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Three New Nearctic Species of *Callophrys* (*Mitoura*), with a Diagnosis of all Nearctic Consubgenera (Lepidoptera: Lycaenidae)

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Introduction and Review of Literature

The paper includes descriptions of three new species and two new subspecies of *Callophrys* (*Mitoura*) along with an analysis of diagnostic characters for all species of the subgenus. In addition, pertinent knowledge from related recent investigations of the group (Johnson 1976a, 1976b, 1976c, 1976d, 1976e) is reviewed.

A project to determine foodplant diversity in *Callophrys* (*Mitoura*) species whose larvae were known to feed on various members of the cypress family (Cupressaceae) (Johnson, 1976a) purposely excluded some western Nearctic populations because of unresolved taxonomic problems. Mainly, these problems concerned the populations previously considered as *C. (M.) nelsoni* (Boisduval). A study of genitalic variation of the Cupressaceae-feeding *Callophrys* (*Mitoura*), excluding *C. (M.) nelsoni*, enabled a reassessment of species limits for the group's included species. All taxa, as redefined by such study (Johnson, 1976c, 1976d) or suggested for redefinition through further work, are homogeneous in their foodplant usage, wing color and maculation, as well as genitalic characters. This standard, applied to an analysis of the geographic ranges and diagnostic relationships of *C. (M.) nelsoni* and the phenotypically similar Great Basin *C. (M.) siva* (Edwards) populations, led to a taxonomic resolution consistent with their respective use of *Libocedrus* sp. and *Juniperus* sp. as larval foodplants (Johnson, 1976e). It also disclosed northwestern United States and Canadian *Callophrys* (*Mitoura*) populations representing three previously undescribed species. These had formerly been considered *C. (M.) nelsoni* but were known in some cases to utilize *Thuja* sp. as the larval foodplant.

The three new species described herein not only represent homogeneous entities, each with consistent foodplant, genitalic, and wing characters, but are of further significance with regard to phyletic relationships within the subgenus. They form a species cluster intermediate in genitalic and wing characters between the previously known Cupressaceae-feeders and the other *Callophrys* (*Mitoura*) species known for exclusive use of Loranthaceae (*Arceuthobium* spp.) i.e. *C. (M.) spinetorum* (Hewitson) and *C. (M.) johnsoni* (Skinner). This paper will describe the new species within the context of other such homogeneous entities of the subgenus as defined by distributional, foodplant, genitalic, and wing color and maculation characters.

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Materials and Methods

The following genitalic dissections were analyzed: Males — *C. siva*, (hereafter dropping abbreviation of the subgeneric name) 39 specimens; *C. gryneus* (Hübner), 20 specimens; *C. hesseli* (Rawson and Ziegler), 7 specimens; *C. turkingtoni* Johnson, 1 specimen; *C. sp.* (Johnson, in press), 1 specimen; *C. nelsoni* (excluding taxa named in this paper), 58 specimens; *C. spinetorum*, 10 specimens; *C. johnsoni*, 8 specimens; *C. loki* (Skinner), 8 specimens; taxa newly described in this paper, 30 specimens; Females — *C. siva*, 49 specimens; *C. gryneus*, 32 specimens; *C. hesseli*, 7 specimens; *C. nelsoni* (excluding taxa named in this paper, 45 specimens; *C. spinetorum*, 10 specimens; *C. johnsoni*, 8 specimens; *C. loki*, 7 specimens; taxa newly described in this paper, 42 specimens; total, both sexes, 395 specimens dissected. In the northwestern United States and Canada, individuals of each known population previously considered to constitute *C. nelsoni* were dissected. Differences discovered during examination and evaluation of these dissected genitalia were then considered in light of the distributional and foodplant integrity of the various phenotypes, along with consideration of their wing color and maculation characters.

Descriptive words for genitalic characters in the group were standardized, defined, and used consistently in the figures and text. Similarly, color terms were used from Ridgway (1912) but related in a separate table to more colloquial terms for persons not having access to this source.

The newly described species are placed in context with the entire subgenus by review of the diagnostic genitalic characters for all species. Likewise, the geographic distributions and foodplant affinities helping define the Cupressaceae-feeding species are presented along with discussion of the pertinent relationships between them.

Results

The categorical genitalic characters defining the Nearctic species of *Callophrys* (*Mitoura*) are presented in Figures 1-3. Standardized nomenclature for describing these structures is presented in the introduction to Table I, a table listing the diagnostic characters of each taxon. The geographic distributions of entities homogeneous in foodplant, genitalic, and wing color and maculation characters are illustrated in Figure 4. Some of these taxa are currently considered subspecies and future work will need to redefine them. However, to illustrate the new taxa within a taxonomically consistent concept of the entire group, they are presented here as distinct entities. For reference, a summary of the known foodplant affinities within the subgenus (Johnson, 1976a) is presented in Table II. A discussion of significant data important to introducing the new taxonomic descriptions follows below.

(Figures 1-3)

Figs. 1-3. Three consecutive pages illustrating by silhouette the categorical diagnostic male and female genitalic traits distinguishing twelve species of Nearctic *Callophrys* (*Mitoura*). Characters illustrated include (top to bottom): male traits — shape of valvae caudad saccus, and saccus; lateral shape, valvae; shape of cornuti, caudal end, aedeagus. female traits — shape of genital plate; shape of signa, corpus bursa, if present.

Order left to right follows "linear" arrangement based on genitalic similarities but may not imply exact phylogenetic relations especially since some new Mexican species are not included.

Order also includes Loranthaceae-feeders (*C. spinetorum*, *C. johnsoni*) at left and Cupressaceae-feeders (remaining ten species) at right [proceeding from *Libocedrus*-feeder (*C. nelsoni*), to *Juniperus*-feeders (*C. siva*, *loki*, *gryneus*, and *g. sweadneri*), to *Chamaecyparis*-feeder (*C. hesseli*), to one related Mexican species possibly feeding on *Juniperus flaccida* (*C. turkingtoni*)].

