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STUDIES ON NORTH AMERICAN PHILOTES (LYCAENIDAE)

II. The biology, distribution, and taxonomy of *Philotes sonorensis* (F. & F.)

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TAXONOMY

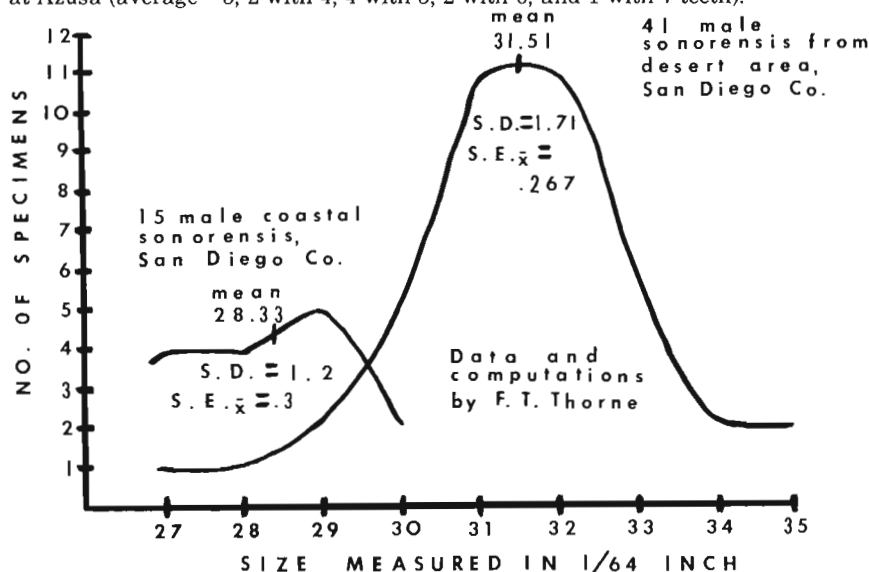
As I presently conceive it here, the Nearctic genus *Philotes* Scudder includes five basic species distinguishable on ♂ genital valve features: *sonorensis* (F. & F.), *speciosa* (H. Edw.), *battoides* (Behr), *rita* (B. & McD.), and *enoptes* (Bdv.). Various authors (see, e.g., the "question" to Forbes, 1948) have noted the difficulty in keeping these species all within the same genus. In a future paper I will give in detail the reasons for making several generic reassignments within the genus, based on comparative morphology, zoogeography, and foodplant relationships. Mattoni (1954) proposed that *sonorensis* is not cogenetic with the rest of the genus and tentatively assigned the Palearctic genus *Turanana* Bethune-Baker to *speciosa*, *battoides*, [*rita*] and *enoptes*. Since *sonorensis* is the type species of the genus *Philotes* (see Hemming, 1967), it would retain the genus name. Beuret (1959) maintains that *Turanana cytis* Christ, approaches *sonorensis* in having well-developed black spots on the upperside of the primaries and similar ♂ genitalia but considered these similarities not enough to combine them into a single genus. In the event that *T. cytis* and *P. sonorensis* should become united into the same genus upon further study, the older genus name is *Philotes*. *T. cytis* flies in Iran, Turkestan, and Pamirs (Seitz, 1909: 305). It should be mentioned that the South African *Leptomyrina lara* (L.) (see Clark & Dickson, 1957) somewhat resembles *sonorensis* in undersurface color and pattern and feeds on Crassulaceae species (e. g. *Cotyledon*); however, it differs from *sonorensis* in ♂ genitalia, gross adult morphology, and immature stages and thus is perhaps a case of convergent evolution.

In the type description of *sonorensis* (Felder & Felder, 1865), the type locality is given as follows: "Habitat: Sonora. (Lorquin.) We agree equally that the hitherto well-known Californian race is a full, isolated, stationary species" (rough translation). Langston (1969) points out that no *sonorensis* are known from the state of Sonora, Mexico, and refers to a paper by F. M. Brown which states that the Felder type localities all come from within California. Grinnell (1904)

mentions that J. M. Lorquin took *sonorensis* in 1852 at San Diego, Calif., which is hereby designated the type locality. I do not know where the type specimen resides.

ADULT VARIATION

Several authors have commented on the relative lack of variation in *sonorensis* throughout its range, (Martin, 1951; Langston, 1969). In series I have examined, the extent of forewing orange spots varies considerably in ♂♂, much less so in ♀♀. The orange spots on the upperside vary in intensity, sometimes a red to very light orange or rarely pink. UFW row of black spots in ♂♂ variable in extent and size of spots, same on secondaries of UW. Also the amount of white overscaling on the undersurface is variable. Six Baja California specimens (♂♂ from San Jacinto, La Guilla, Hamilton Ranch, San Telmo) appear to have a slightly more whitish cast to the blue than the usually iridescent light blue. Langston (1963) notes that central California specimens have a somewhat duller shade of blue than southern California material. The long series of Los Angeles Co. material viewed averages somewhat larger than central Calif. populations. Also ♀♀ from Los Angeles Co. are slightly more boldly marked on the upperside, have a general darker aspect and frequently a wide dark band on the underside, more weakly expressed in central California colonies. Mattoni & Seiger (1963, fig. 1) figure the classes of variation of a sample from San Gabriel Canyon. There was no variation in a short series sampled for valve teeth number from Placerville (average = 5; 2 with 4, 5 with 5, and 2 with 6 teeth) and Fish Canyon at Azusa (average = 5; 2 with 4, 4 with 5, 2 with 6, and 1 with 7 teeth).



Two variations of *sonorensis* have received names. Form *comstocki* (Gunder, 1925) has the upperside spots in both sexes both above and beneath fused into one large black spot on the primaries. Type locality is Duarte, San Gabriel River, Los Angeles Co. Occasionally a specimen will look like this form on the upperside but with undersurface spots normal (e.g. Tujunga Canyon, Los Angeles Co., IV-13-60, 1♂, leg. C. Goodpasture). Ova from a confined ♀ *comstocki* from Fish Canyon, Los Angeles Co., II-18-34, leg. C. Henne, produced one typical ♂ *sonorensis*, emerged I-9-35 (Henne, in litt.). An "aberrant," *sonoralba* (Watson

& Comstock, 1920), has the two red spots on the ♂ primary above and beneath a cream-white (type locality = San Diego). Two specimens I have seen from Azusa (III-12-32, III-27-49, leg. L. Martin) in the LACM collection have cream colored spots on the upperside but with underside spots a definite yellowish-orange. In a short series from Slide Lake, San Bernardino Co., III-26-60, leg. C. Goodpasture, 1♂ 1♀ had cream spots on the upperside with light orange spots on the underside, and 1♂ had the normal orange spots on both surfaces. Both *comstocki* and *sonoralba* are figured in Comstock (1927).

A remarkable gynandromorph, left side ♂, right side ♀, was taken II-28-'00, presumably at Pasadena, Calif. (Herr, 1900). I know of no other such examples.

Emmel, Trew, & Shields (1973) recently found considerable chromosome variation in two central California *sonorensis* populations: N = 17 to 44, with variation in number even within the same individual. We remark that this condition has perhaps resulted from a stressful environment or polyploidy and hybridization between host *Dudleya* species. San Gabriel Canyon is urgently in need of sampling since *sonorensis* displays considerable variation there (e.g. *comstocki*, *sonoralba*) and *Dudleya lanceolata*, *D. cymosa*, and *D. densiflora* all grow there. Hovanitz (1967) notes that this colony has been drastically reduced in the past few years by the ravages of man.

DISTRIBUTION

Central coastal California *sonorensis* records and a distribution map for California appear in Langston (1965). Additional central coastal Calif. locals are given in Langston (1963), and he figures the ♂ genitalia. No distribution records are listed here which are included in these two papers.

Philotes sonorensis records

BAJA CALIFORNIA: Agua del Refugio, IV-1-35 (Harbison, in Powell, 1958). Mesa W. of Cantillas Cyn., III-18-67, 1 ♂ (J. Powell, CIS). Carrizo Canyon, Valle de la Trinidad, III-15-36, 1 ♂ (C. F. Harbison, HR). Hamilton Ranch, IV-18-35, 1 ♂ (LACM). La Grulla, IV-14-35, 1 ♂ (LACM). Llano de Hamalu, IV-15-35, 2 ♂ 1 ♀ (LACM). Mesquite Spring, Valle de la Trinidad, III-16-36, 1 ♂ (C. F. Harbison, HR). Punta Descanso, III-6-47, 1 ♂ (J. S. Garth, JG). Rio San Telmo, IV-14-35, 1 ♂ 1 ♀ (LACM). Mouth of Río Santo Tomas, III-5-47, 1 ♂ (J. S. Garth, JG). San Jacinto, IV-19-35, 1 ♂ (LACM). San Telmo, IV-15-35, 2♂ (LACM). Santo Tomas, 31° 35'N., III-20-35, 1 ♂ (C. F. Harbison, HR). 7.6 mi. N. of Santo Tomas, in arroyo, IV-4-71, 7 ♂ (J. Donahue, D. Patterson, & H. G. Real, HR). 13.4 mi. S. San Vicente, IV-4-71, 1 ♂ (H. G. Real, HR). In the Sierra Juarez (ca. 45 mi. SE of Tecate), IV-12 & 13-63, 2 ♂ 2 ♀ (D. Dirks, OS). Sierra Juarez, 5500', 23 mi. S. of Tijuana-Mexicali Hwy., III-18-67, 1 ♂ (J. A. Powell, CIS). 35 mi. S. of Tijuana, III-9-46 (Provin, in Powell, 1958).

