudophilotes* Beuret is unfortunately a mistranslation of Beuret (1958), who actually suggested that the eastern Palearctic genus *Shijimiaeoides* Beuret of the Glaucopsychni links the male genitalia of the *P. rita-enoptes* group and *S. divina* Fixs. (the adult facies are also similar). The long-term association of Nearctic *Philotes* with the European *Pseudophilotes* (*baton*, *vicrama*, *abencerragus*) by various workers I feel is in error, as the male valve features do not resemble the *rita-enoptes* or *battoides* groups in the slightest (despite an otherwise close resemblance in adult morphology; see the genitalia figures in Hemming, 1929). *Shijimiaeoides divina* flies in Japan and Korea in June. In Japan, the *S. divina barine* Leech myrmecophilous larvae feed on flowers or fruits of *Sophora* L. (Leguminosae); it is single-brooded and hibernates as a pupa (Iwase, 1954). *Pseudophilotes vicrama*'s larval foodplant is *Thymus* (Wiltshire, 1957). In the Atlas Mts. of Morocco, "*Philotes*" *bavius fatma* feeds on *Salvia* (also in the Labiatae) (Wyatt, 1956). In contrast, the North American species feed on Polygonaceae and Crassulaceae.

In my opinion, *battoides* male genitalia do not closely resemble any of the *Pseudophilotes*, although Mattoni (1954) believes it is "a closer relative to the European section of the genus than to *P. enoptes*." The male valve configuration of *battoides* perhaps remotely resembles the South African *Azanus* Moore (*isis* Drury and *natalensis* Trimen), although the adults and immatures are only faintly reminiscent. Other African genera (*Triclema*, *Cooksonia*, *Telipna*) also have male valvae resembling *battoides* in gross structure. However, a *battoides*-type of bifurcate valvae appears in the genus *Caleta* Fruhstorfer of the Lampidinae from the Oriental region (see Eliot, 1973: figs. 83, 85 [*C. decidia*

(Hewitson) and *C. mindarus* (Felder)], although again the adult facies are rather distant to *battoides*. Still, *Caleta* appears to be the closest genus in male genitalia; *battoides* is hereby tentatively placed within it.

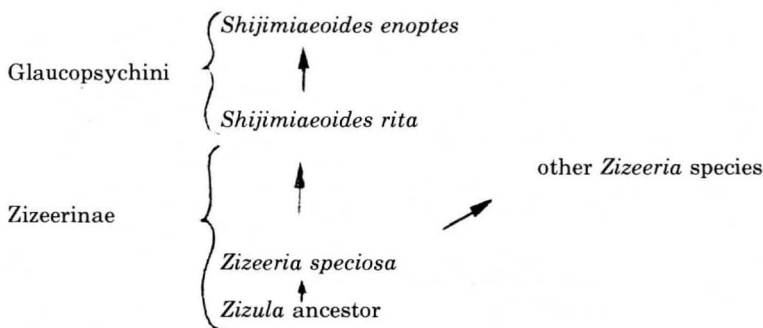
The species *speciosa* appears closest to *Zizeeria* Chapman (especially *karsandra* and *knysna*) in features of the male genitalia (see Chapman, 1910; Beuret, 1955), and in egg and larval characters *speciosa* is much like *Zizula* Chapman, both in the Zizeerinae. *Zizeeria speciosa* appears to occupy a unique phylogenetic position, residing at an intermediate stage between *Zizula* (immatures) and *Zizeeria* (adults). It differs from the other *Zizeeria* in having a high valve teeth number and cristae present; in these respects the male genitalia closely approach *rita*, only on a miniature scale. I consider *speciosa* to be the most primitive member of the genus *Zizeeria*. It differs from *Zizeeria* (as described in Stempffer, 1967) in lacking short, very fine hair on the eyes, but otherwise it agrees closely in details of antennae, legs, and wing shape.

Certainly a most confusing element in properly placing the species within "*Philotes*" has been the ventral maculation and color resemblances between *rita-enoptes* and *battoides*, probably due to convergence or a mimicry complex. Lumping the dissimilar species *sonorensis* and *speciosa* into this same genus was perhaps a matter of not knowing quite where else to put them, historically.