SACCUS VALVAE, ANTERIOR

SPINETORUM



Wide-rimmed,
unindented,
hairy
Parabolic

JOHNSONI



Wide-rimmed
indented,
hairy
Pointed

BYRNEI



Narrow-rimmed
Parabolic,
unindented
Pointed

BARRYI



Wide-rimmed,
oval
Funnel

VALVAE, LATERAL



Round-tapered,
straight



Round-tapered,
curvea



Round, two-
shouldered



Round, two-
shouldered

AEDEAGUS



two, large



two, medium

GENITAL PLATE



SIGNA



dorsal and
ventral



dorsal and
ventral



dorsal and
ventral

dorsal



ventral

ROSNERI



Mid-rimmed, in-
dented, slightly
spiney

Parabolic

NELSONI



Narrow-rimmed,
Round, indented.

Pointed

SIVA



Narrow-rimmed,
parabolic,,
unindented

Pointed

LOKI



Narrow-rimmed,
Parabolic,
indented

Parabolic



Round, one-
shouldered



Chevron-tapered



Round-tapered



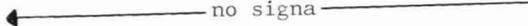
Round-tapered



ventral



dorsal



GRYNEUS



Narrow-rimmed
Slightly shouldered,
indented

Parabolic



Broad-tapered

SWEADNERI



Narrow-rimmed,
Shouldered,
indented

Parabolic



Very broad-tapered

HESSELI



Narrow-rimmed,
Shouldered,
indented

Wide-parabolic



Pointed-tapered

TURKINGTONI



Narrow-rimmed,
Shouldered,
Half-spiny

Parabolic



Pointed-tapered



two, small



"three"



F
E
M
A
L
E

U
N
K
N
O
W
N

no signa

TABLE I

Genitalia of *Callophrys* (*Mitoura*)

Male:

Male genitalia are figured in full for several species in this paper. All *C. (Mitoura)* follow this general structure with diagnostic differences between the species always involving 1. lateral shape of the valvae 2. shape of the valvae caudad the saccus 3. shape of the saccus 4. shape of the aedeagus and/or cornuti. Differences in the shape of the valvae caudad the saccus involve peculiar characters in this group: the valvae curve cephalad and join in various bilaterally symmetrical shapes. This shape is formed by the outline of the sclerotized "rim" of the valvae (shown in silhouettes of Figures 1-3). This rim is sometimes thin with the enclosed area so lightly sclerotized as to be "clear", or in some species very thick with the enclosed area heavily sclerotized and spiny. In still others the rim may be very thick with the enclosed area clear. The degree of indentation where these rims join above the saccus is often diagnostic. The lateral shape of the valvae is usually diagnostic either in its "whole" shape (as in the "irregular" configuration of these new species) or in degrees of difference between related species. The saccus is usually not diagnostic but sometimes possesses a unique trait (like a "notch" or a unique shape). The aedeagi of species differ either in cornuti size or configuration; related species often have very similar aedeagi.

Female:

Female genitalia are extremely helpful in the *Callophrys (Mitoura)* and must be considered in any taxonomic study. Diagnostic traits usually include the presence or absence of signa in the corpus bursae, shape of the lamellae, in some related species the degree of sclerotization where the lamellae join each other or where they join the eighth abdominal sternite, shape and length of the ductus bursae, and nature of the juncture of the ductus bursae with the corpus bursae.

Table of Diagnostic Traits of Male and Female Genitalia in Nearctic

Callophrys (Mitoura)

(in order of illustrations in Figures 1-3)

Female Species	Diagnostic Traits
<i>C. spinetorum</i>	One large signa, upper and lower surface, corpus bursa. Ductus bursae widely cylindrical, flaring out to lamellae. D. bursae joined flush with corpus bursae.
<i>C. johnsoni</i>	One large signa, upper and lower surface, corpus bursae. Ductus bursae widely cylindrical, so wide as not to flare to lamellae. D. bursae joined flush with corpus bursae.
<i>C. byrnei</i>	Two small chevron-shaped signa, upper and lower surface corpus bursae. Ductus bursae cylindrical, flaring widely to roundly "spatulate" lamellae. D. bursae joined flush with corpus bursae, lower surface.
<i>C. barryi</i>	Two small chevron-shaped signa, upper and lower surface corpus bursae. Ductus bursae noticeably narrowing at antrum, lamellae more "mallet" shaped. D. bursae joined to c. bursae with fan-shaped sclerotized structure, upper surface, "wide-armed" structure, lower surface.
<i>C. rosneri</i>	Two signa, one chevroned, other joined to it as a line (= "arrowed"), upper surface, sometimes only as two dots,

- lower surface, corpus bursae. Ductus bursae tapering gradually to antrum, joined to c. bursae with fan-shaped sclerotized structure with obvious mid-rib, upper surface, "wide-armed" structure, lower surface.
- C. nelsoni* Usually no signa, single minute signum apparent in scattered populations (*Cupressus*-feeders). Lamellae more "mallet" shaped, ductus bursae gradually tapering to antrum, slightly sclerotized fan-shaped structure at juncture of ductus bursae and corpus bursae.
- C. siva* No signa, except occasional minute one in some brown populations. Ductus bursae tapering less sharply than *nelsoni*, "club-ended." Lamellae hemispherical, much broader than long; bulky ridges and convolutions where lamellae join each other. No "wide-armed" or fan-shaped structure at juncture with corpus bursae. Lamellae joined heavily to eighth abdominal sternite by sclerotizations.
- C. loki* No signa. Ductus bursae very short, lamellae widely hemispherical, more like *gryneus*.
- C. gryneus* No signa. Ductus bursae longer than *siva* or *loki*, not "club-ended." Lamellae nearly as long as broad, no ridges or convolutions where they join. No distinct structures where d. bursae joined c. bursae.
- C. "g." sweadneri* One signa. Ductus like *siva*, less "club-ended". Lamellae hemispherical, ridges and convolutions beneath 1. postvaginalis as it joins. 1. antevaginalis.
- C. hesseli* No signa. Ductus bursa flaring outward to lamellae such that it appears to taper caudad, rather than cephalad as on other species.
- C. turkingtoni* Female unknown.
- Male*
- C. spinetorum* Valvae, caudad saccus, heavily sclerotized and spiny, Broadly parabolic, unindented, "rims" wide. Saccus parabolic. Aedeagus, cornuti wide, disklike.
- C. johnsoni* Valvae, caudad saccus, heavily sclerotized and spiny. Less broadly parabolic, slightly indented, "rims" wide. Saccus pointed notched below valvae.
- C. byrnei* Valvae, lateral shape "irregular". Valvae, caudad saccus not heavily sclerotized or spiny (= "clear"), narrowly parabolic, unindented, "rims" narrow. Saccus parabolic, notched below valvae. Aedeagus, cornuti intermediate.
- C. barryi* Valvae, lateral shape "irregular." Valvae, caudad saccus "clear", hugely ovate and wide-rimmed. Saccus "funnel" shaped. Aedeagus, cornuti intermediate.
- C. rosneri* Valvae, lateral shape, somewhat "irregular". Valvae, caudad saccus "clear" but somewhat sclerotized and spiny caudad, broadly parabolic, not indented (slightly indented, one ssp.), "rims" medium. Saccus parabolic. Aedeagus, cornuti intermediate.
- C. nelsoni* Valvae, lateral shape, area between upper and lower articulation with vinculum deeply concave in incised "chevron" shape, not "shouldered" or "rounded" as characteristic of "irregular" shape. Valvae, caudad saccus, "clear", rounded and indented, "rims" narrow. Aedeagus, cornuti thin.
- C. siva* Valvae, lateral shape, area between upper and lower articulation with vinculum deeply concave in rounded shape, otherwise like *nelsoni*. Valvae, caudad saccus, "clear",