CALIFORNIA. *Contra Costa Co.*: Mt. Diablo (in Williams & Grinnell, 1905). *El Dorado Co.*: Chili Bar, ca. 4 rd. mi. N. of Placerville, at crossing of S. Fk. American River & Hwy. 193, 980', II-21-70, 16 ♂ 3 ♀ (O. Shields, R. Wells, OS, RW); II-22-70, 1 ♂ 1 ♀ (O. Shields, OS); III-5-70, "12" (R. Wells, RW); III-16-70, "26"; II-18-71, 2♂ 1♀; III-15-71, 15♂ 4♀ (all R. Wells, RW); II-17-73, absent (O. Shields). Rock Creek Rd., S. Fk. American River, Placerville, 1200', II-26-68, 20 ♂ 3 ♀; II-29-68, 12 ♂ 6 ♀; III-23-69, 2 ♂ 4 ♀ (all D. L. Bauer, DB). Rock Creek, II-29-68, 2 ♂ 1 ♀; III-3-68, 1 ♂ 2 ♀; III-6-70 (all P. Herlan, NSM). Rock Creek Road ca. 7 mi. NE Placerville, II-7-71, 16 ♂ 1 ♀ (R. L. Langston, SB). *Los Angeles Co.*: Arroyo Seco, V-20-07, 1 ♀ (V. L. Clemence, CAS). Arroyo Seco, above Pasadena, III-10-28, 3 ♂ (J. S. Garth, JG). Arroyo Seco Canyon, San Gabriel Mts., III-22-32, 1 ♂; III-15-33, 6 ♂; IV-1-33, 2 ♂ (all W. L. Swisher, WS); III-31-47, 1 ♂ (D. L. Bauer, DB). Azusa, IV-20-22, 1 ♂ 1 ♀ (LACM); IV-21-22, 1 ♂ (LACM); II-28-26, 3 ♂ 1 ♀ (J. A. Comstock,

UCD, UI, LACM); III-3-27, 1 ♂ 1 ♀ (Sternitsky, CAS); I-29-28, 1 ♂ 1 ♀ (J. & C. Comstock, AM); II-26-28, 1 ♀ (M. Doudoroff, CIS); II-16-29, 3 ♂ 2 ♀ (CAS, LACM); VI-24-29, 2 ♂ (L. Martin, UW); II-16-30, 5 ♂ 1 ♀ (C. M. Dammers, CAS, LACM); III-1-31, 1 ♂ (LACM); III-14-31, 1 ♂ 3 ♀ (LACM); III-12-32, 13 ♂ 3 ♀ (C. W. Anderson, L. M. Martin, CIS, LACM); III-11-33, 2 ♂ 4 ♀ (CAS); II-24-35, 1 ♂ 2 ♀ (J. A. Comstock, LACM); III-10-35, 7 ♂ 2 ♀ (CAS); III-29-36, 1 ♂ 3 ♀ (CAS); III-20-37, 5 ♂ (MCZ); III-21-37, 2 ♂ 1 ♀ (CAS); III-11-40, 1 ♂ 1 ♀ (F. W. Furry, LACM); III-11-43, 1 ♂ (CAS); III-7-45, 1 ♂ (PO); III-22-48, 1 ♂ 4 ♀ (AM); III-6-49, 2 ♂ (L. M. Martin, LACM); III-26-49, 6 ♂ 3 ♀ (LACM); III-27-49, 1 ♂ 3 ♀ (L. M. Martin, LACM); IV-5-49, 1 ♂ 1 ♀ (AM); IV-11-49, 1 ♂ (C. A. Sekerman, CS); IV-13-49, 1 ♀ (AM); II-28-50, 2 ♀ (AM); III-18-51, 4 ♂ (L. Martin, UW); III-20-53, 1 ♂; II-22-54, 2 ♂ 1 ♀; II-24-54, 1 ♀; II-25-54, 3 ♀; III-1-54, 3 ♀; III-12-54, 1 ♂ 1 ♀; III-7-55, 2 ♀ (all AM); III-22-58, 1 ♀ (L. M. Martin, LACM); III-12-59, 4 ♂ 2 ♀; III-14-59, 1 ♂ 5 ♀ (both K. Hughes, KH). Nr. Azusa, II-28-26, 1 ♂, (LACM); III-24-40, 1 ♂; III-6-41, 1 ♂ 2 ♀ (both C. I. Smith, CIS). Bell Canyon, III-30-57, 1 ♀ (J. Powell, CIS). Big Dalton Canyon, IV-17-21, 2 ♂ (Ingham, in Gunder, 1930). Big Santa Anita, VI-19-07, 1 ♂ (CAS). Big Tujunga Canyon, III-7-48, 1 ♂ (R. L. Langston, RL); II-12-61, 2 ♂ (J. Lane, C. Sekerman, JL, CS). Camp Baldy, IV-7-32, 2 ♂ (T. Craig, CAS, CIS). Camp Josepho, Rustic Canyon, IV-4-69, 1 ♂ (G. A. Gorelick, GG). Claremont, 1 ♂ 1 ♀ (Peck, LACM). Cold Creek, 1200', Santa Monica Mts., II-23-61, 1 ♂ (C. Henne, CH). Dark Canyon, San Gabriel Mts., III-18-51, 1 ♀ (C. L. Hogue, LACM). Eaton Canyon, San Gabriel Mts., V-4-47, 2 ♂ (R. L. Langston, RL). Eaton's Canyon, Pasadena, VI-1-07, 1 ♂ (V. L. Clemence, CAS). Elsmuir Canyon, III-10-40, 1 ♂ (D. L. Bauer, DB). Fish Canyon, nr. Azusa, IV-20-22, 11 ♂ 8 ♀ (LACM); III-7-24, 5 ♂ 1 ♀; III-30-24, 1 ♂ (both J. A. Kusche, CAS, CIS); III-1-25, 2 ♂ 2 ♀ (LACM); II-27-26, 40 ♂ 24 ♀ (J. S. Garth, JG); III-23-27, 2 ♀ (E. Walter, EW); IV-2-27, 25 ♂ 7 ♀ (J. S. Garth, JG); III-7-31, 3 ♂ 1 ♀ (CIS); III-19-31, 1 ♀ (E. Walter, EW); III-13-49, 4 ♀ (L. M. Martin, LACM). Fish & San Gabriel Canyons, III-14-25, 50 ♂ 10 ♀; III-12-27, 13 ♂ 2 ♀ (both J. S. Garth, JG). Glendora, II-16-30, 1 ♀; II-17-30, 2 ♀; II-23-30, 1 ♀; III-27-30, 2 ♂ II-22-31, 3 ♂ (all AM); III-8-31, 1 ♂ 1 ♀ (YU, AM); IV-10-31, 1 ♂ 2 ♀ (LACM); II-22-32, 1 ♂ (OS); II-22-33, 1 ♂ 2 ♀ (OS). Glendora Mtn. Rd., off E. Fk. San Gabriel River, V-7-67, 2 ♂ 2 ♀ (J. Lane, C. A. Sekerman, JL, CS). Henniger Flats, San Gabriel Mts., III-5-60, 1 ♂ (C. L. Hogue, LACM). Indian Springs trail from Big Tujunga Canyon, III-1-42, 2 ♂ (R. L. Langston, RL). Inglewood, III-12-32, 1 ♂ 1 ♀ (YU). Ladybug Canyon, Angeles Crest Hwy., San Gabriel Mts. IV-24-65, 2 ♂ (J. Lane, C. A. Sekerman, JL, CS). La Tuna Canyon, Verdugo Mts., III-17-42, 1 ♂; II-18-48, 1 ♂; III-5-48, 1 ♂ (all W. H. Evans, AM); III-27-48, 1 ♂ (C. I. Smith, CIS); III-4-50, 1 ♂; III-17-51, 1 ♂; IV-9-51, 1 ♂, III-1-54, 1 ♂; III-8-55, 1 ♂; III-25-55, 1 ♂; IV-4-55, 1 ♂; III-20-56, 1 ♂; III-24-57, 1 ♂ (all W. H. Evans, AM); 1200', III-6-53, 1 ♀; 1360', IV-10-47, 1 ♀ (both W. H. Evans, AM). 1 mi. E. of end of Paved Lat. Cn. Rd., 1350', main canyon, La Tuna Canyon, III-20-42, 1 ♀; III-26-42, 1 ♂ (both W. H. Evans, AM). Below spring, Wildwood Fire Rd., La Tuna Canyon, III-6-42, 1 ♂; II-20-42, 1 ♂; III-3-42, 3 ♂; III-27-42, 2 ♂ (all W. H. Evans, AM); III-11-59, 1 ♂; III-18-59, 1 ♂ (both C. Henne, CH). 1 mi. S. Little Rock Dam, San Gabriel Mts., III-25-62, 1 ♀ (C. L. Hogue, LACM). 2 mi. S. of Little Rock Dam, III-25-61, 1 ♀ (C. L. Hogue, LACM). Littlerock Res., III-20-65, 2 ♂ (J. Lane, C. A. Sekerman, JL, CS). Los Angeles, "coll. Le Moul't", 12 ♂ 1 ♀ (AM); III-25-20, 1 ♂ (J. A. Comstock, CAS). Malibu Road, Santa Monica, III-14-15, "44" (Haskins, in Gunder, 1930). Millards Canyon, Pasadena, IV-8-07, 2 ♂ 1 ♀ (V. L. Clemence, MCZ, LACM, CAS); V-24-07, 3 ♂ (V. L. Clemence, CAS); III-22-08, 1 ♂ (LACM); III-14-09, 1 ♂ (F. Grinnell, Jr., CAS); II-27-18, 1 ♀ (J. A. Comstock, LACM); III-19-27, 1 ♂ (J. S. Garth, JG); III-25-27 (Newcomb, in Gunder, 1930); III-16-40, 1 ♀ (J. S. Marsh, RL); III-8-42, 1 ♂ (D. L. Bauer, DB). Mint Canyon, V-4-41, 1 ♂ (D. L. Bauer, DB); III-15-20, 1 ♂ 1 ♀ (J. A. Comstock, LACM). Summit of Mint Canyon, IV-15-28, 4 ♂ (Friday, in Gunder, 1930). Monrovia, II-24-24, 2 ♂ (E. Walter, EW). Mt. Lowe, V-18-19, 1 ♂ (Malcolm, in Gunder, 1930). Mount Wilson Toll Road, III-16-41, 1 ♂ (R. L. Langston, RL). Pallett Crk., 4900', San Gabriel Mts., III-31-62, 1 ♂ (C. Henne, CH). Pasadena, 2 ♂ (CAS); III-10-98, 1 ♂ (LACM); III-28-01, 1 ♂ (Moesser, CAS);