In summary, the following generic assignments are proposed for Nearctic *Philotes*:

Philotes sonorensis
Zizeeria speciosa
Shijimiaeoides rita
Shijimiaeoides enoptes
Caleta battoides

A partial phylogeny:



Beuret (1955) says *Zizeeria* extends from Australia and Indonesia to a large part of Asia, and nearly all of Africa (previously unknown from the New World). (He figures the male genitalia of *Z. karsandra* and *Z. knysna*.) I do not know if the route of migration was from the eastern or the western side of the Old World, for the nearest *speciosa* relative. Clench (1963: 266) believes the New World *Zizula cyna* Edw. is more closely related to *Z. gaika* Trimen populations from eastern Asia than to those from Africa. Likewise, western U.S. *rita-enoptes* find their nearest relative in *Shijimiaeoides divina* from Japan and Korea. The same holds for *battoides* and the Oriental *Caleta*. *Philotes sonorensis* and *Turanana cytis* (see Shields, 1973) could be linked via an Atlantic or Pacific migration route. By either route, a continental separation by sea-floor spreading in Late Jurassic-Early Cretaceous appears likely (Shields, 1974).

Sound-producing organs (which may aid in making taxonomic decisions)

have been found in the pupae of *speciosa*, *rita*, *enoptes mohave*, *Zizeeria labradus*, and *Zizina otis labradus* (Downey, 1966; Downey & Allyn, 1973). Originally, Downey (1966, 1967) has reported that *Philotes* was one of the few lycaenid genera to lack the sound producing structures. In the 1973 paper he and Allyn conclude that the "tooth-cast system" of *speciosa*, *rita*, and *enoptes mohave* is presumably not involved in sound production, although stating that "there is both an actual and a potential relationship of these structures to stridulating devices."

BIOLOGY AND EVOLUTION OF *ZIZEERIA SPECIOSA*

Adult Habits

Charles Sekerman (1973, *in litt.*) states that Dr. John McBurney has observed *speciosa* near Red Mountain, San Bernardino Co., over a 5-year period, where it is on wing only after good rains. During dry winters and springs, he has not taken any in this area. When *speciosa* was out, he usually collected them during the first two weeks of April. In 1973, an unusually wet year, they were taken from April 19 through May 12 by Sekerman and McBurney (approx. several hundred). Adults there seem to prefer flying in washes and land on flowers if present. Both sexes when found near their larval foodplant seem to prefer the flat areas of small hills. Dr. John S. Garth (*in litt.*) reports *speciosa* 25.5 mi. E. of Mojave, Kern Co., IV-23-26 (1♂ 3♀), "flying close to the ground over a field of small poppy-like flowers that sloped gradually toward a large, dome-shaped butte."

J. F. Emmel and I at Lone Mtn., Lovelock, Nev., V-24-70, found 2 fresh ♂♂ *speciosa* territorial at the bases of small ravines, and 2 ♀♀ were seen near the summit of one shoulder flying around *Oxytheca perfoliata* plants (det. by Reveal, *Shields #84*). About 10 eggs were found, all apparently newly laid, in early afternoon.

One pair of *speciosa* in the CIS Collection from Darwin, Inyo Co., V-12-69 (P. A. Opler), is labelled, "copulation [on] bush, 1:30 pm PDT."

John Lane (*in litt.*) states that he and Keith Hughes took *speciosa bohartorum* ♂♂ sparingly in April and May at Briceburg, Mariposa Co., at moist sand along the banks of the Merced River or flying down the slope toward the water. The flight was weak and low, ca. ½ to 1 foot off the ground. The only ♀ taken was apparently roosting on a dry stem at the base of the rocks of a gully, at ca. 10 am.

Larval Foodplants

Thorne (1961) records the larval foodplants of *speciosa* as *Oxytheca perfoliata* T. & G. and *Eriogonum reniforme* Torr. & Frem., and perhaps *Oxytheca trilobata* Gray. Various collectors note that *O. perfoliata* is common at Kramer Hills and 22 mi. NNE of Mojave where *speciosa* flies in good numbers. At the south end of the Stillwater Range, along Hwy. 50, 28-29 road mi. SE of Fallon, Churchill Co., Nev., VI-20-71 (J. Brock, O. Shields, R. Wells), we found *Oxytheca perfoliata* (*Shields #198*) plants, ca. 10-15, growing in a wash, two with *speciosa* eggs on the uppersides of terminal leaves. One was hatched, and the other had a first instar larva inside; a roosting adult was also taken nearby. By VII-3 the *Oxytheca* were drying out (leaves leathery though still "green"). In Arizona, *O. perfoliata* occurs in the vicinity of Lake Meade, Kingman, Ft. Mohave, and Chloride, all in Mohave Co. (herbarium records). Several promising localities are 11 road mi. E. of Corn Creek Guard Station, Clark Co., Nev., and E. of the Kingston Range on Excelsior Mine Rd., San Bernardino Co., Calif., where *O. perfoliata* is abundant (J. Emmel & O. Shields).

