BULLETIN OF THE ALLYN MUSEUM

Published by
THE ALLYN MUSEUM OF ENTOMOLOGY
Sarasota, Florida

Number 36 28 May 1976

Revisionary Notes on *Plebejus (Icaricia) shasta* (Edwards)[1]

Clifford D. Ferris[2]

College of Engineering, University of Wyoming, Laramie, Wyoming 82071

INTRODUCTION

In a prior paper (Ferris, 1970), an arrangement for the subspecies of *Plebejus (Icaricia) shasta* (Edwards) was suggested and a new subspecies was described. Subsequent collecting and distribution studies indicate that several revisions are necessary relative to the 1970 work. The present paper presents distribution data for the *P. shasta* complex and a more strict definition and renaming of the subspecies *browni* Ferris.

Plebejus shasta can be separated into three general groups: the California high Sierran population represented by nominate *shasta;* the Great Basin and prairie populations which are herein all referred to *minnehaha* (Scudder); the arctic-alpine population originally described from Colorado and Wyoming, and designated in 1970 as *browni.*

TAXONOMIC STUDIES

Extensive studies of the facies and the male and female genitalia of *Plebejus shasta* from throughout its range have been conducted. As illustrated by Figs. **23-31**, the male genitalia are quite uniform and the minor variations shown in Ferris (1970, Fig. 1) are not now considered significant, and most probably relate to artifacts in preparing the balsam slides from which the drawings were made. Several female genitalia were found to be abnormal or aberrant. Initially it was thought that two species might be involved, as in *P. acmon* (Westwood and Hewitson) and *P. lupini* (Boisduval) (discussed in a later section of this paper). Examination of more than eighty females yielded six sterigma of the narrow morph shown in Fig. **34**, including two specimens each froh lialiftr ia and Wyoming, one from Nevada, and one from "Petros", Washington (see subsequent discussion of this locality). Three females of *minnehaha* were entirely lacking in reproductive structures. These specimens were from Dinosaur National Monument, Utah, Albany Co., Wyoming, and a female paratype from North Dakota. This condition

[1]Published with the approval of the Director, Wyoming Agricultural Experiment Station, as Journal Article no. JA 787.

[2]Research Associate, Allyn Museum of Entomology, Sarasota, Florida; Museum Associate, Natural History Museum of Los Angeles County, Los Angeles, Calif.

is assumed to be either of pathologic origin or a genetic defect. If the latter is the case and is prevalent in selected colonies, this could explain the paucity of North Dakota records, as only the two type pairs are known. No males were found to have lacking or abnormal genitalic structures. Differences in facies, however, are quite apparent and the several subspecies are discussed below.

Plebejus shasta browni Ferris

Original description. *Entomol. News*, 81:203-207, August, 1970.
Source. Eighty specimens collected by F. Martin Brown, 28 July, 1953.
Type locality. Powder River Pass, 9700', Johnson Co., Wyoming. The type pair is in the collection of the Natural History Museum of Los Angeles County.

Discussion - Detailed examination of numerous Colorado and Wyoming specimens indicates that an unfortunate choice of type locality was made for this taxon. All known Wyoming specimens should be referred to subspecies *minnehaha*, while the montane populations in Colorado represent a distinct entity. Since this means that *browni* falls into synonomy with *minnehaha*, the name *browni* is not available to apply to the Colorado alpine insect. With all due apologies to F. M. Brown for whom the subspecies was named, a new taxon is now proposed to represent the arctic-alpine subspecies from Colorado.

Plebejus shasta pitkinensis, new subspecies

Male - Dorsal surface: Subdued medium blue-violet; marginal fringes pale gray to almost white; narrow brown outer margin shading to gray-brown and gray basad; HW with submarginal row of small triangular chevrons, apices directed basad; distinct submarginal light line distad of chevron row, interrupted by dark veins, and followed by dark band next to fringe; FW with short, narrow cell-end spot; HW discal cell spot small to indistinct. Ventral surface: pale gray-brown, lighter distally than basally; fringes nearly concolorous with ground color of wing; spots medium golden brown faintly ringed by gray; HW with marginal row of metallic green spots, often with dark centers, capped basad by dull orange shading into brown; the region just basad of spots is lighter colored than remainder of wing. Length of costa (right FW), male holotype 11.7 mm.

Female - Dorsal surface: Slate-blue-gray with brownish overtones distally in fresh specimens, worn specimens have a dull brown cast; fringes showing some white but darker than in males; FW dark margins less prominent than in males; HW chevrons prominent, capped basad with dull orange lunules; FW cell-end spot prominent; HW discal cell spot more prominent than in males but indistinct in some specimens. Ventral surface: As in the males, but spots are slightly more distinct in most individuals. Length of costa (right FW), female allotype 12.4 mm.

The types are shown in Figs. **19-20**, and the features which distinguish *pitkinensis* from other subspecies of *shasta* are presented in Table **1**. The genitalia of a male paratype are shown in Fig. **31**.

Type series - 13 males and 10 females from Snowmass Lake, 12,000', Pitkin Co., Colorado. The holotype male bears the following labels: white label with black rubber-stamped data "Snowmass lake/Pitkin Co/COLO" and handwritten in black ink across the right end "12000/vii-15-31"; red label machine-printed in black "P. shasta pitkinensis/Ferris/HOLOTYPE Male". The female allotype carries a locality label identical to the male and a green label machine-printed in black "P. shasta pitkinensis/Ferris/ALLOTYPE Female". The collection dates for the paratypes, which carry blue paratype labels, are: 14-vii-31, 2 males; 15-vii-31, 3 pairs; 18-vii-31, 3 pairs (F. M. Brown is the presumed collector of the types and the 1931 paratypes); 13-16-viii-33, 4 males, 3 females, D. Davenport collector. The type series, with the exception of a paratype pair retained by the author, has been placed in the collection of the Allyn Museum of Entomology, Sarasota, Florida.

The range of the new subspecies is restricted to treeline and above treeline locations in the following Colorado counties: Boulder, Chaffee, Clear Creek, Costilla, Custer, Fremont, Gilpin, Grand, Gunnison, Hinsdale, Huerfano, Lake, Larimer, Mineral, Pitkin, Pueblo, Rio Grande, Saquache, San Juan, San Miguel, Summit. The flight period is strongly dependent upon climatic conditions and the melting of the alpine snowpacks. The butterflies may appear during the first week in July, while in some years they are not on the wing until mid-to-late August. Flight is weak and fluttery and the butterflies alight frequently upon alpine flowers.

This subspecies generally frequents cushion plant communities on partly bare ground associated with subalpine and alpine slopes and ridgetops, at elevations varying from 10,700' to 13,000'. There is some geographic variation in the blue color of the males, probably as a result of weak movement which has permitted local phenotypes to evolve. Specimens from Gilpin Co. show wider borders and a clearer blue color than the more narrow bordered and darker specimens from Clear Creek Co. (Mt. Evans and Mt. Goliath). Cottonwood Pass specimens (Chaffee Co.) tend toward grayish blue. Other local variations are observed.

Plebejus shasta minnehaha (Scudder)

Original description. Proc. Boston Soc. Nat. Hist. 17:86-91, 1874.

Source. Two males and two females collected by J. A. Allen during the Yellowstone Expedition of 1873. Specimens taken at 1800' on 26 June, 1873.

Type locality. Heart River Crossing, Dakotah [*sic*] Territory approximately fifty miles west of the Missouri River. This places the type locality at approximately where State Road 49 crosses the Heart River between Glen Ullin and Elgin, Grant Co., North Dakota. One type pair is in the collection of the Museum of Comparative Zoology at Harvard University, Cambridge, Mass. The other pair is presumed lost. The extant paratype female is illustrated in Fig. **16**.