"3/4", 1♂ (MCZ); "3/12", 1♀ (MCZ); "3-15", 1♀ (LACM); "2/25", 1♀ (MCZ); "2/28", 1♂ (MCZ). Rustic Canyon, Santa Monica Mts., II-25-47, 1♂ (W. A. McDonald, LACM). San Gabriel, III-11-27, 1♂ (YU); III-20-27, 1♂ 1♀ (YU); III-11-37, 1♂ (YU). San Gabriel Canyon, 1♂ (T. Craig, CAS); III-4-?, 1♂ (W. Hovanitz, CAS); III-14-26, 4♂; III-18-26, 6♂ 5♀ (both T. Craig, CAS); III-11-29, 1♂; III-19-29, 1♀ (both E. Walter, EW); III-4-31, 56♂ 10♀ (J. S. Garth, JG); IV-3-31, 4♂ 1♀ (YU); III-19-32, 1♂ (PO); III-4-35, 1♂ 1♀ (LACM); II-9-36, 10♂ 8♀ (LACM, OS); II-29-36, 3♂ 3♀ (E. Y. Dawson, YU); III-6-37, 2♂ 1♀; II-13-38, 8♂ 9♀ (both OS); IV-3-45, 4♂ 4♀ (C. I. Smith, CIS); IV-30-49, 2♂ 1♀ (J. S. Garth, JG); III-24-56, 3♂ 3♀ (UI); II-28-59, 2♂ (UI); III-19-60, 6♂ 6♀ (J. Lane, C. A. Sekerman, JL, CS); IV-9-60, 2♂; I-21-61, 6♂ (both J. Lane, C. A. Sekerman, JL, CS); III-24-63, 2♂ (AM); II-22-64, 1♂ (AM); III-18-24, 1♀; III-27-64, 1♂ (both AM); V-14-65, 1♂ (R. E. Stanford, KH); III-22-68, 3♂ (C. C. Callaghan, AM). Entrance to San Gabriel Canyon, II-12-68, 3♂ (LACM). Lower end San Gabriel Canyon, 2♂ 1♀ (J. Riddell, JJ). Mouth of San Gabriel Canyon, III-2-21, 49♂ 21♀ (Malcolm, in Gunder, 1930); IV-15-33, "15" (W. L. Swisher, WS); II-28-34, 2♂ 1♀; III-4-34, 1♀; III-8-34, 2♂ 1♀; III-21-35, 2♀; III-1-35, 1♂ 5♀; III-14-35, 2♂; III-20-37, 1♀ (all C. Henne, CH); III-14-65, 4♂ (J. Lane, C. A. Sekerman, JL, CS). San Gabriel Canyon, 2 mi. N. of Azusa, II-21-25, 24♂ 2♀ (J. S. Garth, JG). San Gabriel Canyon, near W. Covina, III-20-67, 14♂ 6♀ (G. A. Gorelick, GG). San Gabriel Mts., III-22-08, 1♀ (V. L. Clemence, CAS); III-18-20, 8♂; IV-5-20, 1♂ (both J. A. Comstock, LACM); IV-9-49, 1♂ (R. P. Allen, CAS). San Gabriel River, Azusa, III-26-49, 7♂ 2♀; III-28-49, 5♂ 5♀ (both CAS). San Gabriel Wash, III-17-34, 1♂ (LACM). Santa Anita Canyon, III-14-31, 1♂ 1♀ (CAS, CIS). Santa Monica Canyon, IV-2-17, "fairly common" (M. E. Fountaine, in Fountaine, 1917). Shortcut Canyon, W. Fk. San Gabriel River, V-17-42, 2♀ (R. L. Langston, RL). Summit Sierra Pelona Valley, IV-21-35, 7♂ 1♀ (C. Henne, CH); IV-19-36, 1♂ (C. Henne, CH). Switzers, III-21-32, 1♂ (UCD). Switzer's Camp, Aroyo Seco Canyon, San Gabriel Mts., IV-24-65, 10♂ (J. Lane, C. A. Sekerman, JL, CS); IV-10-71, 1♂ (+ several others) (E. Walter, EW). Tie Canyon, 4700', III-17-50, 1♂ (W. H. Evans, AM). Vasquez Rocks, Mojave Desert, II-23-47, 5♂ (R. L. Langston, RL). *Mariposa Co.*: 4 mi. N. of Bear Valley, IV-15-61, 1♂ (P. A. Opler, RL). Briceburg, III-7-70, 6♂; II-14-71, 3♂ 2♀; III-5-71, 6♂ 1♀ III-20-71, 21♂ 5♀ (all J. Mori, JM); II-18-73, 2♀ (J. Brock, JB). Briceburg, to ca. 1 mi. E. of, along RR bed, III-11-72, "15" (J. Brock, J. Mori, O. Shields, & W. Steele). Jerseydale, along Skelton Creek (canyon to Devil's Gulch), 19E04.1 & 19E04.2, 8.5 air mi. NE of Mariposa, III-29-70, "common" (J. F. Emmel & O. Shields, OS); IV-12-70, 3♂ 1♀ (J. Mori, O. Shields); III-27-72, "6" (M. O'Brien, O. Shields, OS). *Monterey Co.*: Big Sur, V-4-52, 2♀ (T. W. Davies, RL); II-25-54, 5♂ (AM); IV-?-55, 1♂ (M. Doudoroff, MCZ). 10 mi. S. Carmel, IV-14-63, 1♂ (D. W. Conrad, CIS). Partington Canyon, IV-15-52, 5♂; IV-29-52, 1♂ (both AM); V-4-52, 1♂ (T. W. Davies, YU); IV-21-56, 5♂ (P. A. Opler, PO). Partington Canyon, 9 mi. S. of Big Sur, IV-9-68, 13♂ 5♀ (R. L. Langston, RL, CAS, LACM); V-10-68, 1♂ 1♀ (R. L. Langston, LACM); V-11-64, 2♂ (R. M. Brown, RL). *Orange Co.*: Aliso Canyon, Laguna Beach, II-16-35, 1♂ (LACM); III-6-35, 6♂ (D. Meadows, RL); III-10-35, 3♂; III-16-35, 1♂; III-1-36, 1♂ (all LACM). Black Star Canyon, III-8-64, 2♂; II-19-64, 2♂ (both E. Walter, EW). Irvine Park, III-7-34, 4♀; III-11-45, 1♂ 1♀ (both E. Walter, EW). On the hills ca. 1 mi. N. of Irvine County Park, in Santiago Canyon, Santa Ana Mts., III-17-32, 2♂; III-18-33, 1♂ 1♀; III-3-45, 1♂ (all J. W. Johnson, JJ). Ladd Canyon, Santa Ana Mts., II-16-53, "numerous" (J. Mori, JM); III-21-53, 1♂ (Cooper, UW); IV-18-53, 1♂ (Cooper, UW). In hills to N. of Olive, III-2-34, 1♂ 1♀ (E. Walter, EW). San Juan Canyon, 700', Cleveland Nat. Forest, V-5-55, 1♀ (C. Henne, CH). Lower Santa Ana Canyon, IV-1-29, 1♀ (LACM). Santiago Canyon, III-15-24, 3♂; III-15-25, 2♂ III-10-31, 2♂, III-19-33, 2♂; III-15-64, 2♂ (all E. Walter, EW). Silverado Canyon, III-31-28, 2♂ (T. Craig, CAS, CIS); II-16-65, 1♂; III-29-65, 1♂ (both E. Walter, EW). Silverado Canyon rd. from Irvine Park to Silverado Canyon, at fork to Modjeska Canyon (R. Wells). Trubuco River, IV-8-60, 1♂ (J. F. Emmel, OS). *Placer Co.*: near Auburn, III-2-65 (N. La Due, RL); III-25-67, 2♂ (C. Goodpasture, OS). Auburn, Jct. North & Middle Forks of American River, 600', II-29-68, 7♂