Carl Goodpasture noted a ♀ *speciosa* in abdominal probing on flowers of *Eriogonum reniforme* (*Shields #67*) along Hwy. 80 near San Diego Co. border, Imperial Co., III-26-70. The same plant was pressed to insure an accurate identification. Fred Thorne reports finding 10 larvae up to ¼" in length on *E. reniforme* in small sandy rivulets, 2 mi. W. of Christmas Circle, Borrego Valley, San Diego

Co., IV-26-70, on the open desert.

Although Pusateri (1963) lists *O. perfoliata* in his flora of Sierran National Parks as "occasionally found in valley and lower foothills," a careful search of *speciosa bohartorum*'s habitat at Briceburg by myself, John Lane, and Keith Hughes did not uncover this species, and Dr. James Reveal says he has no records from there. However, *Chorizanthe membranacea* Benth. (Shields #87) grows there rather commonly, and we believe it to be a good possibility as a food-plant for *bohartorum* since it is closely allied to *Eriogonum* and *Oxytheca* and since both these genera appear to be absent at Briceburg.

James Reveal (oral comm., XII-12-72) states that the range of *Oxytheca perfoliata* is from SE California and extreme northern Baja California eastward across southern Nevada (S. Nye Co.) to SW Utah (i.e. Washington Co.) and NW Arizona (i.e. Mojave Co.); and the range of *Eriogonum reniforme* from SE California eastward across southern Nevada (S. Nye and Clark Co.) to scattered locations in S. Mojave Co. and Yuma Co., Arizona; also in N. Baja Calif. and NW Sonora Mexico (See also Reveal, 1969).

LARVAL FOODPLANTS OF PROBABLE *SPECIOSA* RELATIVES

(This Table drawn from the following sources: Comstock, 1966, Corbet & Pendlebury, 1956; Dickson, 1965; Iwase, 1954, 1964; Marsh, 1968; de Niceville, 1900; Platt, 1921; Sevastopulo, 1944; Waterhouse, 1932; Wynter-Blyth, 1957)

Zizeeria

- 1) *Zizeeria antanossa* on *Indigofera* species (Leguminosae) [South Africa].
- 2) *Zizeeria gaika* on *Nelsonia campestris* (Scrophulariaceae or Acanthaceae) & *Strobilanthes?* (Acanthaceae), vetches (Leguminosae), *Oxalis corniculata* (Oxalidaceae), *Lantana* (Verbenaceae) [India, South Africa].
- 3) *Zizeeria knysna* on *Amaranthus ascendens* & *A. spinosus* (Amaranthaceae), *Zornia diphylla* (Leguminosae) [Ryukyu Islands, Malay Pen.].
- 4) *Zizeeria labradus* on "clover, lucerne, and many pea-like flowers", *Desmodium umbellatum*, *Indigofera anil*, *Phaseolus adenanthus*, *Vigna catiang* (all Leguminosae) [Australia, Samoa].
- 5) *Zizeeria lysimon* on *Amaranthus viridis* (Amaranthaceae), *Zornia diphylla* (Leguminosae) [India].
- 6) *Zizeeria maha* on *Nelsonia* (Scrophulariaceae or Acanthaceae), *Strobilanthes* (Acanthaceae), *Oxalis corniculata* (Oxalidaceae), *Tephrosia pauciflora* (Leguminosae) [India, Japan, Ryukyu Islands, Hong Kong].
- 7) *Zizeeria trochilus* on *Heliotropum strigosum* (Boraginaceae); *Lotus*. Indigo, pea pods, vetches, *Rhynchosia minima* (all Leguminosae) [India].

Zizina

- 8) *Zizina otis* on *Alysicarpus vaginalis*, *Indigofera*, *Kummerowia striata*, *Lepedeza cuneata*, *Lotus*, *Melilotus suaveolens*, *Mimosa pudica*, *Sesbania aculeata*, *Vigna marina*, *Zornia diphylla* (all Leguminosae) [India, Japan, Ryukyu Islands, Malay Pen., Hong Kong].

Zizula

- 9) *Zizula hylax* on *Chaetacanthus setiger*, *Dyschoriste*, *Phaulopsis imbricata* (all Acanthaceae) [South Africa].