Discussion - As shown in Ferris (1970), *minnehaha* is a low-altitude prairie race originally described from North Dakota, and not the alpine subspecies as indicated by Holland (1931). It is the most widely distributed of the three subspecies and ranges from the western Great Plains into the Great Basin and north into Canada as shown in Fig. **39**. It is a Sagebrush Zone race and generally frequents gravelly or sandy open areas, especially on ridgetops or knolls, but occasionally in canyon bottoms along washes. I have always found it in areas where *Sedum* species (usually *lanceolatum* Torrey), *Eriogonum* species, and various members of the Leguminosae grow. It is usually sympatric and synchronic with *Parnassius phoebus* ssp. Depending upon the season, it is on the wing from early July into late August. It is an erratic and rapid flyer while hovering quite close to the ground, frequently settling upon flowers or the ground. Although *minnehaha* does occur at moderate altitudes (above Angel Lake, ca. 9000', Elko Co., Nevada; slopes of Medicine Bow Peak, 11,500', Carbon Co. and Powder River Pass, 9700', Johnson Co., Wyoming), these areas are in or close to sagebrush associations. In Idaho, Montana, and Wyoming, *minnehaha* appears most common at elevations from 7000-7500'.

Subspecies *minnehaha* is distinguished from *shasta* and *pitkinensis* by its bright blue-lavender color in the males. The females vary considerably within a given colony and from colony-to-colony. In fresh specimens, there is always some basal and limbal blue overscaling on the fore- and hindwings which contrasts with the brown ground color. Many specimens, however, are nearly as blue as the males. The male genitalia are quite uniform. Specimens from the Great Basin tend to be a little brighter and have stronger dark spots (both dorsally and ventrally) than specimens from other parts of the range. I can see no reason, however, to erect any new taxa to describe local colonies within the geographic area occupied by *minnehaha*. There are too many variables involved, including possible changes in environmental conditions on a yearly basis which seem to have some influence

upon facies. Additionally, *minnehaha* occurs in rather isolated colonies and one would not expect any substantial interchange of individuals between colonies. This situation appears to have fostered the development of some local phenotypes, but these should be considered as local forms only rather than separate subspecies. Table **1** delineates the characters which separate *minnehaha* from *pitkinensis* and *shasta*. Specimens from various portions of the geographic range of the subspecies are illustrated by Figs. **15-18**.

Plebejus shasta shasta (Edwards)

Original description. Proc. Acad. Nat. Sci. (Phila.), 14:224-225, 1862.
Source. At least one pair from Dr. H. Behr.
Type locality. "California". Restricted by Brown (1970) to Sheppard Pass Trail* West, head of Tyndall Creek, 11-12,200', Tulare Co., California. The neotype

TABLE 1

Characters of Facies Applicable to Fresh Specimens

	shasta	minnehaha	pitkinensis
DFW cell-end spot	distinct	prominent	shorter and narrower than shasta; least distinct of ssp.
DHW discal cell spot	present	prominent	present to indistinct
Dark margin DFW (males)	wide, up to 50% of wing width, smallest 8.3% from Modoc Co., Calif.	10-11% of FW width	narrow, 6-7% of FW width, maximum 9.1% from Hoosier Pass, Colorado
DHW marginal spots- males	present to obsolete, largest in Cu_1, dull orange lunules present in many specimens in M_2, M_3, some capped basad with dark color, only suggestion of pale line distad of spots in some examples	prominent, largest in Cu_1; rarely any orange lunules and not capped; distinct pale gray to-white marginal line or band interrupted by dark veins, distad to spots, followed by dark band next to fringe	small to obsolete and of nearly uniform size; virtually no orange lunules in M_2, M_3, and not capped; distinct submarginal light line or band interrupted by dark veins distad of spots, followed by dark band next to fringe
Fringe (dorsally)	pale gray to white	white- occasional dark hairs in females	pale gray to almost white
Color- dorsal surface- males	dull to dark blue-violet, frequently heavily suffused or shaded with brown	bright blue-lavender	subdued medium blue-violet
Color- dorsal surface- females	brown, varying blue overscaling from 0 to 50% of wing area	brown, overscaled with blue, sometimes blue as in males, but of paler hue	slate blue-gray shading to brown at borders
Color- ventral surface- both sexes	gray-brown to pale brown in some specimens frequently with darker shading basally and discally, quite variable, esp. in males	uniform pale gray-brown	uniform medium gray with slight "salt-and-pepper" aspect
VFW mid-cell spot in addition to cell-end spot **	present in 97.7% of 342 specimens examined	present in 37.7% of 113 specimens examined	present in 39.8% of 77 specimens examined

** The spot is sometimes double (vertically), and sometimes appears on one side only. The number of specimens indicates the number examined for the spot feature, and not the total number of specimens examined during this study.

*The Ellis and Johnson specimen labels read "Shepherd Pass Trail".

male, collected by Ellis and Johnson, 28-vii-66, is in the collection of the Carnegie Museum of Natural History, Pittsburgh, Pennsylvania.

Discussion - Nominate *shasta* occurs along the high Sierras in California through the Cascades in Oregon and into Washington (?). In addition, there is one old record from "Northwest British Columbia" and two specimens from Alaska which are discussed subsequently. Fig. **39** indicates the geographic distribution for this subspecies. In Oregon, some intergrading with *minnehaha* occurs (Klamath Co., 3000').

In the author's collection, and in various museums are numerous specimens of *shasta* bearing printed labels with the following data: Petros, Washington, R. G. Wind Collection, and dates in the early 1930's. This locality presents a problem as neither Leighton (1946) nor Pyle (1974) list *shasta* as occurring in Washington, although Holland (1931) and Comstock (1927) mention the state. The name Petros does not appear on Washington maps. Dr. Jon H. Shepard of Nelson, B.C., in correspondence with the author, has suggested that this is probably a misspelling of Pateros, Okanogan Co., Washington, a community along the Colombia River where the late J. C. Hopfinger lived. Hopfinger sold specimens and apparently tended to label much of his material "Pateros", even though the collecting sites were in surrounding areas, sometimes rather far removed from Pateros. Thus the "Petros" material may have come from such areas as Sawtooth Ridge, Harts Pass, or not from Washington at all. Since both Hopfinger and Wind are deceased, it is not possible to resolve this matter. The "Petros" specimens tend to have rather prominent dark borders, especially in the males, and in actuality may have come from the Yosemite region in California.

In the collection of the American Museum of Natural History in New York, are two females of typical *shasta* labeled Lazy Bay, Alaska, July, 1913. They appear to be slightly larger than California *shasta,* but otherwise of typical facies. Both came from the collection of H. J. Dietz. One passed through the collection of N. W. Gillham, while the other temporarily resided in the collection of P. Ehrlich. Nabokov (1949) in writing about *Lycaeides argyrognomon alaskensis* (F. H. Chermock) noted: "It is interesting to note that the first specimens were referred to what is now known as *Icaricia shasta* (Edwards). There does exist a curious homoptic resemblance between the two." He does not, however, cite the Lazy Bay locality in his records for *argyrognomon.* The two AMNH specimens are very definitely *shasta.* This species has not been taken in recent years in Alaska, although the collecting resulting from the Alaska Lepidoptera Survey has been extensive. It is possible that the specimens were mislabeled.

Also in the collection of the American Museum are two specimens of *shasta* labeled from British Columbia. One male which is typical *minnehaha* carries the data: Ft. Calgary, N.W. Brit. Columbia, Chas. Palm Coll., but no date. This locality is presumed to be Calgary, Alberta, as the specimen is typical of those from the eastern slopes of the Canadian Rocky Mtns. The other specimen, also a male, is typical *shasta* and bears data: N.W. Brit. Cola., Chas. Palm Coll., and again no date. Jones (1951) does not list records for *shasta* in British Columbia. Neither Jon H. Shepard nor Richard Guppy (*in litt.*) have any B. C. records for *shasta,* so this specimen should be considered of dubious origin until further collecting confirms the locality. The specimen is definitely not of the facies associated with Alberta material.