3 ♀ (D. L. Bauer, DB). American River E. of Auburn, III-15-69, absent (O. Shields); I-27-70, absent (R. Wells); II-4-70, absent (R. Wells). 3 mi. NE of Auburn on Hwy. 49, Middle Fk. American River, 580', ½ mi. upstream from bridge, II-21-70, 4 ♂ 3 ♀ (O. Shields, R. Wells, OS, RW); II-23-70, 2 ♀ (R. Wells, RW); I-30-71, absent (R. Wells); II-2-71, absent (R. Wells); II-10-71, 2 ♂ 2 ♀ (R. Wells, RW); III-8-70, 1 ♂ (+ many eggs) (R. Wells, RW). Rocks above & W. of Murderer's Bar, Middle Fk. American River, ½-1½ mi. E. of juct. of Middle & North Fk. of American River, II-6-71, 2 ♂; II-13-71, 58 ♂ 12 ♀ (both O. Shields, R. Wells, OS, RW); II-14-71, 17 ♂ 8 ♀ (R. Wells, RW); II-20-71, 14 ♂ 1 ♀; II-23-71, 6 ♂; III-16-71, 4 ♂ 1 ♀ (all R. Wells, RW); II-12-72, absent (O. Shields, R. Wells); II-19-72, "41" (J. Mori, R. Wells, JM, RW); II-20-72, 20 ♂ 4 ♀ (O. Shields, R. Wells, OS, RW); II-17-73; 2 eggs, no adults (S. Mattoon, O. Shields, S. Sims); II-23-73, 7 ♂ (O. Shields, S. Sims, OS). North Fk. American River, 3 mi. NE of Auburn, III-23-65, 1 ♂ 2 ♀ (R. L. Langston, CIS); III-23-68, 1 ♂ (R. L. Langston, RL); II-22-70, 11 ♂ 1 ♀ (R. L. Langston, RL, NSM). *Riverside Co.*: L. S. C., Arlington, II-22-42, 1 ♂ (D. L. Bauer, DB). The Gavilan, IV-2-30, 2 ♀ (C. M. Dammers, CAS); III-9-41, 7 ♂ (C. Dammers, LACM). Gavilan Hills, 2200', III-14-59, 1 ♂ 1 ♀ (C. Henne, CH). La Sierra College, III-12-39, 1 ♀; III-19-39, 1 ♀ (both D. L. Bauer, DB). Mockingbird Canyon, III-20-45, 1 ♂; III-23-46, 1 ♀ (both W. H. Evans, AM). Perris, III-19-53, 1 ♂ (LACM). Pinon Flat, Santa Rosa Mts., IV-23-51, 2 ♂ (C. D. MacNeill, RL). Railroad Canyon, 4 mi. E. of Elsinore, IV-17-65, 1 ♀ (J. Powell, CIS). Sage, III-20-51, 6 ♂ 2 ♀ (R. H. Reid, LACM). Snow Creek, III-12-33, 1 ♂ (CAS). Upper San Andreas Canyon, III-22-31, 3 ♂ 1 ♀ (J. S. Garth, JG). Snow Creek Canyon, III-30-29, 2 ♂ (J. S. Garth, JG). Whitewater, III-25-30, 1 ♀ (C. M. Dammers, CAS). *San Benito Co.*: Chalmers Crk. trail to the Balconies, Pinnacles Natl. Mon., III-18-72, 6 ♂ (R. Langston, P. Sisk, RL, SB). Fremont Peak (in Tilden & Mansfield, 1941). Lime Kiln Canyon, 5 mi. W. Paicines, III-24-66, 1 ♂ 3 ♀ (R. L. Langston, J. Powell, CIS); III-2-68, 1 ♂ (R. L. Langston, LACM). *San Bernardino Co.*: 5 air mi. SW of Lucerne Valley, mts. S. of Rabbit Dry Lake, IV-14-64, 1 ♂ (R. L. Langston, CIS). Along bank of Mojave River, 6 mi. SE of Hesperia, IV-15-62, 1 ♂ (R. M. Brown, RL). San Bernardino, 1 ♀ (Wright, CIS). Slide Lake, III-26-60, 2 ♂ 1 ♀ (C. Goodpasture, OS). Upland, IV-18-58, 2 ♂ (T. M. Blackman, LACM). *San Diego Co.*: Bennington Cemetery, Point Loma, II-16-30, 27 ♂ 5 ♀; II-22-32, absent; II-28-32, absent; II-12-33, 3 ♂ 2 ♀; II-19-33, 10 ♂ 4 ♀; III-4-33, 4 ♂ 7 ♀; II-12-34, 4 ♂ 1 ♀; II-26-34, absent (after several heavy rains); II-12-35, 1 ♂ 1 ♀; III-1-36, 20 ♂ 4 ♀; II-22-37, 12 ♂ 2 ♀ (all F. T. Thorne, FT). Boiling Springs, Laguna Mts., IV-29-34, "1" (F. T. Thorne, FT). S. slope of Dictionary Hill, in large canyon, IV-5-62, 1 ♀ (F. T. Thorne, FT). Division Street, about 5600 to 5900 blocks, National City, II-3-48, 1 ♂ (R. W. Breedlove, SD); II-21-50, 4 ♂ 1 ♀; III-7-50, 1 ♂ 8 ♀; III-12-50, 21 ♂ 5 ♀; II-8-51, too early; II-19-51, 1 ♂ (all F. T. Thorne, FT); II-24-51, 1 ♂ 1 ♀ (R. L. Langston, RL); II-25-51, 12 ♂ 3 ♀ (F. T. Thorne, FT); III-4-51, 1 ♂ (R. L. Langston, RL); III-14-51, "Santa Ana condition, adults common"; III-3-52, 2 ♂ 1 ♀; III-6-52, 2 ♂; II-6-53, 4 ♂ 1 ♀; II-7-53, 7 ♂ 1 ♀; II-15-53, 2 ♂ 3 ♀; IV-9-54, absent (all F. T. Thorne, FT); III-14-55, 2 ♂ (R. W. Breedlove, SD); III-3-56, 4 ♂ 2 ♀; III-7-57, absent; II-21-58, absent (all F. T. Thorne, FT); III-21-59, 1 ♀; II-26-61, 2 ♂ 1 ♀ (both R. W. Breedlove, SD); III-4-62, 1 ♂ (F. T. Thorne, FT); IV-1-62, 1 ♂ (R. W. Breedlove, SD); II-5-64, absent; II-7-68, absent (both F. T. Thorne). Encanto, III-11-50, 5 ♂ 1 ♀; II-24-51, 2 ♂ 1 ♀ (both J. Powell, CIS); III-28-52, 1 ♂ 1 ♀ (M. J. McKenney, CIS). Summit of Garnet Peak, 6000', Laguna Mts., V-17-69 (F. T. Thorne, RL); V-8-70, 1 ♂ (R. Priestaf, RL). 3 mi. W. of Jacumba, 3200', III-11-60, 1 ♀ (O. E. Sette, RL). Julian, IV-13-'99, 1 ♂ (LACM). Laguna Mts., "6/3/51", 1 ♀ (M. J. McKenney, CIS); VI-1-56, 2 ♂ (R. E. Stanford, KH). Hills E. of La Jolla, III-2-40, 7 ♂ 1 ♀; III-3-40, 4 ♂ 2 ♀; III-5-40, 2 ♂ (all O. E. Sette, RL). Back of La Jolla country club, II-23-41, "2" (F. T. Thorne, FT). La Pressa Canyon, SE of Dictionary Hill, III-5-55, 1 ♂; III-12-55, 1 ♂; III-15-55, 2 ♂; III-19-55, 1 ♂; III-1-58, 1 ♂ (all R. W. Breedlove, SD). Lemon Grove (in Wright, 1908). Mine Canyon, Pinon Mts., Anza Borrego State Park, II-14-71, 7 ♂ 4 ♀ (S. K. Dvorak, SD). N. side of Mission Valley, in canyon about opposite Co. Hospital, III-1-42, "8" (F. T. Thorne,