- C. loki* parabolic and unindented, not shouldered caudad as on *gryneus*. Saccus, short, parabolic. Aedeagus, cornuti thin. Valvae, lateral shape, area between upper and lower articulation with vinculum deeply concave, somewhat "chevron" in shape, slightly "shouldered" as in "irregular" shape of *rosneri*. Valvae, caudad saccus, "clear", roundly parabolic, slightly indented, "rims" narrow. Aedeagus, cornuti thin.
- C. gryneus* Valvae, lateral shape, area between upper and lower articulation with vinculum only slightly concave. Valvae, caudad saccus, "clear", rounded and indented, shouldered caudad. Saccus, long, broad. Aedeagus, cornuti thin.
- C. "g." sweadneri* Valvae, lateral shape, area between upper and lower articulation concave. Valvae, caudad saccus, "clear", rounded and indented, extremely shouldered caudad. Aedeagus, cornuti long, thin.
- C. hesseli.* Valvae, lateral shape, caudad extension of valvae much longer than other species, roundly concave between upper and lower articulation with vinculum. Valvae, caudad saccus, "clear", broadly rounded, slightly indented, extremely shouldered caudad. Aedeagus, cornuti thin.
- C. turkingtoni* Valvae, lateral shape, caudad extension of valvae even longer than *hesseli*. Valvae, caudad saccus, only partly "clear", heavy sclerotization beginning immediately caudad. Falces not arched caudad, but straight. Saccus parabolic. Aedeagus, upper cornutus bifurcate.

Note: The structure of the labides on *Callophrys (Mitoura)* is usually not helpful in diagnosis since they are subject to distortion by dissection. However, in *C. byrnei* and *C. barryi* the structures are distinctive, as can be noted in the drawings accompanying the taxonomic descriptions.

Glossary of nomenclature used in describing configurations of genitalia in this paper (Table I and Figures 1-3).

Shape of Valvae, Caudad Saccus

- | | |
|---------------|---|
| Wide-rimmed | Heavily sclerotized edge of valvae, caudad saccus, forming bilaterally symmetrical configuration is very wide. |
| Mid-rimmed | This area is of medium width. |
| Narrow-rimmed | This area is narrow, forming only a distinct outline. |
| Indented | Area where bilaterally symmetrical rims join, immediately caudad the saccus, exhibits "w"-shaped configuration. |
| Unindented | This area is completely entire, with edge curved or straight. |
| Spiny | Area enclosed by "rims" heavily sclerotized and showing many spines (indicated by cross-hatching, Figures 1-3). |
| Clear | This area so lightly sclerotized as to be transparent |

Shape of Saccus

- | | |
|----------------|---|
| Parabolic | Saccus gradually tapering and rounded cephalad. |
| Pointed | Saccus abruptly tapering and pointed cephalad. |
| Funnel | Saccus broader caudad, forming "funnel"-shape. |
| Wide-parabolic | Saccus parabolic, but tapered less gradually. |

Lateral Shape of Valvae

- | | |
|-------|--|
| Round | Refers to shape of the valvae between its dorsal and ventral |
|-------|--|

	articulations with the vinculum, in this case being obviously ovate.
Tapered	The valvae extending caudad taper gradually to a point.
Round-tapered	Shape characterized by the above two combinations.
Two-shouldered	The "arms" of the valvae articulating dorsally and ventrally both are distinctly curved, preventing gradually tapering configuration.
Irregular	The combination of Round and Two-shouldered, characterizing the three newly described species.
Straight	Shape of valvae from arm ventrally articulating with vinculum to caudal point is not obviously curved.
Curved	Shape of same is more obviously curved or wavy.
One-shouldered	A reduction of the Two-shouldered condition by less curvature in arm articulating dorsally to the vinculum.
Chevron	Shape of valvae between dorsal and ventral articulations with vinculum distinctly angled and not curved.
Broad	Area between dorsal and ventral articulations with vinculum only slightly ovate.
Pointed-tapered	Caudal extensions of valvae are extremely long and slender.

Shape of *Signa*

Chevroned	<i>Signa</i> are distinctly "v"-shaped
Arrowed	There is a single chevron followed by a sclerotized line.

Shape of *Cornuti*

Large	Expansive and disklike.
Medium	Small, but broad.
Small	Small and narrow.
Three	Three distinct tips, not two.