Takhtajan (1969) states that Caryophyllales (Amaranthaceae) is closely linked with Polygonales (Polygonaceae). This would mean that *Zizeeria knysna* and *lysimon*, on the basis of foodplant relationships, would be close to *Zizeeria*

speciosa. Beuret's (1955) drawings of ♂ valve of *knysna* closely approach *speciosa*, as well. The above species pair of *Zizeeria gaika* and *maha* on Acanthaceae and Oxalidaceae suggests a possible link between these two families, although Takhtajan places the families far apart. Takhtajan further says that Geraniales (Oxalidaceae) and Rutales-Saxifragales are related, which are close to Fabales (Leguminosae). A major radiation of *Zizeeria* (at least 6 species) appears to have taken place on Leguminosae.

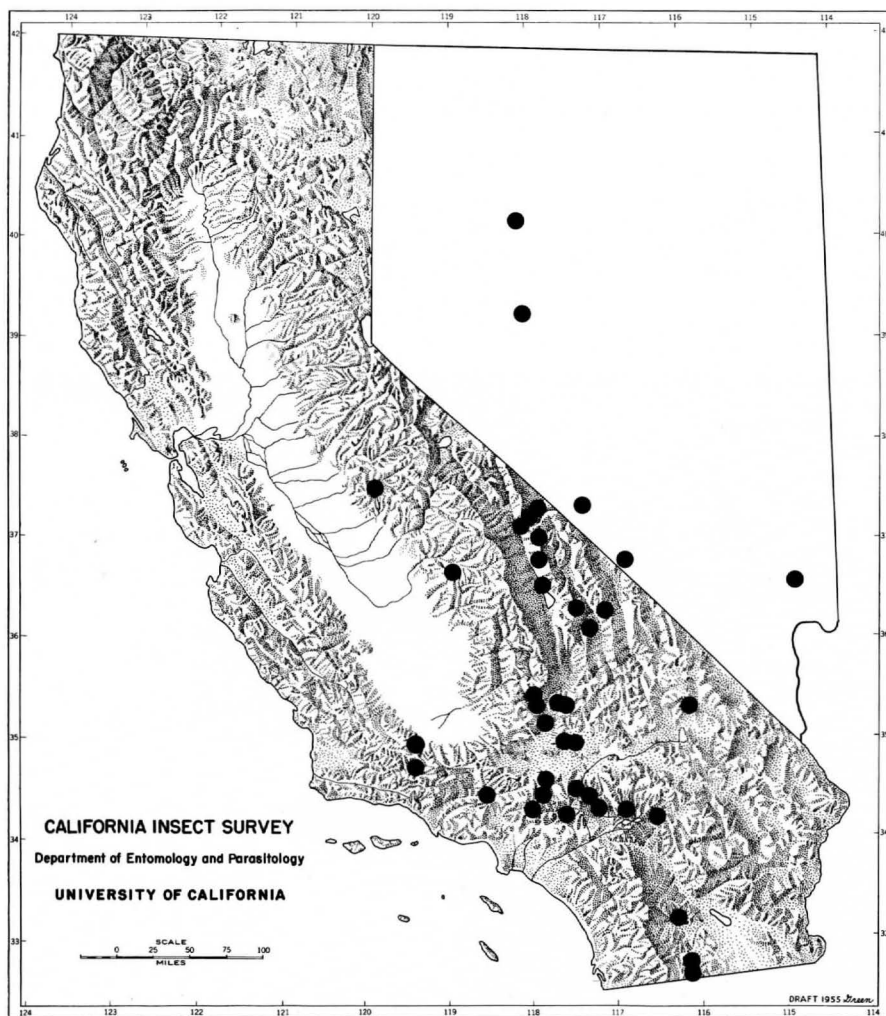


Fig. 1. Distribution of *Zizeeria speciosa*.

Nectar Sources

Zizula hylax (F.) adults in the Gombe Reserve, Lake Tanganyika, Tanzania, visit *Asystasia gangetica* (L.) T. Anderson (Acanthaceae; Scropulariales) by crawling deep into the corolla tube (Ehrlich & Ehrlich, 1972). At 2 road mi. SW of Westgard Pass, Hwy. 188, White Mts., Inyo Co., Calif., VII-8-71, Paul Rude found a ♂ *Z. speciosa* sitting on a *Phlox* sp. (Polemoniaceae; Polemoniales) in a wash bottom at 12:35 pm PST. Takhtajan (1969) feels that Scropulariales is "very near to the Polemoniales, with which they had a common origin."

Life History

Comstock (1930, 1932) gives a life history description and drawings of immatures of *speciosa* (see also Emmel & Emmel, 1973). Figures 2 and 3 compare the micropylar regions of *Z. speciosa* and *S. enoptes*.