Fowler, FT). Monument Peak, Laguna Mts., IV-16-33, 1 ♂ (F. T. Thorne, FT). Hills 1 mi. S. of Otay, III-17-51, 4 ♂ (R. L. Langston, RL, CAS, CIS). "Paradise Hills", 6 mi. SE of San Diego, III-3-56, 5 ♂ 1 ♀ (O. E. Sette, RL). S St. and Otay Rd., III-3-56, 2 ♂ (F. T. Thorne, FT). San Diego, II-27-14, 1 ♂ (G. H. Field, YU); "2 July 1917", 1 ♀ (YU); II-15-47, 1 ♀ (J. Powell, CIS); II-24-51, 3 ♂; III-11-51, 3 ♂ (both M. J. McKenney, CIS); II-13-53, 3 ♂ (J. Powell, CIS). San Felipe Creek, Anza Desert, III-5-60, 2 ♂ (R. W. Breedlove, SD). Canyon off Warner leg of Scissors Crossing, III-15-49, 3 ♂ 1 ♀ (F. T. Thorne, FT). Near Scissors Crossing at base of Grapevine Mts., III-25-51, 1 ♂ + 10 eggs; III-20-52, "1" + eggs & 1 larva (both F. T. Thorne, FT). Scissors Crossing, II-16-54, 7 ♂; II-20-54, 10 ♂ 1 ♀; II-21-54, 14 ♂; II-22-54, 14 ♂ 2 ♀; II-19-55, 1 ♂; II-21-55, 2 ♀; III-12-55, 4 ♂ 3 ♀; II-19-56, absent; III-4-56, 6 ♂ 3 ♀; II-26-57, 7 ♂ 1 ♀; I-11-58, 7 ♂ (all F. T. Thorne, FT); I-28-58, 16 ♂ 4 ♀ (R. Albright, F. T. Thorne, FT); III-29-58, 1 ♂; II-19-61, 1 ♀ (both O. Shields, LACM); III-11-51, 1 ♂ (R. L. Langston, CIS); III-12-55, 1 ♂ (F. T. Thorne, OS); II-17-60, "3"; III-11-61, 4 eggs, no adults; II-18-62, 1 ♂; II-16-63, 1 ♂ 2 ♀; II-18-63, 3 ♂; II-22-64, 2 ♂ (all F. T. Thorne, FT). 6 mi. E. of Scissors Crossing, III-12-60, 1 ♂ (O. Shields, LACM). 3 mi. E. of Scissors Crossing, III-11-51, 4 ♂ 1 ♀ (R. L. Langston, RL, CIS). 1 mi. W. of Scissors Crossing, II-13-61, 1 ♀ (O. Shields, LACM). "Two Mile Hill", 2500', W. of Scissors Crossing, III-1-64, 1 ♀ (O. Shields, LACM). Hills NE of Scissors Crossing, 7 mi. E. of Banner, III-4-56, 15 ♂ 3 ♀ (O. E. Sette, RL). 1 mi. NE of Scissors Crossing, San Felipe Valley, III-19-66, 2 ♂ 1 ♀ (S. K. Dvorak, SD). 2 mi. N. of Scissors Crossing, II-1-58, 3 ♂ 3 ♀; III-6-60, 3 ♂ (both D. Dirks, O. Shields, LACM). 3 mi. N. of Scissors Crossing, II-1-58, 2 ♂ 1 ♀ (D. Dirks, O. Shields, LACM). Tributary canyon in middle of Sentenac Canyon, II-8-46, 2 ♂ 1 ♀; II-24-46, 3 ♂ 1 ♀ (both F. T. Thorne, FT). Sentenac Canyon, III-14-53, 9 ♂ 3 ♀ (J. Powell, CIS); III-22-53, 1 ♀ (R. A. Mackie, UI); III-22-53, 12 ♂ 2 ♀ (J. Powell, CIS); III-24-53, 1 ♂ (M. J. McKenney, CIS); II-26-57, 7 ♂ 2 ♀; III-2-57, "1" (both F. T. Thorne, FT); I-11-58, "2"; II-8-58, "2" (both F. T. Thorne, FT); II-9-58, 2 ♂; II-6-59, 1 ♂ (both K. Hughes, KH); II-27-59, 2 ♂ 1 ♀; III-8-59, 2 ♂ (both F. T. Thorne, FT); III-12-60, 1 ♂ (S. K. Dvorak, SD); III-30-60, absent (F. T. Thorne); II-19-61, 3 ♀ (O. Shields, LACM); III-11-61, 1 ♂; III-17-62, 2 ♂; II-9-63, 1 ♀ (all S. K. Dvorak, SD); II-16-63, 17 ♂ 1 ♀ + "18" (R. W. Breedlove, S. K. Dvorak, F. T. Thorne, FT); II-18-63, 4 ♂; II-22-64, 2 ♂ (both F. T. Thorne, FT); 2000', III-1-64, 1 ♂ (O. Shields, AM). Sentenac Canyon & Two Mile Hill, II-14-65, 16 ♂ 2 ♀ (R. W. Breedlove, FT). Sweetwater Lake, III-19-60, 1 ♀ (D. Dirks, O. Shields, LACM). Sweetwater Valley near Higgins Ranch, Bonita, III-3-40, 3 ♂; III-17-40, 1 ♂; II-4-41, 2 ♂; III-6-41, 3 ♂; II-15-42, absent; III-8-42, 4 ♂ 4 ♀; II-12-44, absent; IV-2-44, 1 ♂; III-10-49, absent; I-29-53, absent; II-25-53, absent (all F. T. Thorne, FT). Telegraph Canyon, SE of Chula Vista, III-1-18, 3 ♂ 1 ♀; III-8-18, 1 ♀; III-9-18, 1 ♂; III-16-18, 3 ♂; IV-30-18, 1 ♀; III-3-56, 2 ♂ (all O. E. Sette, RL). N. entrance to Torrey Pines State Park, 50', S. of Del Mar, II-21-64, 1 ♂ (O. Shields, LACM). "Two Mile Hill", 2500', 4 mi. E. of Banner, III-4-56, 1 ♀ (O. E. Sette, RL); II-26-57, "2"; II-9-58, 1 ♀; III-11-61, absent (all F. T. Thorne, FT); II-18-68, 10 ♂ 1 ♀ (R. W. Breedlove, FT). Vallecito Mts., III-6-49, 1 ♂ (D. L. Bauer, DB). *San Luis Obispo Co.*: Atascadero, III-6-32, 5 ♂; III-7-32, 1 ♂; III-8-32, 1 ♂; III-13-32, 3 ♂; III-16-32, 2 ♂; III-18-32, 4 ♂; IV-4-32, 1 ♂; III-14-35, 1 ♂; III-26-35, 1 ♂; IV-5-35, 1 ♀ (all V. L. Clemence, LACM). Cerro Alto Canyon, IV-16-61, 1 ♂ (V. Chang, OS). Vicinity of Montana De Oro State Park, S. of Morro Bay, ca. II-25 or 26-72, "about a dozen" (T. Tolman, WS). Oso Flaco sand dunes, 1 mi. SE of Oso Flaco Lake, III-1-72, 1 ♂; III-9-72, 1 ♂ (both W. L. Swisher, WS). Paso Robles, III-10-94, 1 ♂ (W. G. Wright, CIS). *Santa Barbara Co.*: Nr. Davy Brown Campground, San Rafael Mts., III-24-73 (R. C. Priestaf, R.P.). Mission Canyon, Santa Ynez Mts., III-?-62, 1 ♂ (J. W. Tilden, AM); II-23-71 (R. C. Priestaf, RP). Oso Creek, San Rafael Mts., early III-69 (R. Priestaf, R.P.). Refugio Pass, III-11-61, 5 ♂ (J. S. Garth, JG). Old San Marcos Pass Rd., Santa Ynez Mts., II-21-71 (R. C. Priestaf, RP). Santa Barbara, IV-14-33, 1 ♂ (UI); II-8-34, 1 ♀ (LACM). Santa Ynez Mts., "early III-70" (R. Priestaf, RL), "reappeared early Mar. after disastrous 1964 fire." *Santa Clara Co.*: Alma, II-?-?, "2" (Grundel, in Coolidge, 1908). Alum Rock, II-23-47, 3 ♂