After examining a substantial number of *shasta* from California, in addition to a long series of "Petros" specimens, I can see no basis for retaining the subspecies *comstocki* Fox. Material from Yosemite National Park is quite variable in the width of the dark borders on the FW of the males. It is interesting to note that the examples of *shasta* and *comstocki* which Comstock (1927) figures are all from Glacier Point, Yosemite National Park. In Plate 54, Figs. 23-26 illustrate nominate *shasta* collected 11 August, 1921 and Figs. 27-30 depict *comstocki* collected 11 July, 1922. It does not seem reasonable that two separate subspecies should fly sympatrically.

The month's disparity in dates is not considered significant, since different years are involved. Of the better than 300 specimens of *shasta* that I have examined from California, the majority were collected in early to mid-July.

Additionally, the wide borders and darker colors to which Fox alluded in his description of the taxon are characters not restricted to the Yosemite population alone. Specimens from Fresno Co. exhibit exceptionally wide borders as do many of the "Petros" specimens. There is a wide variation in what I consider "good" *shasta* as indicated in Table 1 and Figs. **1-4**. At best, *comstocki* is a local form of *shasta* and has no standing with the Code of the I.C.Z.N. Source information for this taxon is:

Plebejus shasta comstocki Fox = *P. s. shasta* (Edwards)

Original description. Entomol. News 35:140-141, April, 1924.
Source. Thirty-five specimens (26 males, 9 females) taken on 11 July, 1923 by John [*sic*] D. Gunder at Glacier Point, Yosemite National Park, California.
Type locality. Glacier Point, Yosemite National Park, California. The location of the types is not known by the author. They were originally placed in the collection of Jeane D. Gunder. Paratypes from the Natural History Museum of Los Angeles County have been examined.

Further discussion - There is a date disparity that should be pointed out. Fox (1924) listed the collection date for the type series of *comstocki* as 11 July, 1923. Comstock (1927) in Plate 54, Figs. 27-28 figured the holotype male and allotype female with the date 11 July, 1922. The labels attached to the two paratypes (a male and female) that I examined from the Natural History Museum of Los Angeles County were blurred. The year could be interpreted as 1922, 1923, or 1933.

The yellow paratype labels carry the data: "PLEBEJUS/SHASTA VAR/ COMSTOCKI/ C. L. Fox" handwritten in black ink. Attached to the pin of each specimen is a white label machine-printed in black: "COLLECTION OF/JEANE D. GUNDER/[handprinted in black ink] PLEBEJUS SHASTA/*VAR. COMSTOCKI*/GLACIER POINT, Y.N.P./CALIF. JULY. 11. 19--. [numbers blurred]". Thus initially, Fox considered *comstocki* as a variational form which can be interpreted as either a subspecies or simply a local form. Fox in his description of the taxon, distinguishing *comstocki* from *shasta,* cited: "Separable from *shasta* and *minnehaha* . . . . , different ground color and absence of white markings on the under side of both male and female." Both paratypes clearly show the underside white markings characteristic of *shasta,* so it appears that Fox himself was confused about the insect. Comstock's figures depict *comstocki* with a pronounced orange submarginal spot band on the dorsal hindwing of the female, while little orange appears on the female of the illustrated *shasta.* This is a highly variable feature in the females of *shasta* from California and a distinct orange spot band or row appears more common than not.

The nominate subspecies is the darkest of the three subspecies. The ground color dorsally of the males is a dusky blue-violet, frequently heavily suffused with brown. The borders of the forewings may intrude extensively into the blue areas. Many females exhibit little to no blue color dorsally. Occasional females resemble the males. In both sexes, the ground color of the underside is quite dark, in comparison to the other subspecies, especially on the hindwings in the basal and discal areas. Two characters which separate *shasta* from the other subspecies are, in the males dorsally, the frequency of appearance of the submarginal orange lunules on the hindwings, and the extended width of the dark margins on the forewings. Other characters are summarized in Table 1.

Based upon the previous discussion, the following arrangement is proposed for the taxa referred to *Plebejus shasta:*

Plebejus (Icaricia) shasta (Edwards)

(a) *s. shasta* (Edwards), 1862
synonyms: *zelmira* (Felder & Felder), "1864-7" (October, 1865)
calchas (Behr), 1867
calcas (McDunnough), 1938 (*lapsus calami*)
nivium (Boisduval), 1869
form *comstocki* Fox, 1924
(b) *s. minnehaha* (Scudder), 1874
synonym: *browni* Ferris, 1970
(c) *s. pitkinensis* Ferris, 1976

BIOLOGY

J. F. Emmel and O. Shields have studied the foodplants and early stages of *shasta* and their work is in preparation for publication. In Colorado, oviposition has been observed for *pitkinensis* on *Trifolium dasphyllum* (T. & G.) on Baldy Peak, Custer Co. (J. Scott, *in litt.*). The prairie *minnehaha* colony which exists just east of Laramie, in Albany Co., Wyoming must use another legume, as no clover is present. Oviposition has not been observed, but adults fly in association with *Astragalus spatulatus* Sheld. *A. calycosus* Torr. has been cited as a hostplant in the Toquima Range, Nye Co., Nevada (Downey in Howe, 1975).

DISTRIBUTION

Distribution data are summarized in detail in the Appendix, while Fig. **39** illustrates the range of each subspecies. Our knowledge of the full extent of *shasta's* geographic distribution is still incomplete. Old records exist for Nebraska, Cary (1901); Leussler (1938), but Johnson (1972 [1973]) does not report the species. At present, I have no records for South Dakota, but *minnehaha* should occur in appropriate environments in the western portion of the state. Although the types of this subspecies came from North Dakota, Puckering & Post (1960) did not list it. I suspect that *minnehaha* is much more widely distributed in Idaho, Montana, Nevada, Utah and Wyoming than current records indicate. The butterfly's habitat is of such a nature that many collectors tend to pass it by as being too barren to warrant further investigation. It is a rather inconspicuous little insect and is easily overlooked, unless it is swarming as it sometimes does, or unless one is searching for it. Although many collectors have worked in eastern Colorado, it was not until 1974 that T. Dimock confirmed *minnehaha* in Weld Co.

Collection records for Washington, British Columbia and Alaska remain in doubt at this time as noted in the discussion for ssp. *shasta*. The recent reference by Gregory (1975) to its occurrence in British Columbia probably relates to the two specimens in the collection of the American Museum of Natural History mentioned previously, and to some erroneous records discussed subsequently. Jones (1951) did not list the species and Dr. Jon H. Shepard who is compiling a checklist of British Columbia butterflies has no records. There are no specimens from this province in the Canadian National Collection at Ottawa.