Distribution

CALIFORNIA. *Imperial County:* Coyote Wells, 2♂ 1♀, iii (EW). Devils Canyon, ca. 1000', westbound leg of Hwy. 8, many, ii-iv- (FT). In Ko Pah Gorge, 1000', ca. 12 mi. E. of Jacumba, many, iii-iv (os, RL, FT, RF, LACM, PO, CAS, CIS, KH). *Inyo County:* Argus Mts., 1♀, v (LACM). 4 mi. E. of Big Pine, 3♂, v (CIS). Darwin, 8♂ 1♀, v (CIS). 4 mi. N. of Darwin, ♂, v (CIS). Gilbert Pass, 4♂ 2♀, v (RL). Inyo Mts., 6500'. 15 mi. NE of Independence, 1♂ 1♀, v (CIS). Lone Pine, 1♀, v (RL).

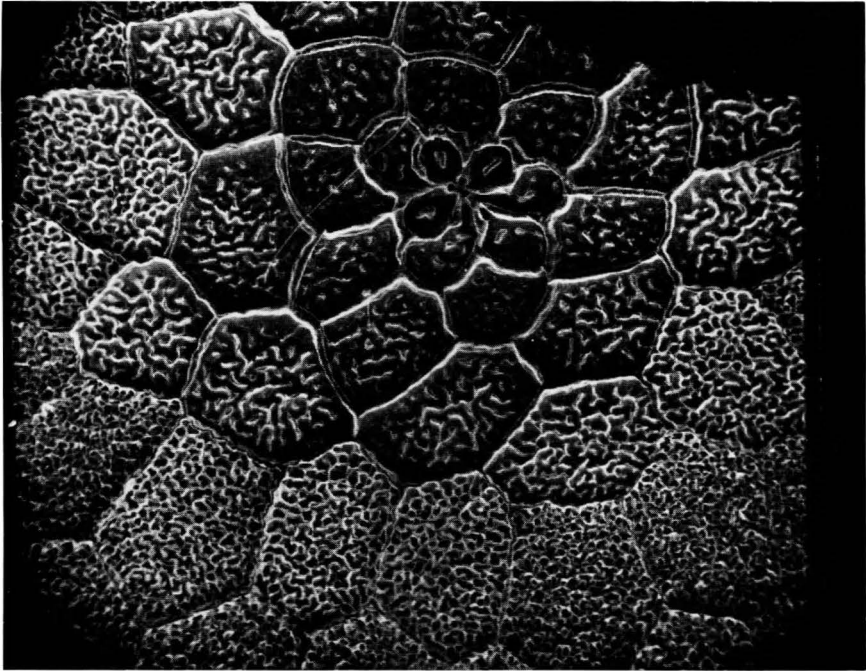


Fig. 2. Egg micropylar region of *Z. speciosa* from Lone Mtn., Lovelock, Nev., approx. 700X, SEM photo (courtesy C. Goodpasture).

Mazourka Canyon, 8 mi. NE of Independence, 34♂ 13♀, v (AM, CIS). Tuttle Canyon Road, Alabama Hills, W. of Lone Pine, 1♂, iv (RL). Waucoba Canyon, 6000', 16 mi. SE of Saline Valley Junction, 5♂ 1♀, v (GG). Westgard Pass, Lower Payson Canyon, 6000', 2♂, v (DB). Westgard Pass, west side, 5500', 1♂, v (DB). 2.0 road mi. SW of Westgard Pass, Hwy. 188, 1♂, vii (OS). Wild Rose Canyon, 5500', Panamint Mts., 3♂, v (DB). 4 mi. E. of Wildrose Station, 3♂, v (CIS). *Kern County*: Near Cantil, 22 mi. NE of Mojave, 2000', 18♂ 11♀, iv (AM, FT, OS, RL). Johannesburg (Haskin, 1915). 22 mi. E. of Mojave, on the old Randsburg Road, 2♂, IV (JG). 25.5 mi. E. of Mojave, on the old Randsburg Road, 1♂ 3♀, iv (JG). 30 mi. E. of Mojave, 3♂ 1♀, iv (AM). 22 mi. N. of Mojave, Randsburg Road, 2♀, iii (JL). Randsburg, 15♂ 10♀ iv (LACM, CAS, MCZ, UW, RL). N. end Red Rock Canyon, 1♂ 1♀, iv (RL). 4 mi. N. of Red Rock Canyon, 1♂, v (CIS). *Los Angeles County*: Chilao Creek, San Gabriel Mts., ca. 5500', 1♂, v (CH). Juniper Hills, 3700', Mojave Desert, 1♂, v (CH). Mint Canyon, 1♀, v (LACM); 2♂, v (Friday, in Gunder, 1930). 5 mi NE of Pearblossom, Lovejoy Buttes, 2♂, iv (CAS, CIS). 2 mi. NW of Valyermo, 1♂, v (CIS). *Mariposa County*: Briceburg, 4♂ 1♀, iv-vi (CAS, RL, JL, OS). Ca. 1 mi. S. of Mariposa, 1♂ v (CAS). *San Bernardino County*: 9.6 mi. N. of Adelanto, 2700', 4♂, v (CH). Apple Valley, 1♀, v (RL). 19 mi. NE of Baker, 4♂, v (CAS, CIS), 5 mi. S. of Beechers Corners, Kramer Hills, 2♂, iv (CAS, CIS). Box S Ranch, on road from Victorville to Warren's Well at Big Bear Lake turnoff, 1♀, v (LACM). Kramer Hills, 2900-3000', 28 mi. NNW of Victorville, 72♂ 58♀, iv-v (FT, LACM, OS). Kramer Junction (Beechers Corner), 20♂ 30♀, iv-v (LACM, KH, CH). 11 mi. E. of Kramer Junction, 2♂, iv (CIS, CAS). Lucerne Valley, 1♂, iv (FT). Oro Grande, 2625', 1♂, iv (CH). Phelan area, iv (in Remington, 1950). S. of Rabbit Dry Lake, in the Lucerne Valley, "2", iv (RL). Randsburg, 1♀, iv (CIS). Red Mountain, 1♀, v (RL). Rock Corral, nr. Lucerne Valley,