(YU). Alum Rock Canyon, III-16-40, 1 ♂ (CAS). Alum Rock Park, III-1-42, 1 ♂ I-30-48, 2 ♂ (both AM); II-19-50, 3 ♂ (T. W. Davies, YU); II-21-54, 1 ♂ (P. A. Opler, RL); III-7-54, 1 ♂ (LACM); III-11-56, 2 ♂ 2 ♀ (P. A. Opler, PO); III-21-57, 3 ♀ (O. E. Sette, RL); II-21-59, 1 ♂ (P. A. Opler, PO); II-27-59, 1 ♂ (R. E. Stanford, KH); III-8-59, 1 ♀ (P. A. Opler, PO); III-14-60, 1 ♂ (R. E. Stanford, KH); IV-2-60, 1 ♂ (O. E. Sette, RL); II-12-64, 12 ♂ 5 ♀ (R. L. Langston, RL, CIS, CAS, LACM, AM); II-21-64, 1 ♂; II-22-64, 7 ♂ 1 ♀; III-7-64, 1 ♂; II-11-65, 1 ♂; II-13-65, 1 ♂ (all P. A. Opler, PO); II-14-65, 2 ♂ (A. J. Slater, CIS); II-20-65, 4 ♂ 1 ♀ (W. J. Steele, RL); III-1-65, 5 ♂ 3 ♀ (P. A. Opler, PO); II-21-67, 13 ♂ 8 ♀ (R. L. Langston, RL, CAS, LACM, AM); II-26-67, 7 ♂ 1 ♀; II-28-67, 7 ♂ 6 ♀ (both G. A. Gorelick, GG); III-1-67, 3 ♀ (C. D. MacNeill, RL); I-30-71, 5 ♂ 1 ♀ (R. L. Langston, RL, SB); II-14-73, 31 ♂ 9 ♀; II-23-73, 7 ♂ (both J. Brock, JB). Coyote Crk. nr. China Hole, Henry W. Coe State Park, III-20-71, 1 ♂ (G. Frisch, RL); III-21-71, 1 ♂ (P. Sisk, RL). Gilroy (in Coolidge, 1908). Soda Springs Creek, Henry W. Coe State Park, III-20-71, 4 ♂ (R. L. Langston, RL, SB). *Santa Cruz Co.*: Gavilan Mt., 2400', Santa Cruz Mts., IV-18-18, 1 ♀ (W. E. Groth, CAS). *Stanislaus Co.*: At mouth of Adobe Cyn., on Del Puerto Cyn. road, 1320', ca. 2½ rd. mi. W. of Frank Raines Park, S. 15, T.6S., R.5E., II-23-70, 3 ♂ (J. F. Emmel, OS). 18 road mi. W. of Patterson, ca. 1700', Del Puerto Canyon, III-7-70, 1 ♂ 1 ♀ (O. Shields, OS). Del Puerto Canyon, 21 mi. W. of Patterson, III-15-69, 1 ♂ 1 ♀ (R. L. Langston, RL); II-27-72, 2 ♂ 2 ♀ (R. L. Langston, C. Henne, RL, SB). Del Puerto Canyon, 22 mi. W. of Patterson, III-5-63, 1 ♀; IV-30-63, 1 ♂; II-22-64, 4 ♂ 4 ♀; III-12-66, 1 ♀ (all R. L. Langston, RL, CIS, CAS); III-30-68, 1 ♀ (G. A. Gorelick, GG); III-15-69, 2 ♂ (R. L. Langston, LACM); III-29-69, 7 ♂; IV-10-69, 2 ♂ (both G. A. Gorelick, GG); 1200', II-20-70, 2 ♂ 2 ♀; II-25-70, 7 ♂; II-7-71, absent (all J. Mori, JM); III-11-73, 1 ♂ 1 ♀ (O. Shields, OS). Del Puerto Canyon, 23 mi. W. of Patterson, II-19-67, 1 ♂; III-25-69, 5 ♂ 2 ♀ (both J. Powell, CIS); 1500', II-27-72, 2 ♂ 2 ♀ + 7 eggs (C. Henne, R. L. Langston, RL). 0.3 road mi. SSE of mouth of Hideout Cyn., 1550-1600', Del Puerto Canyon road, S. 16, T.6S., R.5E., II-23-70, 2 ♂ (J. F. Emmel, OS). *Tuolumne Co.*: N. Fk. Tuolumne River, 3 mi. NE of Tuolumne, IV-2-61, 1 ♂; II-20-65, 1 ♂; IV-25-65, 1 ♂ (all M. R. & S. H. Lundgren, CIS, CAS); III-23-66, 4 ♂ (R. L. Langston, CIS). *Ventura Co.*: Derrydale Canyon, 3600', Los Padres Nat. For., IV-19-58, 1 ♂ (C. Henne, CH). 1 mi. S. of Lake Sherwood, Santa Monica Mts., III-17-67, 2 ♂ (P. Opler, J. Powell, CIS). 2 mi. E. of Lake Sherwood, III-16-67, 1 ♂ (J. Powell, CIS). Port Hueneme, 10 mi. E. of, II-26-'94, 2 ♂ (W. G. Wright, CIS, CAS). *County undetermined*: Augusta, III-16-46, 1 ♂ (L. M. Martin, UW). Fork Canyon, III-11-24, 1 ♂ (CAS). Mouth of San Antonio Canyon, III-25-32, 1 ♂ (T. Craig, CAS). *Doubtful or erroneous records*: Brawley, II-18-25, 1 ♂ 3 ♀ (Fortener, "E. A. Dodge Collection", CAS). "Near Brawley", V-6-25, 1 ♀ (Wehner, CAS). Laguna Mts., "Sep. 18 25", 1 ♂ 1 ♀ ("J. P. Strohbeen Collection", CAS); [below this questionable date is "Brauley", which may explain the "Brawley" data].

Records for *P. sonorensis* form *comstocki*

CALIFORNIA. *Los Angeles Co.*: Mouth of Fish Canyon, II-25-30, 1 ♂ (Ingham, in Gunder, 1930). Fish Canyon, III-20-37, 1 ♂ (C. H. Ingham, AM). Mint Canyon, III-20-21, 1 ♂ (Malcolm, in Gunder, 1930). Mouth of San Gabriel Canyon, III-9-30, 1 ♂ (Friday, in Gunder, 1930); III-4-33, 4 ♀; III-7-33, 1 ♂; II-18-34, 1 ♂; II-28-34, 1 ♀; III-8-34, 1 ♂ 1 ♀; II-16-35, 1 ♂ 1 ♀; III-1-35, 1 ♂; III-12-35, 2 ♂; III-7-36, 1 ♂; III-15-36, 1 ♂; III-28-36, 1 ♀; III-7-37, 1 ♂ (all C. Henne, CH; note, Henne estimates that the ratio of *comstocki* to typical *sonorensis* here is 1 to 200). San Gabriel River, Duarte, III-15-22, holotype (AMNH). *Ventura Co.*: Derrydale Canyon, 3600', Los Padres Nat. For., IV-19-58, 1 ♂ (C. Henne, CH).

Records for *P. sonorensis* ab. *sonoralba*

CALIFORNIA. *Los Angeles Co.*: mouth of Fish Cyn., Duarte, III-12-35,

1 ♀; III-20-37, 1 ♀ (C. Henne, CH). San Gabriel Wash, III-5-24, 1 ♂ (J. A. Comstock, in Gunder, 1930).

LARVAL FOODPLANTS

P. sonorensis in central California is found in association with *Dudleya cymosa* (Lem.) Britt. & Rose. *D. cymosa* ssp. *cymosa* is used at North Fork American River E. of Auburn, Placer Co. (det. R. Moran), where a larva collected V-13-70 emerged VIII-30-70 (♀). Adults were reared from larvae on this ssp. at Briceburg, Mariposa Co. (Shields #68, det. D. Breedlove), and adults were taken in association with it at Skelton Creek Canyon E. of Jerseydale, Mariposa Co. (Shields #71, det. D. Breedlove). Langston took adults in association with it at 3 mi. NE Tuolumne City, Tuolumne Co. Adults have been collected around *D. cymosa* ssp. *setchellii* (Jeps.) Moran at 5 mi. SW Paicines, San Benito Co.; Alum Rock Park, Santa Clara Co.; and Del Puerto Canyon, Stanislaus Co. (Langston records). *D. cymosa* ssp. *minor* (Rose) Moran is the host at Partington Creek, 200-300', ca. 9 road mi. S. of Big Sur, Monterey Co.; 3rd instar on V-10-69 emerged II-7-70 (J. F. Emmel). Also eggs collected on this *Dudleya* V-14-68 produced 9 adults that emerged III-25 to IV-3-69 (C. Henne). This subspecies is also found in at least 4 southern California *sonorensis* localities: Arroyo Seco Cyn., San Gabriel Mts.; San Gabriel Cyn.; Eaton Cyn., San Gabriel Mts.; and Millards Canyon, L. A. Co. R. Wells and I searched *D. cymosa* ssp. *gigantea* (Rose) Moran colonies in the vicinity of Mokelumne River, Sutter Creek, and Plymouth on II-22-70 without success.