Discussion

As mentioned above, all *Callophrys* (*Mitoura*), including those described herein, form groups, each sharing related foodplants, male and female genitalic characters, as well as the more traditionally used wing color and maculation characters. This scheme remains consistent if (1.) Florida populations currently referred to as *C. gryneus sweadneri* (Chermock) and California *Cupressus*-feeding populations presently referred to as *C. nelsoni muii* (Edwards) are elevated to species status (Johnson, 1976c), and (2.) new taxa are described with strict regard to the criteria of species limits set forth in this paper. This view, as illustrated in the accompanying figures and tables, best reflects, I feel, the biological relationships between the various taxa in the subgenus.

Special mention of some unique problems in western North American *Callophrys* (*Mitoura*) is needed to provide adequate perspective on new species in the group. Firstly, the localizing nature of the perching behavior of *Callophrys* (*Mitoura*) species (Johnson and Borgo, 1976), added to the disjunct occurrences of the larval foodplants, results in extreme variation between local populations. Such local variation becomes more pronounced in *C. siva*, *nelsoni*, and this paper's new species respectively, and helps explain why (with lack of genitalic studies of the group) the latter have gone unrecognized until this time. Although there has been general acceptance of such local intra-specific variation in well-sampled California species, ignorance of the categorical genitalic differences in northwestern United States and Canadian populations (which had been noted to feed on a different genus of plants) and an unawareness of these populations' relationship to the

subgenus as a whole, most notably *C. johnsoni*, apparently resulted in their being overlooked.

Table II

Known Larval Foodplants of Nearctic Loranthaceae and Cupressaceae-feeding

*Callophrys (Mitoura)**

Loranthaceae

- C. (M.) spinetorum* various *Arceuthobium* Bieb. sp.
C. (M.) johnsoni *Arceuthobium douglassi* Engelm.

Cupressaceae

- C. (M.) byrnei* *Thuja plicata* Wats. suspected
C. (M.) barryi *T. plicata* or *Juniperus occidentalis* Hook. suspected
C. (M.) rosneri *T. plicata*
C. (M.) nelsoni muiri *Cupressus sargentii* Jeps.
C. (M.) nelsoni *Libocedrus decurrens* Torr.
C. (M.) siva *Juniperus scopulorum* Sarg.
J. virginiana L.
J. virginiana x *J. scopulorum*
J. horizontalis Moench.
J. virginiana x *J. scopulorum* x *J. horizontalis*
J. osteosperma (Torr.) Little
J. monosperma (Engelm.) Sarg.
J. deppeana Steud.
J. californica Carr.
J. occidentalis
C. (M.) loki *J. californica*
C. (M.) gryneus *J. virginiana*
J. virginiana x *J. scopulorum*
J. virginiana x *J. horizontalis*
J. ashei Buch.
J. pinchotii Sudw.
J. deppeana
C. (M.) g. sweadneri *J. silicicola* (Small) Bailey
C. (M.) hesseli *Chamaecyparis thyoides* (L.) B.S.P.
C. (M.) turkingtoni *Juniperus flaccida* Schlecht. suspected

*adapted from data in Johnson 1976a.

The apparent lack of obvious wing character differences in the ventrally brown northwestern United States and Canadian *Callophrys (Mitoura)* species needs consideration. Popular usage of the names *C. nelsoni* and *C. siva*, following the work of O. Elton Sette and Peter Herlan on Great Basin "brown" *Callophrys (Mitoura)*, led to recognition (at least in the curation of museum collections) that *C. siva* turns from ventrally green to ventrally brown in Nevada. However, it is less well known that whereas brown *C. siva* supposedly feed on *Juniperus osteosperma* (Torr.) Little, other brown *Callophrys (Mitoura)* on *J. occidentalis* Hook. in Oregon (called species *nelsoni* and purported to be extensions of *C. nelsoni* on *Libocedrus decurrens* Torr. in the Cascade Mountains of western Oregon) are actually genitically *C. siva* (Johnson, 1976e). Redefinition of Oregon brown populations in relation to more southern brown populations (Johnson, 1976e) resolved this confusion, making consistent the foodplant patterns and indicating wing traits

are convergent between these two species and not diagnostically reliable. This pattern of unreliability in wing characters demonstrates what I have found to be expected of northwestern North American *Callophrys* (*Mitoura*) populations in general, and of the new species in particular.

Thus, since one cannot lump convergent *C. siva* and *C. nelsoni* on the basis of similar wing traits and "minor" but consistent genitalic differences (since because of foodplant knowledge and similar limits in genitalic divergence it would imply considering *C. gryneus* and *C. loki* as conspecific with these as well), it is not surprising that three previously unrecognized species representing a generic foodplant difference and categorical genitalic differences have gone unnoticed because of wing trait similarity to *C. nelsoni*. In fact, excluding only two wing characters (hingwing, under surface, mesial line quite jagged toward anal angle; forewing, under surface, light marking, discal cell), *C. johnsoni* could reasonably be mistaken for the "old concept" of *C. nelsoni*, and has been in some collections. It feeds on a different family of plants and has completely different genitalia, a "step" in magnitude beyond the new complex described in this paper.

Finally, to complete the perspective in which the new species should be described, it is important to present a listing of the species groups of Nearctic *Callophrys* (*Mitoura*) as they are defined by foodplant, genitalic, and wing color and maculation characters. The list follows in the order of Table I and Figures 1-3.