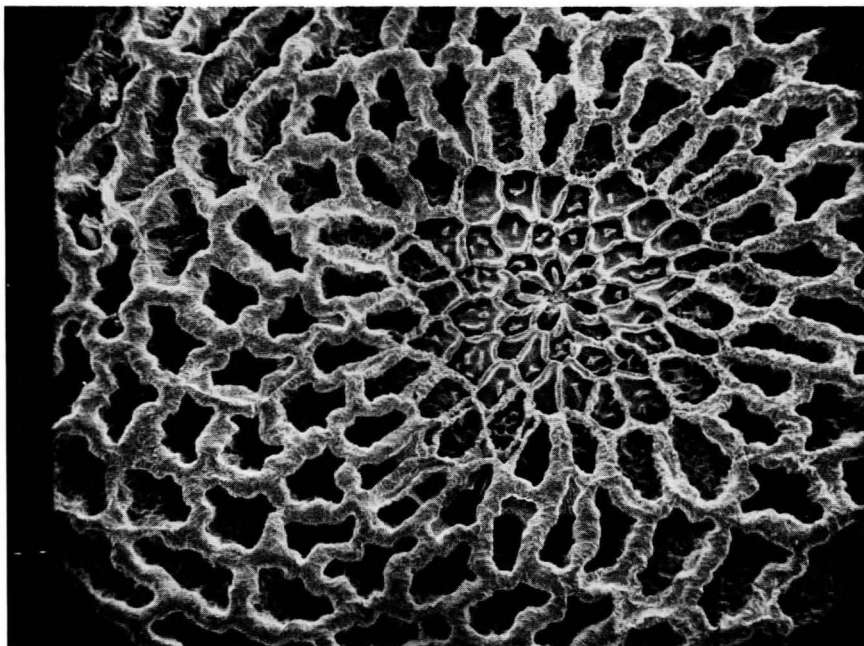


Fig. 3. Micropyle and dorsal surface of *Shijimiaeooides enoptes* egg from 2 mi. E. of Emigrant Gap, Placer Co., Calif., approx. 500X, SEM photo (courtesy C. Goodpasture).

1♂ 1♀, iv (JL, CS). *San Diego County*: Borrego Springs, 2♀, iii-iv (FT, CAS). N. across the road from Sun & Plunge trailer park, ca. 2 mi. W. of Christmas Circle, Borrego Valley, 10 larvae, iv (FT). Mountain Palm Canyon, ca. 900', 4 mi. NW of Sweeney Pass, "abundant", iii-iv (FT). Sweeney Pass, ca. 900', 15 mi. N. of Jacumba, "some", iii-iv (RL, FT). *Tulare County*: on the road to Hume Lake, 6000', General Grant National Park, 1♀, vii (JG). *Ventura County*: Quatal Canyon, NE Ventura Co., 1♂, iv (CIS). *County undetermined*: Mojave Desert, 78♂ 60♀, iv-v (MCZ, LACM, CAS, AM, YU, CIS, JL). "Koebele Collection, Apr.", 1♂ (CAS).