Dudleya abramsii Rose ssp. *abramsii* is not known to be a host but is found in the Sierra Juarez, B. C., and on Monument Pk., Laguna Mts., where *sonorensis* occurs.

D. lanceolata (Nutt.) Britt. & Rose is reported to be the *sonorensis* foodplant in San Gabriel Canyon (Martin, 1951; Hovanitz, 1967). *Lanceolata* occurs also at the following *sonorensis* localities: Mint Canyon, Arroyo Seco, Fish Canyon, Point Loma, and San Diego (ex herbaria records).

D. saxosa (Jones) Britt. & Rose ssp. *aloides* (Rose) Moran is found at Sentenac Canyon and vicinity Scissors Crossing, San Diego Co. where *sonorensis* flies. F. T. Thorne found 20 *sonorensis* ova on the flat-leaves near Scissors Crossing on III-15-49.

D. stolonifera Moran occurs only at Aliso and Laguna Canyons, Orange Co.; *sonorensis* flies at the former, so this may be a possible foodplant.

D. edulis (Nutt.) Moran may be used by *sonorensis* where it flies at Torrey Pines, La Jolla, and Sweetwater Dam in San Diego Co.

D. ingens Rose occurs at two known *sonorensis* localities in Baja Calif.: San Telmo and Hamilton Ranch. However, *D. attenuata* is also found at San Telmo (data from Moran, 1951a).

Langston (1963) found no adult *sonorensis* on *Dudleya farinosa* (Lindl.) Britt. & Rose and *D. caespitosa* (Haw.) Britt. & Rose in central coastal California based on several seasons of spring collecting. In San Diego Co. I have not seen *sonorensis* at *D. pulverulenta* (Nutt.) Britt. & Rose locals at the proper time. Reports in the literature of *Sedum* as a foodplant appear erroneous.

Following Moran's (1951a) classification, *Dudleya* (Crassulaceae; Echeverioideae) has 38 species in western North America grouped as follows:

- I. Subgenus Veradudleya
 - A. Section Stylophyllum-9 species
 - B. Section Eududleya-25 species
- II. Subgenus Hasseanthus-4 species

This is a difficult genus with many unsolved problems, especially in section Eududleya which is not easily separated into species and which has a high degree of polyploidy (39% of the species). *Dudleya* reaches its greatest development

on the coasts and islands of California and Baja, and extends inland to southern Nevada and central Arizona, with the San Diego coastal region the center of distribution (above data from Moran, 1951a).

When the known and suspected *sonorensis* foodplants are superimposed on Moran's classification, an interesting pattern emerges. Nearly all the species used fall within the first 10 primitive members of Eududleya:

1. *stolonifera*--possible host
2. *guadalupensis*--Guadalupe Island, B. C. only
3. *cymosa*--host
4. *farinosa*--Langston (1963) says it is not used, at least in part of its range
5. *caespitosa*--Langston (1963) says it is not used, at least in part of its range.
6. *greenei*--San Miguel, Santa Rosa, Santa Cruz, and Santa Catalina Islands
7. *lanceolata*--host
8. *saxosa*--host
9. *linearis*--San Benito Islands, B. C. only
10. *abramsii*--possible host

The only other Eududleya used, *ingens*, ranked no. 18 of 25, may or may not be a foodplant (*D. attenuata* of the Stylophyllum being the other candidate). In section Stylophyllum, only *edulis*, ranked as the most advanced member, is perhaps used, although *attenuata*, ranked close to *edulis*, may also be used. *D. densiflora* (Rose) Moran, known only from Fish Canyon and San Gabriel Canyon (where *sonorensis* flies) is apparently closely allied to *edulis*. No Hasseanthus are known to be hosts.

Moran states that it is uncertain if the prototype was Stylophyllum or Eududleya. The *sonorensis* foodplant relationships suggest that it was an advanced Stylophyllum which gave rise to Eududleya. A hybrid between *edulis* X *stolonifera* is known; *stolonifera* "seems intermediate in some respects between the subgenera Eududleya and Stylophyllum" (Moran, 1949).

The diploid *cymosa* appears to intergrade with the polyploid *caespitosa* and *lanceolata* and perhaps with *farinosa* and *abramsii*. It is possible that *cymosa* ssp. *setchellii* and *abramsii* ssp. *murina* are connected in the inner South Coast Range, and it is also possible that *cymosa* ssp. *minor* intergrades with *abramsii* ssp. *abramsii* in the San Bernardino and San Jacinto Mts. *D. saxosa* ssp. *aloides* morphologically connects with *lanceolata* (above data from Moran, 1951a).

Clausen, Moran, & Uhl (1945) note possible connecting link species between Hasseanthus and Stylophyllum (chromosomal resemblance among Hasseanthus, *D. pumila*, *D. viscida*); *H. elongatus* is near *Dudleya* in appearance and in the condition of the basal leaves. None of these are known *sonorensis* foodplants. Wild hybrids are known between *Dudleya edulis* X *Hasseanthus blochmaniae* (Moran, 1951b).

The rock substrate was sampled from two localities where *sonorensis* flies abundantly on *D. cymosa* ssp. *cymosa*. At Murderer's Bar, 4 mi. NE Auburn, Placer Co., the *Dudleya* grows on metavolcanic green schist; and at Skelton Creek Canyon, E. of Jerseydale, Mariposa Co., it grows on slopes of slates (=metatuff), greenstone (metavolcanics), and metaquartzite or siliceous metatuff (samples det. by Dr. E. M. Moores, UCD Geology Dept.). In Del Puerto Canyon, 22 mi. W. of Patterson, Stanislaus Co., *D. cymosa* ssp. *setchellii* grows on rocky serpentine slopes where *sonorensis* flies.

I have had no success with *sonorensis* in the foothills W. and NW of Sacramento. *D. cymosa* ssp. is fairly common in Thompson Canyon, Vaca Mts., Yolo Co., where it grows on Upper Cretaceous sedimentary rocks of shales, sandstones, siltstones, and conglomerate lenses. No sign of *sonorensis* there during weekly Feb.-March collecting over a three-year period. In Rumsey Canyon, 3 mi. W. Rumsey, Yolo Co., on exposed S-facing wall of canyon, on III-13-71, much *D. cymosa* ssp. but no *sonorensis* (leg. R. Wells). At an ideal habitat on

serpentine outcrops W. of Leesville, Lake-Colusa Co. line, no sign of *sonorensis* on III-15-73, *D. cymosa* ssp. common.

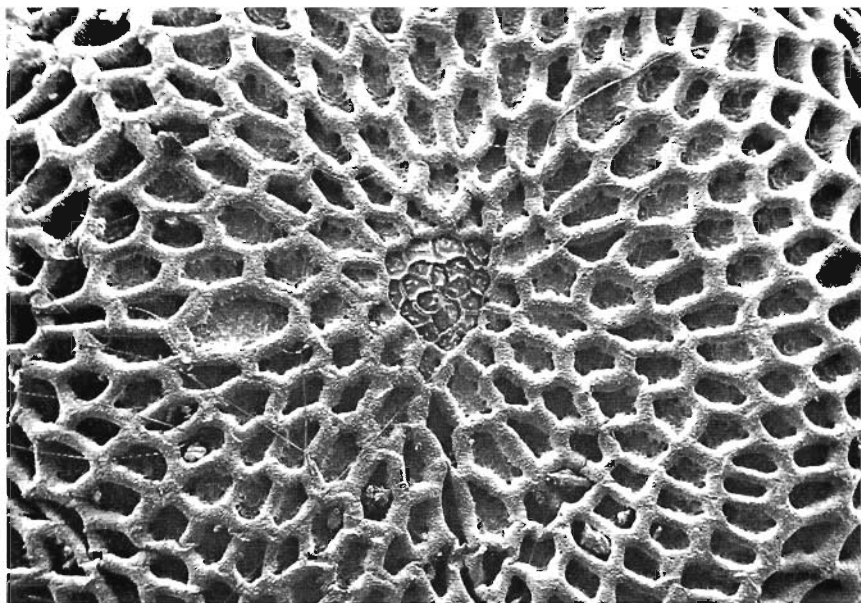


Fig. 1. SEM (Cambridge) micrograph of a *P. sonorensis* egg surface from a top view, ca. 460 X; egg collected at Chili Bar, 4 mi. N. Placerville, El Dorado Co., Calif., II-21-70.