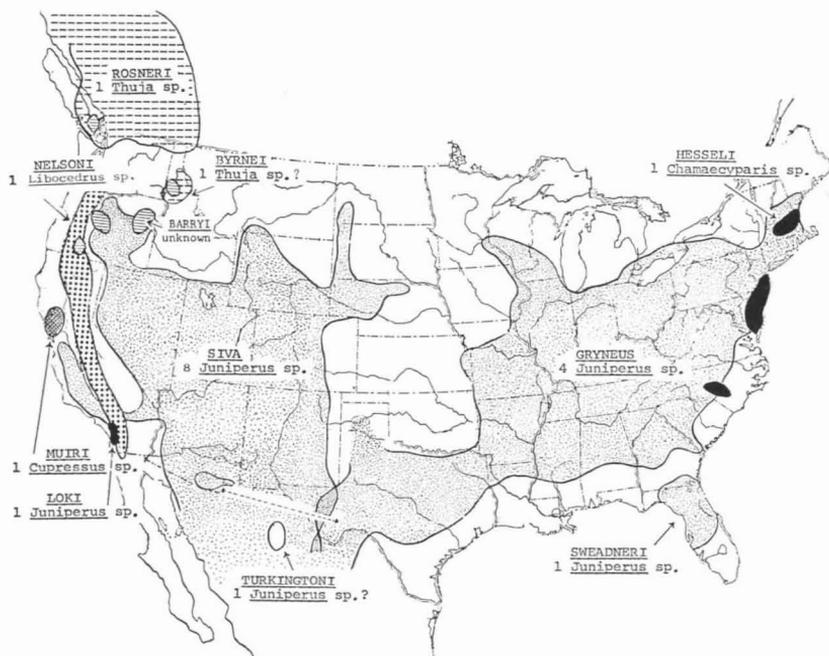


Fig. 4. Map of Nearctic Realm from northern Mexico north to southern Canada illustrating the ranges of species of *Callophrys* (*Mitoura*) defined as homogeneous aggregations of populations consistent with data on foodplant relations, relations between the foodplants themselves, genitalic characters of males and females, and characters of the wing. Diversity of foodplant usage per species is noted from data in Johnson (1976a). Ranges illustrated are for butterfly populations only, without regard to those of the plants. "These are simplified and some local populations not assignable to unrevised species are disregarded".

<i>Species</i>	<i>Foodplant (Table II)</i>	<i>Distinct Traits (Table I)</i>
<i>C. (M.) spinetorum</i>	Loranthaceae	Large signa, corpus bursae; heavily sclerotized anterior valvae; large cornuti.
<i>C. (M.) johnsoni</i>	Loranthaceae	
new species	<i>Thuja</i> (?)**	small signa, corpus bursae;
new species	(?)	irregular lateral valval shape;
new species	<i>Thuja</i>	unique anterior valval shapes.
<i>C. (M.) n. muiri*</i>	<i>Cupressus</i>	minute signum, corpus bursae, etc.
<i>C. (M.) nelsoni</i>	<i>Libocedrus</i>	no signa, corpus bursae; thin-
<i>C. (M.) siva</i>	<i>Juniperus</i>	rimmed unsclerotized anterior
<i>C. (M.) loki</i>	<i>Juniperus</i>	valvae; tapered lateral valval
<i>C. (M.) gryneus</i>	<i>Juniperus</i>	shape; small cornuti.
<i>C. (M.) g. sweadneri*</i>	<i>Juniperus</i>	elongated valvae; shouldered
<i>C. (M.) hesseli</i>	<i>Chamaecyparis</i>	anterior valval shape; unique
<i>C. (M.) turkingtoni</i>	<i>Juniperus</i> (?)**	genital plates.

* taxa warranting redefinition in future work.

**only circumstantial evidence for foodplant

New Species Complex

The new species complex described in this paper, and noted above as the second grouping of taxa in the *Callophrys* (*Mitoura*), is characterized by two major genitalic traits setting it easily apart from both the Loranthaceae-feeders and the other Cupressaceae feeders: Females — two small signa on both the upper and lower surface of the corpus bursae [Loranthaceae-feeders have one large signum on each surface; the other Cupressaceae-feeders have no signa except a slight single signum in the *Cupressus*-feeding populations and the populations now called *C. (M.) g. sweadneri*. The latter taxa is probably of Mexican origin (Johnson, 1975c) explaining the presence of its signa. Occasional specimens from some populations of *C. (M.) nelsoni* and brown *C. (M.) siva* show slight sclerotization of the corpus bursae surface in the area occupied by signa in other species. These appear as slightly brownish tinges on the bursae surface but no signa are present.] Males — unique lateral valval shape, both anterior “arms” (the extensions to the upper and lower articulations with the vinculum) are broadly convex forming the “shouldered” condition dorsally and the “rounded” condition ventally. This configuration comprises the “irregular” shape in relation to the other characteristic valval shapes in the subgenus. These and other categorical genitalic differences are summarized for the subgenus in Table I and Figures 1-3.

Taxonomic Descriptions

Callophrys (Mitoura) rosneri, new species

Diagnosis. Distinguishable from *C. nelsoni* by female genitalia: corpus bursae with two "chevroned" or "arrowed" signa on upper surface; under surface, same, often more reduced. Male genitalia: valvae (lateral view) "irregular," "shouldered-rounded," saccus "parabolic." Wing characters: expanse consistently larger than most *nelsoni*, smaller than most *johnsoni*; markings much like *johnsoni* but forewing, under surface, no marking discal cell; hindwing, under surface, mesial line concise and "rounded", not jagged toward anal angle. 4-5 dark blotched spots, vein 2A to M_2 (or M_1) on *rosneri*. Ground color basad mesial line always much darker than distad, usually helping separate *rosneri* from *nelsoni*.

Male. Upper surface of the wing: (all upper case colors Ridgway, 1912) Prouts Brown, lightened to Sanford's to Amber Brown in limbal area between veins 2A to M_3 (both wings), sometimes more. Forewing, androconia usually indistinct over ground color. Under surface of the wing: forewings Amber Brown, sometimes russet towards margin; submarginal line, white distad, near black centrad, deeper brown basad and extending costal margin caudad to Cu_1 , sometimes basad along tornus to inner margin. Hindwings ground color Vinaceous Russet to Cameo Brown, much darker basad mesial line; mesial line continuous, uniformly bright, white distad, black centrad, deep Cameo Brown basad; limbal area, usually four (sometimes five) black spots between veins 2A to M_2 (or M_1), then orange, then blue-gray distad these.

Length of forewing: 13.0 mm to 15.0 mm

Female. Upper surface of the wing: Amber Brown to Sanford's Brown; Prouts Brown outline along margin and at wing base. Under surface of the wing: same as male.

Length of forewing: 13.0 mm to 15.0 mm

Male Genitalia. Valvae, anterior end, caudad saccus — "mid-rimmed, unindented to slightly indented, spiney." Lateral shape — "irregular" "slightly shouldered, rounded." Saccus — "parabolic."