NEVADA. *Clark County*: Arrowhead Canyon Range, 1♂, v (NSM). *Churchill County*: N. end Sand Springs Range, 5 mi. W. of Frenchman, 2♂, v-vi (DB). S. end Stillwater Range, along Hwy. 50, 28-29 road mi. SE of Fallon, 1♂, vi (OS). *Esmeralda County*: St. Hwy. 3, 5 mi. E. of Lida, 5♂ 2♀, v (DB). *Nye County*: Armagosa Desert, W. of Beatty, 11♂ 2♀, v (DB). Armagosa Desert, 6 mi. W. of Beatty, 7♂, v (DB). Armagosa Desert, W. side S. of Hwy. 58, 6♂, iv (OS). *Pershing County*: S. slope of Lone Mtn., 4200-4674', WNW of Lovelock, T.27N., R.31E., 2♂ (OS).

Zizeeria speciosa collected by J. A. Comstock labelled "Mojave Desert", April 15-18, 1923, and May 12, 1924, some 126 specimens, came from approx. 20-24 mi. NE of Mojave, Kern Co. Lloyd Martin (letter dated II-25-71) says that Comstock showed him, George Rawson, and C. M. Dammers this locality, where it was found quite commonly in the dry washes.

It would appear that isolated *speciosa* localities like Mariposa and Briceburg, Hume Lake, Quatal Canyon, and Chilao Creek are relictual populations rather than stray-dispersal from the desert, although gusty winds may disperse colonies on the desert proper. I believe *speciosa bohartorum* (Tilden, 1967) to be a valid name. *Z. speciosa speciosa* remains rather constant otherwise in size and markings throughout its range, except that ♀♀ vary from a deep brown or black ground color to a lighter brown.

Flight Season

Z. speciosa's flight period at the In Ko Pah region, Imperial Co., Calif., in 1960 was 19 days, and at Kramer Jct., San Bernardino Co., Calif., in 1935 was 24 days. Thus, it is probably on wing for approx. 3-4 weeks. The flight range of *Z. speciosa* (sum of all years): San Diego and Imperial Cos. = mid March to mid April (III-8 to IV-10), Kern Co. = late March to early May, San Bernardino Co., = early April to late May, Inyo Co. = May primarily (extremes = IV-9, VIII-8), and Mariposa Co. = mid April to early June.

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BIBLIOGRAPHY

- Beuret, H., 1955. *Zizeeria karsandra* Moore in Europa und die systematische Stellung der Zizeerinae (Lepidoptera, Lycaenidae). *Mitteilungen der Entomologischen Gesellschaft Basel*, 5(9): 123-130, 146.
- Beuret, H., 1958. Zur systematischen Stellung einiger wenig bekannter Glaucoptychidi (Lep., Lycaenidae). *Mitteilungen der Entomologischen Gesellschaft Basel*, 8(6): 61-79, 81-100.
- Brown, F. M., 1972. *Pseudophilotes* Beuret, 1958. *J. Lepid. Soc.*, 26: 111.
- Chapman, T. A., 1910. On *Zizeeria* (Chapman), *Zizera* (Moore), a group of lycaenid butterflies. *Trans. Ent. Soc. Lond.*, 58: 479-497, pls. LI-LX.
- Clench, H. K., 1963. A synopsis of the West Indian Lycaenidae, with remarks on their zoogeography. *J. Res. Lepid.*, 2: 247-270.