ERRONEOUS RECORDS

In the recently published Canadian checklist compiled by Gregory (1975), the entry "*Plebejus shasta spangelatus* Burdick" appears citing occurrence in Alberta and British Columbia. Burdick placed *spangelatus* as a subspecies of *lupini* (Boisduval). Recent studies by Goodpasture (1973) and confirmed by the author, have shown that *spangelatus* is a subspecies of *acmon* based upon the sterigma in the females, as illustrated in figs. **37-38**. The Canadian National Collection holdings in the Plebejinae were reorganized several years ago and apparently some species were incorrectly placed. To date, *spangelatus* is known only from the Olympic Mtns. in Washington. Paratypes of *spangelatus*

are in the Burdick Collection at the University of Colorado Museum, while the types are in the Canadian National Collection. *P. acmon spangelatus* is figured in Figs. **21-22**, and the genitalia in Figs. **32, 36**. The British Columbia records cited by Gregory are probably *P. acmon* and the Alberta records either *P. acmon* or *P. s. minnehaha.*

The origin of some of the other literature references noting the occurrence of *shasta* in Washington and British Columbia probably lies in a mixed series of specimens from the American Museum of Natural History collection. When I examined this series recently, four distinct taxa were included under *shasta.* There were four *bona fide* specimens of *shasta,* while the remaining specimens were as follows: *Plebejus acmon spangelatus* Burdick, 5 specimens from Hurricane Ridge, Olympic Mtns., Washington, 26-vii-41, Grace H. & John L. Sperry Collection. *Lycaeides argyrognomon alaskensis* (Chermock), 1 specimen from Whitehorse, Yukon Territory, 23-vii-42. *Lycaeides argyrognomon* nr. *alaskensis* (Chermock), 7 specimens from Smithers, B.C., 21-31-vii-31, A. M. Gartrell collector from the J. D. Gunder Collection.

Although some forms of *acmon* or *lupini* might be confused with *shasta,* the male genitalia clearly distinguish the latter from the former. Females may be distinguished by facies by anyone familiar with the species.

ACKNOWLEDGEMENTS

Many collectors and museum specialists generously provided collection records and specimens for study during the preparation of this paper. To them sincere thanks are accorded. These individuals include: C. D. Bird, Univ. of Calgary, Calgary, Alberta, F. M. Brown, Colorado Spring, Colo., H. K. Clench, Carnegie Museum of Natural History, Pittsburgh, Pa., P. J. Conway, Chicago, Ill. (Field Museum of Natural History records), J. P. Donahue, Natural History Museum of Los Angeles County, Los Angeles, Calif., E. J. Dornfield, Corvallis, Ore. (extensive distribution records for Oregon), J. D. Eff, Boulder, Colo., J. F. Emmel, Hemet, Calif., M. S. Fisher, Littleton, Colo., W. W. Gregory, Oakville, Ont., R. Guppy, Thetis Is., British Columbia, P. Herlan, Carson City, Nev., S. J. Kohler, Missoula, Mont., J. D. Lafontaine, Agriculture Canada, Ottawa, Ont., R. L. Langston, Kensington, Calif., U. Lanham, Univ. of Colorado Museum, Boulder, Colo., T. L. McCabe, Dilworth, Minn., W. C. McGuffin, Agriculture Canada, Ottawa, Ont., S. O. Mattoon, Chico, Calif., N. D. Riley, British Museum (N. H.), London., F. H. Rindge, American Museum of Natural History, New York, N. Y., J. C. Scott, Museum of Comparative Zoology, Cambridge, Mass., J. H. Shepard, Nelson, British Columbia, A. C. Sheppard, Lyman Museum, Ste.-Anne-de-Bellevue, Quebec, R. E. Silberglied, Museum of Comparative Zoology, Cambridge, Mass., R. E. Stanford, Denver, Colo. The staff of the Rocky Mountain Herbarium, Univ. of Wyoming kindly provided plant identifications.

Ms G. C. Blackman of the National Geographic Society, Washington, D. C. was most helpful in providing geographic coordinates for several localities.

The author would like to express his appreciation to Dr. Lee D. Miller and Mr. A. C. Allyn for their assistance during the preparation of this paper and for making its publication possible.

LITERATURE CITED AND COLLECTION LOCALITY SOURCES

Behr, H. H. 1867. Enumeration of the California species of *Lycaena. Proc. Calif. Acad. Nat. Sci.,* 3(4)([signature]18):279-283.

Boisduval, J. A. 1869. Lépidoptères de la Californie. *Ann. Soc. Entomol. Belge* xii (94 pp.).

Brown, F. M., Eff, J. D. and B. Rotger. 1957. *Colorado Butterflies.* Denver Museum, Denver, Colorado (368 pp.).

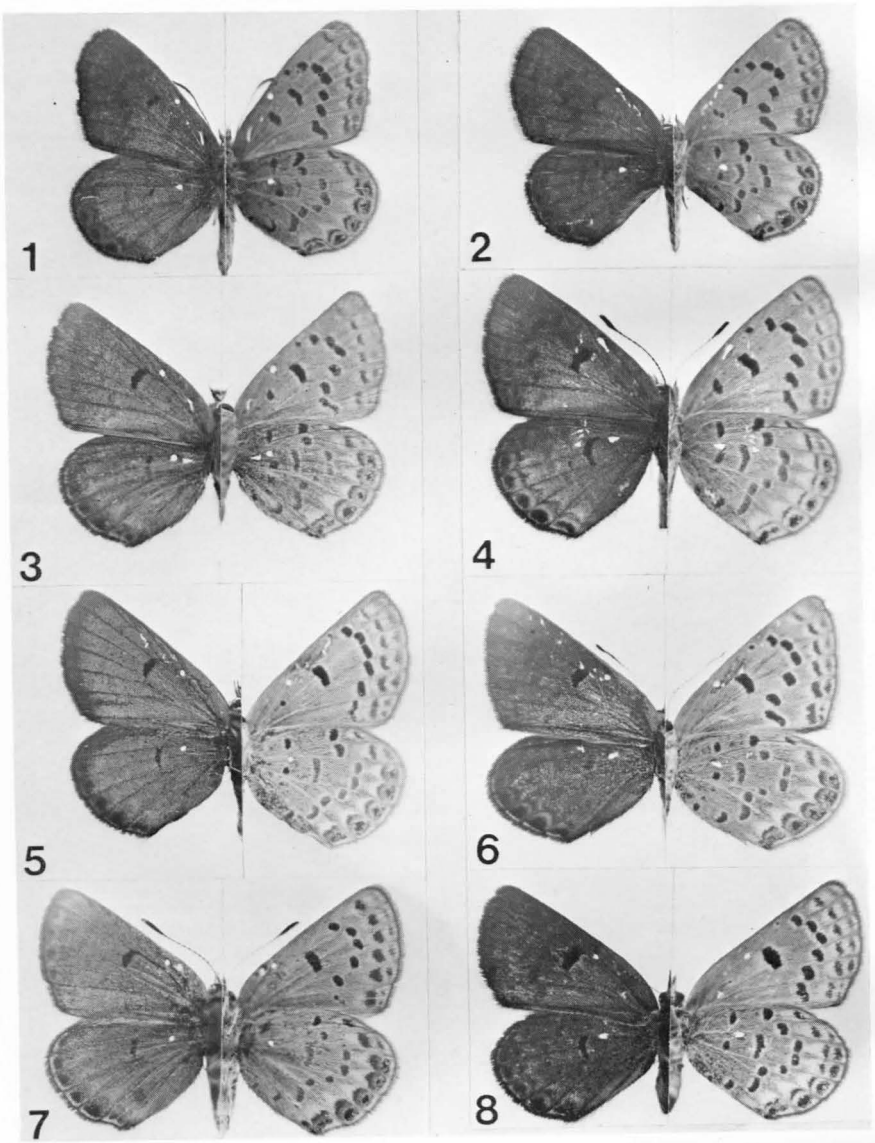
Brown, F. M. 1970. The types of the Lycaenid butterflies named by William Henry Edwards Part III. Plebejinae. *Trans. Amer. Entomol. Soc.* 96:353-433.
Callaghan, C. J. and K. B. Tidwell. 1972. A checklist of the Utah butterflies and skippers. *J. Res. Lepid.* 10(3):191-202.
Cary. M. 1901. Notes on the butterflies of Sioux County, Nebraska. *Canad. Entomol.* 33:303-311.
Comstock. J. A. 1927. *Butterflies of California.* Publ. by author, Los Angeles, California (334 pp.).
Elrod, M. J. 1906. *The Butterflies of Montana.* Bull. No. 10 Biological Series. Univ. Montana (174 pp.).
Felder, C. and R. Felder. 1865. Reise der Österreischen Fregatte Novara um die Erde, etc. Zoologischer Theil, zweiter Band, Zweite Abtheilung, Lepidoptera Heft II, Vienna, pp. 137-152.
Ferris, C. D. 1970. A new subspecies of *Plebejus (Icaricia) shasta* from Wyoming (Lepidoptera, Lycaenidae). *Entomol. News* 81:203-207.
Fox, C. L. 1924. A new Lycaenid (Lep.) from the Pacific Coast. *Entomol. News* 35:140-141.
Goodpasture, C. 1973. Biology and systematics of the Plebejus (Icaricia) acmon group (Lepidoptera: Lycaenidae) I. Review of the group. *J. Kan. Entomol. Soc.* 46(4):468-485.
Gregory, W. W. 1975. *Checklist of the Butterflies and Skippers of Canada. Lyman Entomol. Mus. and Res. Lab.* Memoir No. 3 (Special Publ. No. 10), Ste.-Anne-de-Bellevue, Quebec (44 pp.).
Holland, W. J. 1931. *The Butterfly Book.* Doubleday and Co., New York (424 pp.).
Hooper, R. R. 1973. *The Butterflies of Saskatchewan.* Sask. Dept. of Nat. Resources. (216 pp.).
Howe, W. H. 1975. *The Butterflies of North America.* Doubleday and Co., Inc. Garden City, New York (633 pp.).
Johnson, K. 1972(1973). The butterflies of Nebraska. *J. Res. Lepid.* 11(1):1-64.
Jones, J. R. J. L. 1951. *An Annotated Checklist of the Macrolepidoptera of British Columbia.* Ent. Soc. Brit. Columbia, Occ. Pap. 1.
Leighton, B. V. 1946. The Butterflies of Washington. *Univ. Wash. Publ. in Biology* 9:47-63.
Leussler, R. A. 1938. An annotated list of the butterflies of Nebraska with the description of a new species (Lepid.: Rhopalocera). *Entomol. News* 49:3-9, 76-80, 213-218, 275-280.
Nabokov, V. 1949. The Nearctic members of the genus *Lycaeides* Hübner (Lycaenidae, Lepidoptera). *Bull. Mus. Comp. Zool.* 101(4):478-543 (p. 498).
Puckering, D. L. and R. L. Post. 1960. *Butterflies of North Dakota.* North Dakota Agric. Coll., Fargo, North Dakota.
Pyle, R. M. 1974. *Watching Washington Butterflies.* Seattle Audubon Soc., Seattle, Washington (109 pp.).
Scudder, S. H. 1874. Report on the butterflies collected by Mr. J. A. Allen on the Yellowstone Expedition of 1873. *Proc. Boston Soc. Nat. Hist.* 17:86-91.