Female Genitalia. Genital plate — lamellae hemispherical; lamellae postvaginalis about one third size of lamellae antevaginalis, indented broadly at antrum; sclerotized "lips" where the parts of lamellae join. Ductus — long, joining corpus bursa ventrad with wide "armed" structure and dorsad with a "wing" shaped structure with sclerotized midrib. Signa — two "chevroned" or "arrowed."

Early Stages. Unknown.

Foodplant. *Thuja plicata* Wats. based on conclusive knowledge in one subspecies below and from range.

Remarks. This species is divided into two allopatric subspecies. The nominate one is more russet on the wing under surface, on the male genitalia lacks any indentation of the valvae's anterior end caudad the saccus, and flies from April to July in the Rocky Mountains from northeastern Washington, United States, north to 55° latitude in Canada. The second subspecies is less russet on the wing under surface, shows slight indentation in the area of the male genitalia above, exhibits reduced signa on the female genitalia and flies from late April to mid-June from the Puget Sound area of Washington, United States, north along the Pacific Coast of Canada to 52° latitude.

Etymology. This species is named for Ms. Renate Rosner of the Holy Spirit Association for the Unification of World Christianity (Unification Church) to whom I owe many things.

Callophrys (Mitoura) rosneri rosneri, new subspecies

Figure 5

Diagnosis. This subspecies exhibits distinct dark Vinaceous Russet coloration basad the mesial line, under surface of the hindwings, on the male genitalia lacks any indentation where the bilateral lobes of the valvae join caudad the saccus, and on the female genitalia shows no reduction of the signa on the under surface of the corpus bursae. It is limited to the Rocky Mountain areas from northeastern Washington, United States, north to 55° latitude, Canada.

Male. Upper surface of the wing: (all upper case colors Ridgway, 1912) Prouts Brown, lightened to Sanford's to Amber Brown in limbal area between veins 2A to M₃ (both wings), sometimes more. Forewing, androconia usually indistinct over ground color. Under surface of the wing: forewings Amber Brown, sometimes russet towards margin; submarginal line, white distad, near black centrad, deeper brown basad and extending costal margin caudad to Cu₁, sometimes basad along tornus to inner margin. Hindwings ground color Vinaceous Russet, much darker basad mesial line; mesial line continuous, uniformly bright, white distad, black centrad, deep Cameo Brown basad; limbal area, usually four (sometimes five) black spots between veins 2A to M₂ (or M₁), then orange, then blue-gray distad these.

Length of forewing: 14.5 mm (holotype); 14.0-15.0 (\bar{x} =14.6) mm, 5 paratypes

Female. Upper surface of the wing: Amber Brown except for Prouts Brown outline along margin and at wing base. Under surface of the wing: same as male.

Length of forewing: 14.5 mm (allotype); 13.5-15.0 (\bar{x} =14.3) mm, 8 paratypes

Male Genitalia. Fig. 10. Valvae, anterior end, caudad saccus — "mid-rimmed,

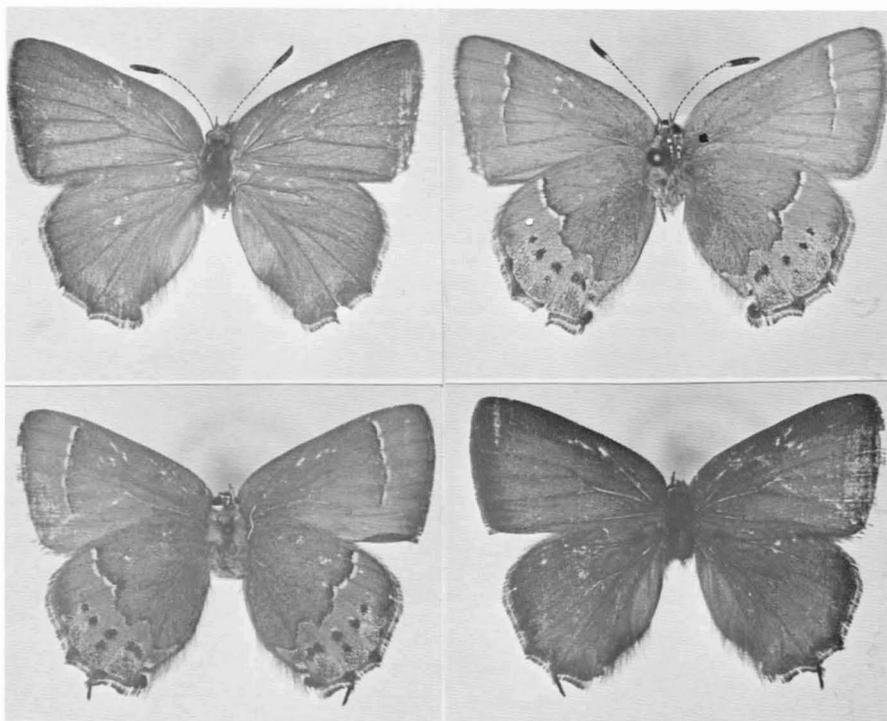


Fig. 5. Holotype and allotype of *Callophrys (Mitoura) rosneri rosneri*, new subspecies. Top left, upper surface, holotype (AME); right, under surface, same. Bottom left, under surface, allotype (AME); right, upper surface, same.

unindented, spiny." Lateral shape — "irregular," "slightly shouldered, rounded." Saccus — "parabolic."

Female Genitalia. Fig. 15. C. Genital plate — lamellae hemispherical; lamellae postvaginalis about one third size of 1. antevaginalis, indented broadly at antrum; sclerotized "lips" where the parts of lamellae join. Ductus — long, joining corpus bursa ventrad with wide "armed" structure and dorsad with a "wing" shaped structure with sclerotized midrib. Signa — two "chevroned" or "arrowed."

Early Stages. Unknown.

Foodplant. *Thuja plicata* Wats. based on conclusive knowledge in subspecies below and from range.