- Comstock, J. A., 1930. Studies in Pacific Coast Lepidoptera (Continued). *Bull. So. Calif. Acad. Sci.*, 29: 22-31 (p. 23).
- Comstock, J. A., 1932. The metamorphosis of six California Lepidoptera. *Bull. So. Calif. Acad. Sci.*, 31: 88-100.
- Comstock, J. A., 1966. Lepidoptera of American Samoa with particular reference to biology and ecology. *Pacific Insects Monograph* 11: 1-74.
- Corbet, A. S., & H. M. Pendlebury, 1956. *The butterflies of the Malay Peninsula*. Oliver & Boyd, London: 537 p., 55 pls.
- Dickson, C. G. C., 1965. Recently observed food-plants of some South African lepidopterous larvae. *J. Ent. Soc. So. Africa*, 28: 11-20.
- Downey, J. C., 1966. Sound production in pupae of Lycaenidae. *J. Lepid. Soc.*, 20: 129-155.
- Downey, J. C., 1967. Sound-production in Netherland Lycaenidae. *Ent. Berichten*, 27: 153-157.
- Downey, J. C., & A. C. Allyn, 1973. Butterfly ultrastructure. 1. Sound production and associated abdominal structures in pupae of Lycaenidae and Riodinidae. *Bull. Allyn Mus.*, (14), 47 p.
- Ehrlich, P. R., & A. H. Ehrlich, 1972. Wing-shape and adult resources in lycaenids. *J. Lepid. Soc.*, 26: 196-197.
- Eliot, J. N., 1973. The higher classification of the Lycaenidae (Lepidoptera): a tentative arrangement. *Bull. British Mus. (Nat. Hist.), Ent.*, 28: 371-505.
- Emmel, T. C., & J. F. Emmel, 1973. The butterflies of Southern California. *Nat. Hist. Mus. Los Angeles County, Science Ser.*, 26: 1-148.
- Gunder, J. D., 1930. Butterflies of Los Angeles County, California. *Bull. So., Calif. Acad. Sci.*, 29: 39-95.
- Haskin, J. R., 1915. Some rare California butterflies. *Ent. News*, 26: 424-425.
- Hemming, A. F., 1929. Revision of the *baton* group of the genus *Turanana* Bethune-Baker, with an account of an unrecognized species, *T. vicrama* Moore. *The Entomol.*, 62: 27-34, 60-64, 84-89.
- Iwase, T., 1954. Synopsis of the known life-histories of Japanese butterflies. *Lepid. News*, 8: 95-100.
- Iwase, T., 1964. Recent foodplant records of the Loochooan butterflies. *J. Lepid. Soc.*, 18: 105-109.
- Marsh, J. C. S., 1968. *Hong Kong butterflies*. Publ. by the Shell Company of Hong Kong Ltd., Hong Kong: 113 p.
- Mattoni, R. H. T., 1954. (Abstract) Taxonomy and distribution in the genus *Philotes*. *Lepid. News.*, 8:8.
- de Niceville, L., 1900. The food-plants of the butterflies of the Kanara District of the Bombay Presidency, with a revision of the species of butterflies there occurring. *J. Asiatic Soc. Bengal*, 69: 187-278.
- Platt, E. E., 1921. List of foodplants of some South African lepidopterous larvae. *So. African J. Nat. Hist.*, 3: 65-138.
- Pusateri, S. J., 1963. *Flora of our Sierran National Parks: Yosemite-Sequoia and Kings Canyon*. Carl & Irving Printers; Tulare, Calif.: 170 p.
- Reveal, J. L., 1969. A revision of the genus *Eriogonum* (Polygonaceae). Ph. D. dissertation, Brigham Young Univ. (Libr. Congr. Card No. Misc. 70-4714), *Univ. Microfilms*, Ann Arbor, Michigan.
- Sevastopulo, D. G., 1944. Substitute food-plants. *Ent. Rec.*, 56: 74-78.
- Shields, O., 1973. Studies on North American *Philotes* (Lycaenidae). II. The biology, distribution, and taxonomy of *Philotes sondrensis* (F. & F.). *Bull. Allyn Mus.*, (15): 16pp.
- Shields, O., 1974. Biogeographic and geologic considerations of the expanding-earth hypothesis. (ms. in prep.)
- Stempffer, H., 1967. The genera of the African Lycaenidae (Lepidoptera: Rhopalocera). *Bull. British Mus. (Nat. Hist.), Ent. Suppl.*, 10: 1-322.
- Takhtajan, A., 1969. *Flowering plants: origin and dispersal*. Smithsonian Inst. Press, Washington D. C.: 310 p.

- Thorne, F., 1961. Extensions of range and a new host plant of *Philotes speciosa* (Lepidoptera: Lycaenidae). *Bull. So. Calif. Acad. Sci.*, 60: 37-39.
- Tilden, J. W., 1967. A previously unrecognized subspecies of *Philotes speciosa*. *J. Res. Lepid.*, 6: 281-284.
- Waterhouse, G. A., 1932. *What butterfly is that? A guide to the butterflies of Australia*. Angus & Robertson Ltd., Sydney: 291 p., 34 pls.
- Wiltshire, E. P., 1957. *The Lepidoptera of Iraq*. Nicholas Kaye Ltd., London: 162 p.
- Wyatt, C., 1956. Lepidoptera collecting in the Atlas Mountains of Morocco. *Lepid. News*, 10: 214-222.
- Wynter-Blyth, M. A., 1957. *Butterflies of the Indian region*. The Bombay Nat. Hist. Soc., Bombay: 523 p., 72 pls.