APPENDIX

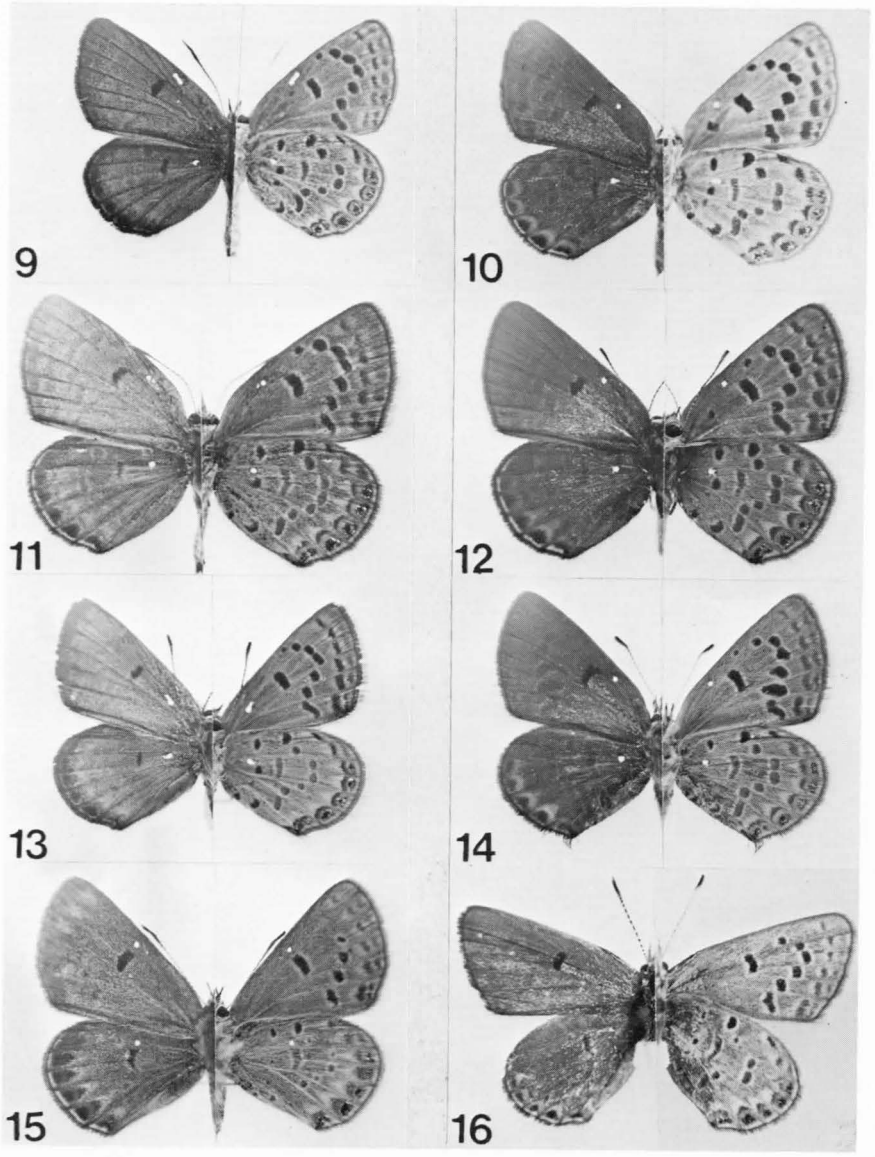
Collection Records and Material Studied

In the interest of conserving space, dates, number and sex of specimens, and collector's names are omitted. Since flight times are quite variable from year-to-year, extremum dates are indicated for each subspecies. Over 1000 specimens of *Plebejus shasta* ssp. were examined during this study, and additional information was supplied by individual collectors and museums.

Collector's names (from specimen labels): R. J. Albright, J. A. Allen, J. H. Baker, W. Bauer, H. M. Bower, F. M. Brown, C. J. Callaghan, F. C. Clark, J. A. Comstock, C. R. Crowe, D. Davenport, H. J. Dietz, T. Dimock, D. Dirks, E. J. Dornfeld, J. F.