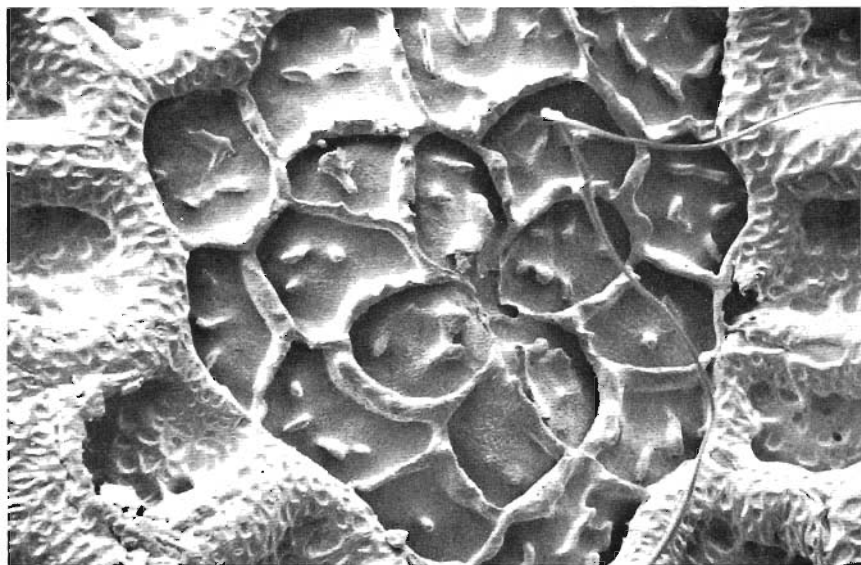


Fig. 2. Same, close-up of micropyle region, ca. 1600 X.

LIFE HISTORY NOTES

A detailed life-history description of *sonorensis* is given by Comstock & Coolidge (1930), and the egg is figured in Comstock (1927).

Confined females can lay at least 100 ova. A female from National City, San Diego Co., captured III-3-52, produced 100 ova; one confined ♀ from Bennington Monument, San Diego Co., taken II-19-33, laid 27 ova Feb. 20, 39 ova Feb. 21, 24 ova Feb. 22, hatched Feb. 25 & 26 (90 ova); same locality, III-4-33, 6 ♀♀ kept alive laid over 200 ova March 6 and 50 ova March 7 (F. T. Thorne records).

Along an abandoned road between slope above Murderer's Bar and junction of Middle & North Fk. American River, NE of Auburn, Placer Co., II-14-71, leg. O. Shields & R. Wells. Counted *sonorensis* eggs on *Dudleya cymosa* plant clumps (up to 4-7 plants per clump; those plants more than one foot away were counted as another clump) at serpentine rock outcrops along steep 45° angle roadcut:

- (1) Location #1, SW exposure, receives afternoon sun. On W. Side, 36 plant clumps, 10 having eggs (28%); on E. side, 30 plant clumps, 2 with eggs (7%).
- (2) Location #2, S. exposure, receives morning and afternoon sun. On W. side, 32 plant clumps, 13 with eggs (41%); on direct S. side, 6 plant clumps, 5 with eggs (83%); on E. side, 19 plant clumps, 2 with eggs (11%).
- (3) Location #3, direct S. exposure, 8 clumps, 6 with eggs (75%).

The range was 1-9 eggs per plant clump having eggs (average = 2.8). Eggs on leaf upper surface = 66; eggs on leaf under surface = 41. II-17-73, Murderer's Bar, only 2 eggs, no adults seen (one egg was collapsed, other held its shape but was perhaps infertile?). The *Dudleya* were not yet large size, mostly medium sized. On II-23-73, Murderer's Bar, leg. OS & S. Sims, found 8 unhatched eggs, layed on leaf uppersides toward upper part of leaf near the margin, and on center of small leaves at center of rosette. II-21-70, Chili Bar, 4 mi. N. Placerville, El Dorado Co., leg. OS & R. Wells, found ca. 25 eggs, mostly on 6-8 plants close together on exposed rocky outcrop, mostly on basal half of leaves of young plants. *Dudleya* plants further up the river where partial shade had no eggs or adults. On II-22-70, 12 more eggs. On II-27-70, most of the eggs had emerged and larvae appeared sizable if still 1st instar. They eat out the side of the egg and burrow into the *Dudleya* leaf in close proximity to the egg site, generally. Larvae were feeding head down and burrowed deep within the leaf; several found crawling over the leaf surface.

Observations of larvae in the wild:

- (1) 3 mi. NE of Auburn, Placer Co., V-13-69, three 5th instars in *D. cymosa* leaves along road; feeding evidence of earlier larvae in many plants.
- (2) 4 mi. N. Placerville, So. Fk. American River, El Dorado Co., V-4-69, leg. OS & R. F. Denno. Found about 3 last instar, 4-6 3rd-4th (?) instar larvae in *Dudleya* leaves on a small slate knob by river. Larvae red, mine inside of leaves, located by disturbed leaves and frass by entrance holes; all were inside the leaves.
- (3) Vicinity of Briceburg, Mariposa Co., V-6-69, leg. OS & N. La Due. Along old RR track line on N. side of river. Numerous larvae (ca. 50) found mining leaves of *D. cymosa*. Plants in exposed places had mined leaves but no larvae, other plants in less exposed places had ca. 2nd-5th instar larvae. Larvae were sometimes found on the outside of the leaves. Some larvae also found on road cut along W. side of road ca. ½-¼ mi. S. of Briceburg.

ADULT BEHAVIOR

Observations of adult behavior:

- (1) Murderer's Bar, II-13-71, leg. OS & R. Wells. 58 ♂♂ 12 ♀♀ *sonorensis* taken, ♂♂ flitting about tops of a weed (perhaps in search of freshly emerged ♀♀)

and flying over areas where *Dudleya cymosa* grew, along roadcut banks at various rock outcroppings and S-facing slope of monolithic limestone rock above the Bar. ♀♀ noted flying low, slowly over *Dudleya* and alighting on *Dudleya*. Most adults taken between 11:00 am-1:00 pm PST, in wind protected areas behind rocks. Warm, dry day, clear in morning, 65-75°, probably up to 80° in protected areas near rocks, cooler and high overcast later in the afternoon (2 pm on). A small swift lizard noted following a ♀ *sonorensis* that flew close to rocks over *Dudleya*'s, almost got her. II-12-72, no *sonorensis* on a warm day; *Dudleya* mostly small, few nearly full-grown. Nearly all January was cold. Warm weather the next week, and 65 adults (10 ♀♀) taken on II-19 & 20-72, also a few eggs. By May 6th, the *Dudleya*'s were fast drying out and most in bloom; much evidence of feeding in dried-out leaves but no larvae found.

- (2) Chili Bar, 4 mi. N. Placerville, II-21-70, leg. OS & R. Wells. 16 ♂♂ 3 ♀♀ mostly freshly emerged, taken between 1:00-2:30 pm PST, all showed "flutter flight" in a small outcrop of slate with *Dudleya*, exposed directly to sun. Several ♂♂ also perched on vegetation and rocks.
- (3) 18 road mi. W. Patterson, Del Puerto Canyon, cal. 1700' Stanislaus Co., III-7-70, 1 ♀ worn *sonorensis* "sunning" near *Dudleya* plants on slope.
- (4) Briceburg, III-11-72, 1 ♀ oviposited on leaf underside of *D. cymosa* at 12:15 pm PST, after alighting on plant, walking down leaf, flexing hind wings back and forth, then walking underneath, in rather jerky motions.
- (5) At Skelton Creek Canyon E. of Jerseydale, Mariposa Co., in 1970, J. F. Emmel & I noted several ♂♂ adults that rocked from side to side while alighted, with wings partway open (4-5X), = "clicking" motion.
- (6) Sentenac Canyon and Two Mile Hill, San Diego Co., II-14-65, R. Breedlove took 16 ♂♂ 2 ♀♀, temperature 55° F., the only butterflies on wing at this cool temp. (Thorne records).



Fig. 3 *P. sonorensis* larva, ca. 4th instar, entering a new leaf of *Dudleya cymosa* to feed; note also the *sonorensis* egg; Middle Fork American River, 4 mi. NE Auburn, Placer Co., Calif., March 1971 (courtesy J. Mori).

- (7) Scissors Crossing, San Diego Co., III-4-56, 6 ♂♂ 3 ♀♀, so windy they were almost unable to fly (F. T. Thorne).

I have seen ♂♂ in "patrol" flights up and down the canyons at side draw in Sentenac Canyon and vicinity of Scissors Crossing, and at La Pressa Canyon, SE of Dictionary Hill, in San Diego Co. Adults fly over open rocky slopes where *Dudleya* is growing at Jerseydale and Del Puerto Canyon.

Adults feeding on flowers appears to be rarely observed. One fresh ♂ on "sweet alyssum flowers", *Lobularia maritima*, a European escape, at La Tuna Cyn., Los Angeles Co., III-5-48 (W. H. Evans, AM). At Chili Bar, 4 mi. N. Placerville, some adults were seen on *Lomatium* sp., II-18 and III-15-71 (leg. R. Wells). At Briceburg, III-11-72, several fresh ♂♂ were noted hovering around a damp seep.

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Fig. 4. *P. sonorensis* male sunning on a weed, Middle Fork American River, 4 mi. NE Auburn, March 1971 (courtesy J. Mori).

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