Types. Holotype, ♂, 2 mi. S. Kaslo, nr. Kootenay Lake, British Columbia, 7 June 1975, Neal and Pat Speer. Genitalia KJ # 240. Allotype, ♀, same data. Genitalia KJ # 241. All deposited Allyn Museum of Entomology (AME). Foodplant specimens (adult association) KJ # 15, with author. Paratypes. American Museum of Natural History (AMNH): 1♀, 1♂, 1 mi. N. Balfour, nr. Kootenay Lake, British Columbia, 7 June 1975, Neal and Pat Speer. United States National Museum (USNM): 3♂, 3♀, Kaslo Cr., British Columbia, Dr. H. G. Dyar Collection, no other data. 1♂, 3♀, Kaslo, British Columbia, 8 May 1915, Barnes Collection. Carnegie Museum (CM): 1♀, Kaslo (*sic.*) [Kaslo], British Columbia, "4/28" (date), Skinner.

Distribution. Known from the eastern allopatric *T. plicata* range in Canadian Rockies of eastern British Columbia and western Alberta, north to 55° latitude and south into the scattered extensions of *T. plicata* in northeastern Washington state, United States, at least to Stevens County.

Flight period. Dates on specimens range from April ("4/28"?) to 28 June.

Remarks. The genitalia of all specimens listed were examined and compared with 83 male and female genitalia of *C. nelsoni*, 78 male and female genitalia of *C. siva*, and 24 male and female genitalia of the other species in the new complex. Other known specimens of *C. r. rosneri* are as follows: AMNH: 1♂, 1♀, Cedar Lake, 38 mi. N. Colville, Stevens Co., Washington, May 1962, W. Ivie; 1♂, Sicamous, British Columbia, 17 June 1946; 1♂, Robson, British Columbia, 28 June 1939, O. Bucholz Collection. USNM: 1♀, Goldstream, British Columbia, 22 May 1904; 1♀, same locality, 6 June 1916, E. H. Blackmore.

Callophrys (Mitoura) rosneri plicataria, new subspecies

Figure 6

Diagnosis. This subspecies is distinct in being less russet and more brown on the undersurface of the hindwings. Also, on the female genitalia, the signa in the corpus bursae are reduced, especially on the under surface. Male genitalia show a slight indentation where the bilateral lobes of the valvae, broader themselves than on *r. rosneri*, join caudad the saccus. There is less sclerotization and fewer spines here than on the nominate subspecies, and the lateral shape of the valvae are less "rounded." It is limited to the Pacific coastal areas from Puget Sound northward into Canada.

Male. Like *r. rosneri*, but with under surface of wings Cameo Brown.

Length of forewing: 13.0 mm (holotype); 13.0-15.0 ($x=13.7$) mm, 5 paratypes.

Female. Like *r. rosneri*, but with upper surface of wings Sanford's Brown to Amber Brown, under surface, Cameo Brown.

Length of forewing: 13.0 mm (allotype); 13.0-15.0 ($x=14.1$) mm, 4 paratypes.

Male Genitalia. Fig. 11. Valvae, anterior end, caudad saccus — "mid-rimmed, slightly indented, somewhat spiny." Lateral shape — somewhat "shouldered, rounded." Saccus — "parabolic."

Female Genitalia. Fig. 15. D. Like *r. rosneri* except lamellae more often curving gradually caudad from antrum, and with signa reduced, especially on under surface.

corpus bursae.

Early Stages. Has been reared, but larvae and pupae not described (see below).

Foodplant. Usage of *T. plicata* in this region well known from rearing of "*C. nelsoni*" by D. McCorkle and D. Carney in western Washington and British Columbia (Lepid. Soc., 1963; Ehrlich and Ehrlich, 1961; Howe, 1975). Reared from larvae found on *T. plicata* at Wellington, British Columbia, 5 August 1904, by J. Bryant, adult emerged 21 March 1905 (USNM collection).

Types. Holotype, ♂, Cameron Lake, S. Vancouver Island, British Columbia, 11 June 1953, R. Guppy. Genitalia KJ # 242. Allotype, ♀, same data. Genitalia KJ # 243. All deposited AME. Paratypes. Los Angeles County Museum (LACM): 1♀, Cameron Lake, S. Vancouver Island, 11 June 1953; 1♂, same locality, same leg., 24 May 1952; 1♂, Wellington, [S. Vancouver Island], British Columbia, 8 June 1948, R. Guppy. AMNH: 1♂, 1♀, Victoria, [S. Vancouver Island], British Columbia, 19 May 1917. USNM: 1♂, Wellington, [S. Vancouver Island], 19 May 1917; 1♀, same locality, 23 May 1903; 1♀, same locality, reared by J. Bryant, emerged 28 March 1905; 1♂, Victoria, [S. Vancouver Island], British Columbia, 1937, B. H. Blackmore.

Distribution. Puget Sound region of Washington state, United States, northward on Vancouver Island and western coast of mainland British Columbia, Canada.

Flight Period. Dates on specimens range from 25 April to 11 June.

Remarks. This subspecies is sympatric with the species named below and thus care should be taken to distinguish the two by dissection if one is unsure of wing