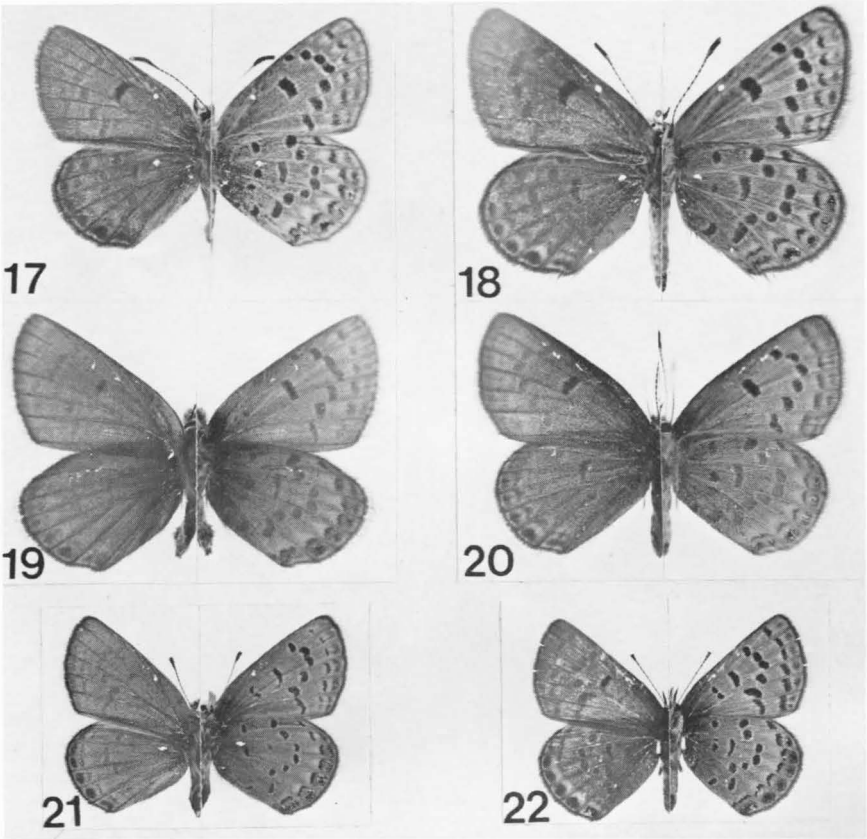
Figures 1-8: *Plebejus shasta* subspecies. 1-4: *P. s. shasta;* Male (1) and female (2) "Petros", WN, 9-vii-32 (R. G. Wind), male (3) Mt. Shasta, Siskiyou Co., CA 28-vii-32, and female (4) Carson Spur, Mono Co., CA 24-vii-58 (R. J. Jae). 5-8: *P. s. minnehaha;* male (5) and female (6) Cathedral Valley Rd., Wayne Co., UT 19-vi-72 (S. Ellis), male (7) jct. Highwood Rd. and Kananaskis Rd., Bow River For., ALTA 15-vii-70 (C. D. Ferris), female (8) Wheeler Peak, Snake Range, White Pine Co., NEV 2-viii-70 (C. Callaghan).



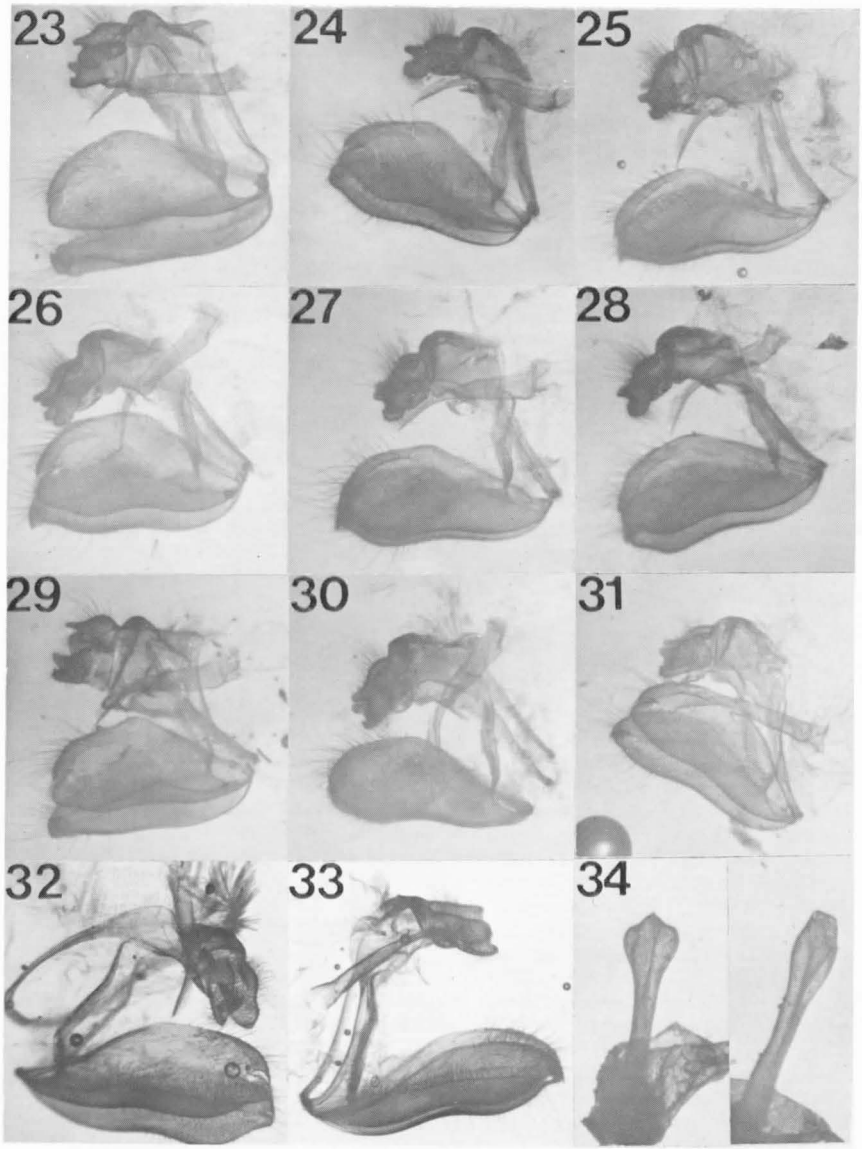
Figures 9-16: *Plebejus shasta minnehaha.* Male (9) and female (10) above Angel Lake, E. Humboldt Range, Elko Co., NEV 11-vii-74 (C. D. Ferris), male (11) and female (12) 5.6 mi. SE park Creek Camp, Challis N.F., Custer Co., IDA 17-vii-72 (C. D. Ferris), male (13) and females (14-15) T15N, R73W, E of Laramie, Albany Co., WYO 12-vii-70, (15) 16-vii-69 (C. D. Ferris), female paratype (16) Heart River Crossing, Dakota Territory, 26-vi-1873 (J. A. Allen) [specimen is in the collection of the Museum of Comparative Zoology, Cambridge, Mass.].

Emmel, J. D. Eff, S. Ellis, W. A. Evans, C. D. Ferris, M. S. Fisher, A. M. Gartrell, A. I. Good, L. P. Grey, D. R. Groothuis, J. D. Gunder, R. L. Hardesty, M. I. Howard, W. H. Howe, R. R. Hooper, R. J. Jae, S. G. Jewett, (?). Johnson, S. J. Kohler, R. J. Lavigne, F. E. Lutz, J. Macoun, L. M. Martin, S. O. Mattoon, D. Meadows, J. C. and N. H. Montgomery, V. Nabokov, W. P. Neill, C. W. Nelson, E. J. Newcomer, J. S. Nordin, C. Palm, F. and J. Preston, R. H. Reid, F. H. Rindge, B. Rotger, J. Scott, O. E. Sette, O. Shields, G. H. and J. L. Sperry, R. E. Stanford, K. B. Tidwell, J. B. Wallis, R. G. Wind, J. K. Windsor, F. H. Wolley Dod, A. K. Wyatt.

P. shasta minnehaha 19 June - 9 August
CANADA. Alberta: Canmore; Ft. Calgary (Calgary); Gleichen; 50 mi. N of Gleichen; Lethbridge; Lake Louise; Munson Ferry; Oldman River Cpgd. Rd. off Kananaskis Rd.; Wild Horse; jct. Fish Ck. and Bow River; jct. Highwood Rd. and Kananaskis Rd. **Saskatchewan:** Cypress Hills; Eston; Rosefield; Swift Current Divide; Val Marie. **UNITED STATES. Colorado:** *Jefferson Co.* Mouth of Golden



Figures 17-22: *Plebejus* species. 17-18: *P. s. minnehaha* = *browni* (paratypes); male (17) and female (18) Powder River Pass, 9700', Johnson Co., WYO 28-vii-53 (F. M. Brown). 19-20: *P. s. pitkinensis;* holotype male (19) and allotype female (20) Snowmass Lake, 12,000', Pitkin Co., COLO 15-vii-31 (F. M. Brown). 21-22: *P. acmon spangelatus;* paratype male (21) and paratype female (22) Gray Wolf Range, Olympic Mtns., Clallam Co., WN 30-vii-36 (W. N. Burdick).



Figures 23-34: Genitalic slides made after Figures 1-22 were prepared. The number in ( ) refers to figure number of specimen. 23 (1); 24 (3); 25 (5); 26 (7); 27 (9); 28 (11); 29 (13); 30 (17); 31 same data as (19) but different specimen; 32 (21); 33 *P. l. lupini,* So. boundary of Crater Lake N. P., Klamath Co., ORE 18-vii-71 (C. Goodpasture); 34 normal (left) and abnormal (right) sterigma from female *P. s. minnehaha,* Albany Co., WYO.

Gate Canyon [3 males on 30-vi-48 by J. D. Eff; record may be in error and specimens have apparently been lost]. *Moffat Co.* Echo Park Overlook and Harper's Corner, Dinosaur Nat. Mon.; Diamond Pt. *Weld Co.* 1 mi. S of Pawnee Buttes. **Idaho:** *Custer Co.* 5.6 mi. SE of Park Ck. Cpgd., 7100'. *Lemhi Co.* N side Gunsight Peak, 9200'. **Montana:** *Carbon Co.* Rock Ck. Canyon SW of Red Lodge. *Meagher Co.* Martinsdale. *Sweet Grass Co.* Swamp Ck. Rd. N of Big Timber, Crazy Mtns. **Nebraska:** *Sioux Co.* Pine Ridge area. **Nevada:** *Clark Co.* Willow Ck., Charleston Range, 6000-8000'; Mt. Charleston; Spring Mtns. *Elko Co.* Above Angel Lake ca. 9000'. *Humboldt Co.* Pine Forest Range, ca. 7500'. *Nye Co.* Toquima Range. *Mineral Co.* Cory Pk. 10 mi. S of Hawthorne, 10,200'; TV Hill, Wassuk Range, 10,000'. *White Pine Co.* Wheeler Pk., 10,000'. **North Dakota:** *Grant Co.* Heart River crossing 50 mi. W of Missouri River. **Utah:** *Box Elder Co.* Willard Pk.; Clear Ck. Canyon, Raft River Mtns. *Emery Co.* Big Spring Wash. *Juab Co.* Deep Ck. Mtns. *San Juan Co.* Buckboard Flats, Abajo Mtns. *Sanpete Co.* Mt. Sanpete. *Sevier Co.* 1 Mile Ck.; Last Chance Ck. *Tooele Co.* Deep Ck. Mtns., 9000'; Sheep Rock Mtns. *Uintah Co.* Blue Mtn. Plateau, Dinosaur Nat. Mon. *Wasatch Co.* Soldier Summit. *Washington Co.* Granite Mtn.; Cedar Mtns. *Wayne Co.* Cathedral Valley Rd. at Elkhorn Camp Rd., NE side 1000 Lake Mtn., 9400'; Cathedral Valley Rd., 8400'. **Wyoming:** *Albany Co.* Sybille Canyon; Libby Flats, Snowy Range; T15N, R73W, E of Laramie, 7500'; Telephone Ck. Canyon, Laramie Mtns., 8900'. *Carbon Co.* Bottle Ck. Camp, 9000'; nr. Medicine Bow, 6800'; slopes of Medicine Bow Peak, 11,500'; N of Riverside, 7000'; Rawlins, 6800'. *Converse Co.* Douglas, 4815'; No. Horseshoe Ck. *Fremont Co.* NE of South Pass; Dubois, 6917'. *Johnson Co.* No. Clear Ck., Cloud Peak Wilderness, 8800'; Powder River Pass, 9700'. *Natrona Co.* Casper, 5100'. *Sheridan Co.* S of Burgess Jct. *Sweetwater Co.* Green River, 6100'. *Teton Co.* Jackson, 6300'. *Yellowstone National Park.* Sylvan Pass, 8550'; unspecified locations in Park.

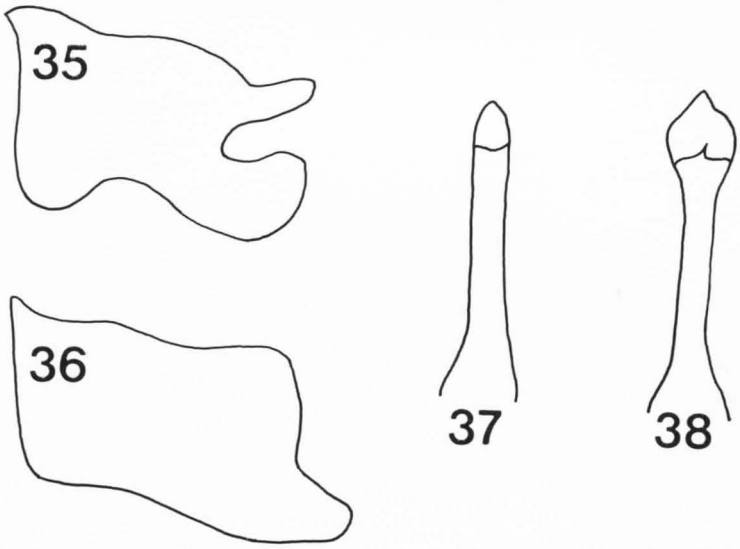


Figure 35. Lateral view of distal portion of uncus in male *P. shasta.*

Figure 36. Lateral view of distal portion of uncus in male *P. acmon* and *lupini.*

Figure 37. Sterigma of female *P. acmon.*

Figure 38. Sterigma of female *P. lupini* and *shasta.*

P. shasta pitkinensis 30 June - 1 September
Colorado: *Boulder Co.* Arapahoe Pass Trail; Banana Lake; Bob Lake N of Rollins Pass; btwn. Bob Lake and King Lake, N of Rollins Pass; Rollins Pass nr. Jenny Lake, 11,500'; above Upper Diamond Lake; Lefthand Park; Mt. Audubon; Niwot Ridge S of Long Lake; Red Deer Lake; Mt. Audubon N of Brainerd Lake; Needles Eye Tunnel, Rollins Pass. *Chaffee Co.* Cottonwood Pass; Mt. Ouray, 12,000'. *Clear Creek Co.* Mt. Evans; Mt. Goliath; Summit Lake, Mt. Evans, 12,750'; Guanella Pass, 11,665'; Loveland Pass, 12-13,000'. *Costilla Co.* Old Baldy Pk., 12,800'. Custer Co. Rainbow Lake 10,500'; 6 mi. W of Hillside, Sangre de Cristo Mtns.; Greenhorn Pk., 12,349' and ridges to NW; highest ridge of Wet Mtns., W of Pueblo. *Fremont Co.* Hayden Pass, 10,700'; 7 mi. SW of Howard; 7 mi. SW of Coaldale; West Ck. nr. Hunts Lake, 11,200', Sangre de Cristo Mtns. *Gilpin Co.* Head of Golden Gate Canyon; nr. James Pk.; Kingston Ridge S of Tolland; Rollins Pass above Heart Lake; Tolland-Apex Rd. *Grand Co.* Berthoud Pass. *Gunnison Co.* East Maroon Pass above Copper Lake; Monarch Pass, 11,312'; Cottonwood Pass, 12,095'. *Hinsdale Co.* Nr. Rio Grande Pyramid. *Huerfano Co.* Greenhorn Pk. area, ca. 12,300'. *Lake Co.* Independence Pass, 12,000'. *Larimer Co.* Fall River Pass, 12,000', Rocky Mtn. Nat. Park. *Mineral Co.* Rainbow Bridge, 12,000'; Treasure Mtn., 12,000'. *Park Co.* Vic. Alma; Hall Valley, 12,000'; Kite Lake; Mosquito Pass, 12,300'; Western Pass, 12,000'. *Pitkin Co.* Snowmass Lake, 12,000'; Snowmass Peak, 12,000'. *Pueblo Co.* Vic. Greenhorn Pk., ca. 12,300'. *Rio Grand Co.* Grayback Mtn., 12,500', nr. Summitville, *Saguache Co.* Hayden Pass area, 10,700'. *San Juan Co.* Ice Lake Basin, 12,000-12,500'. *San Miguel Co.* Dolores Peak, 12,000'. *Summit Co.* Gray's Pk.; Loveland Pass, 12-13,000'.

P. s. shasta 24 June - 16 August.
CANADA. British Columbia: "NW British Columbia" AMNH collection, probably mislabeled.
UNITED STATES. Alaska: Lazy Bay, 56°53'30" N, 154°14'30" W, AMNH collection, probably mislabeled. **California:** *Alpine Co.* Ebbetts Pass, 8730'. *Fresno Co.* Huntington Lake; Kaiser Crest; Mr. Kyser [*sic*]. *Inyo Co.* 0.5 mi. SE Goat Spgs., 4 mi. S. Co. Line Hill, White Mtns. *Kern Co.* Tehachapi Mtns. *Lassen Co.* Susan River nr. Bridge Ck. Camp, 5500'. *Mariposa Co.* Mt. Loyal. *Modoc Co.* NW slope Mt. Bidwell, Warner Mtns., 7800-8200'. *Mono Co.* Bodie; Carson Spur; Mammoth Camp; Mammoth Lakes; Minaret Summit; Mono Lake; Mt. Dana, 13,055'; Red Mtn.; Sonora Pass, 9624'; Tioga Pass, 9946'; White Mtns., 10,000'. *Placer Co.* Donner Summit nr. Truckee. *Shasta Co.* Summit City. *Siskyiou Co.* Mt. Shasta. *Tulare Co.* Kings-Kern Divide; Sheppard [*sic*] Pass Trail West, head of Tyndall Ck., 12,200'; Shepherd Pass Trail btwn. Wrights Lakes and Tyndall Ck., 11,200-12,200'. *Tuolumne Co.* Elizabeth Lake; May Lake; NW of Tioga Pass on Gaylor Lake Trail, 10,750'. *Yosemite National Park.* Bert Lake; Donahue Pass; Evelyn Lake; Glacier Point, 7214'; Helen Lake; Tioga Lake; 2 mi. NW of Tioga Pass; Tuolomne Meadows; Young Lake Trail. *Undetermined County.* Tallac Mt.; Mt. Ida; Lake Tahoe (*El Dorado* or *Placer Co.*). **Oregon:** *Deschutes Co.* Cultus Creek, 4500'; Davis Lake, 4395'; Little Cultus Lake, 4500'; Pringle Falls, 4200'; Snow Creek, 4600'. *Grant Co.* Dry Soda, 4045'. *Harney Co.* Steens Mtns: Fish Lake, 7400'; Head of Little Blitzen Ck., 9300'; Steens Mtn. Summit, 9500'. *Jefferson Co.* Nr. Camp Sherman, 3000'. *Klamath Co.* 5-10 mi. E of Beaver Marsh, ca. 4700'; Hwy. 97 10 mi. S of Beaver Marsh, 3050'; Cannon Well, 5400'; 4 mi. SE of Crescent, 4500'; Gilchrist, 4500'; Skookum Meadow, 5200'. *Lake Co.* Drake Peak, 8000', 3 mi. S of Silver Lake, 4800'. *Washington:* Okanogan Co. Vic. of "Petros" [Pateros] - locality questionable. Comstock (1927) and Holland (1931) allude to Washington records, but no hard data are given.

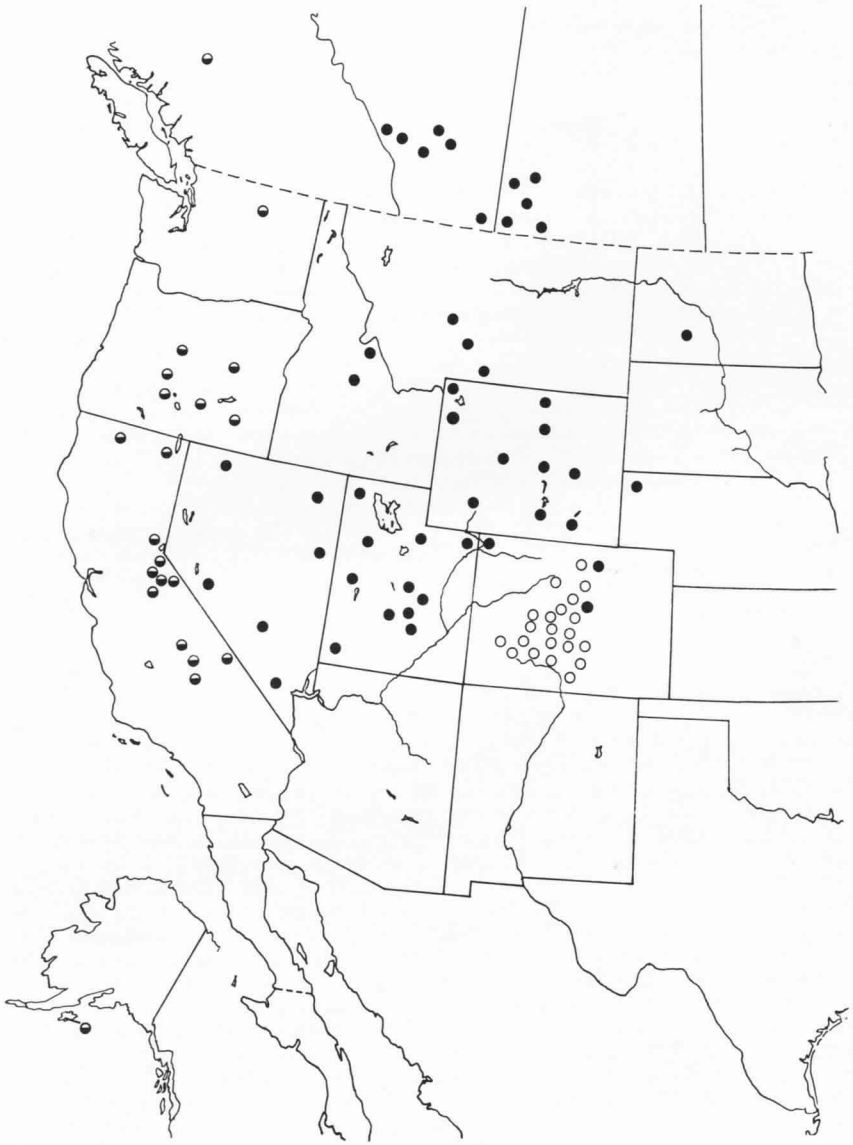


Figure 39. Distribution of *P. shasta* in North America (by county in U. S.). Solid circles = *minnehaha;* open circles = *pitkinensis;* half-open circles = *shasta.*