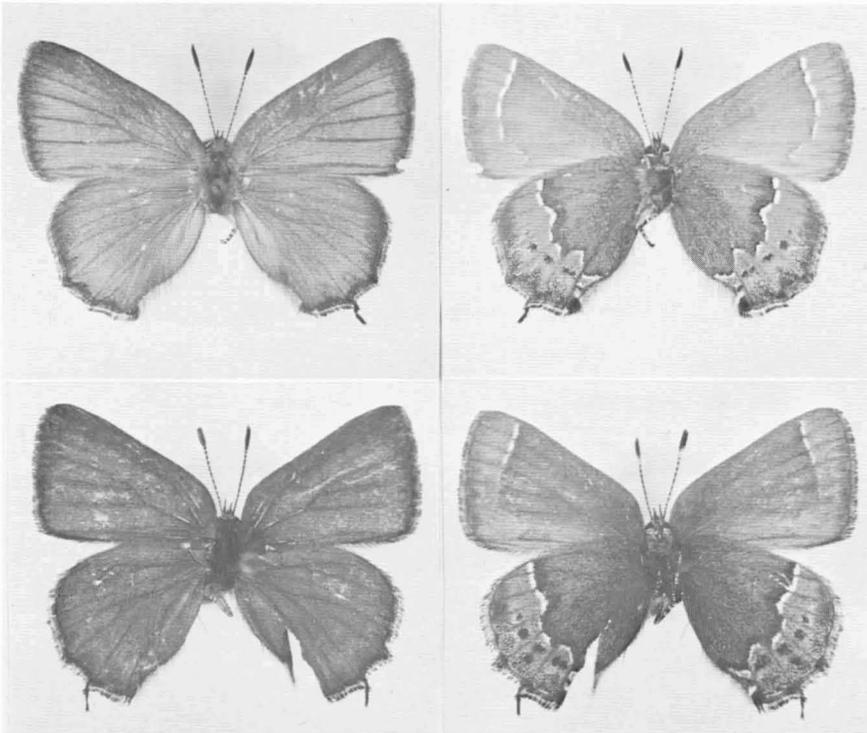


Fig. 6. Holotype and allotype of *Callophrys (Mitoura) rosneri plicataria*, new subspecies. Top left, upper surface, holotype (AME); right, under surface, same. Bottom left, upper surface, allotype (AME); right, under surface, same.

trait differences. All specimens mentioned above were dissected and compared to the aforementioned specimens of *C. nelsoni* and *C. siva* and the genitalic dissections of the species mentioned in the rest of this paper. Other known specimens of *plicataria* are as follows: 1♀, Vancouver, British Columbia, 27 May 1905, R. V. Harv [ey?]; 1♀, same locality, 14 April 1906, same leg; 1♂, same locality, 1 June 1913, A. H. Bush; 1♂, same locality, no other data; 1♀, same, 25 April 1915; 1♀, same, 1 June 1913; 1♀, Spuzzum, British Columbia, 8 May 1914, W. A. Newcombe; 2♀, Bellingham, Washington, 30 June 1917, J. F. Clarke, all USNM. 1♀, Ovington, Washington, 21 June 1934, G. H. and J. L. Sperry, AMNH.

Etymology. This subspecies is named for the foodplant of *rosneri*, adding "aria" to the name, meaning "around the."

Callophrys (Mitoura) barryi, new species

Diagnosis. Can be immediately recognized by males broadly ovate and wide-rimmed anterior valval structure, dorsal or ventral view; by extreme "shouldered, rounded" lateral shape of valvae; and "funnel" shaped saccus. Female genitalia — two large chevron-like signa, upper and lower surface, corpus bursae. Wing characters — Most specimens noticeably yellow-brown in ground color, under surface, hindwing; some populations showing unique yellowing of the limbal area, hindwings, upper surface.

Male. Upper surface of the wing: Ground color Prouts Brown to Mummy Brown, Hazel to Tawney in limbal area between veins 2A to M₃ (both wings), some more extensively. Forewing, androconia usually indistinct over ground color. Under surface of the wing: Ground color yellow-browns (Hazel to Tawney) to reddish dull browns (Cameo Brown), basad mesial line often heavily flecked with dark scales giving appearance of Prouts Brown overcast. Forewing, submarginal line white distad, ground color or slightly darker brown basad. Hindwing, mesial line continuous, bright (sometimes faded caudad if Prouts Brown overcast heavy), white distad, black centrad, brown basad. Limbal area, usually four (sometimes five) black spots between veins 2A to M₂ (or M₁), then orange, then blue-gray, distad these.

Length of forewing: 13.0 mm to 13.5 mm.

Female. Upper surface of the wing: Raw Sienna over expanse of wing, except for Prouts Brown outlining margins and at wing base. Some populations noticeably Dull Orange Rufous to Xanthine Orange in limbal area, upper surface, hindwings. Under surface of the wing: same as male.

Length of forewing: 12.5 mm to 14.5 mm.

Male Genitalia. Fig. 12. Valvae, anterior end, caudad saccus, distinctly "wide-rimmed, oval." Lateral shape — "shouldered, rounded", "irregular." Saccus — "funnel"-shaped.

Female Genitalia. Fig. 15, A. Genital plate — lamellae "mallet"-shaped, lamellae, antevaginalis slightly indented at antrum. Ductus — longer than breadth of lamellae, constricted before antrum, without "armed" structures caudad. Signa — two "chevroned"-shaped signa, upper and under surface, corpus bursae.

Early Stages. Unknown.

Foodplant. The larval foodplant is unknown. If not *Thuja plicata*, *C. barryi* may feed on *Juniperus occidentalis*. Its scattered populations occur where either species may be disjunctly present. One population occurs where *T. plicata* was verified for "*C. nelsoni*" by McCorkle and Carney (*loc. cit.*) The disjunct distribution of *C. barryi* suggests it may be tied to a foodplant which has undergone disturbance of its former range. The range of variation in its unique genitalia also suggests this, indicating it may be occurring only in relict populations of its foodplant.

Remarks. This species is divided into two subspecies. The nominate subspecies is represented by populations from the eastern Deschutes Plateau of Oregon north-

eastward into Idaho and is generally more yellow brown on the under surface of the wings, with some limbal yellow brown on the upper surfaces. The distinct valval structures are very ovate. The other subspecies occurs westward along the edge of the Deschutes Plateau and Cascade Mountains and thence southward in the Cascades to southern Oregon and northward to Vancouver Island. It is more red-brown or dull brown beneath, without limbal yellow above on the wings, and exhibits a less ovate and more pointed valval structure caudad the saccus.

Distribution of the species as a whole (see subspecies below) suggests pattern of isolation similar to that in *C. rosneri* — two basic allopatric populations (coastal mountains and Rocky Mountains) separated by lowland plains. Exact foodplant data is needed to determine if this resulted from suspected utilization of respective allopatric range of *T. plicata*. Otherwise, no reason is apparent why the species should not occur across the lowland juniper belt in Oregon where large samples of *C. siva* have yielded no *C. barryi*. Also, *C. barryi*'s western distribution appears broken into disjunct areas (reminiscent of *C. hesseli*) since as yet no specimens are known from Washington state.

Etymology. This species is named for Mr. Aidan Barry, Director of the Unification Church in New York in gratitude for his personal support during a difficult theological transition.

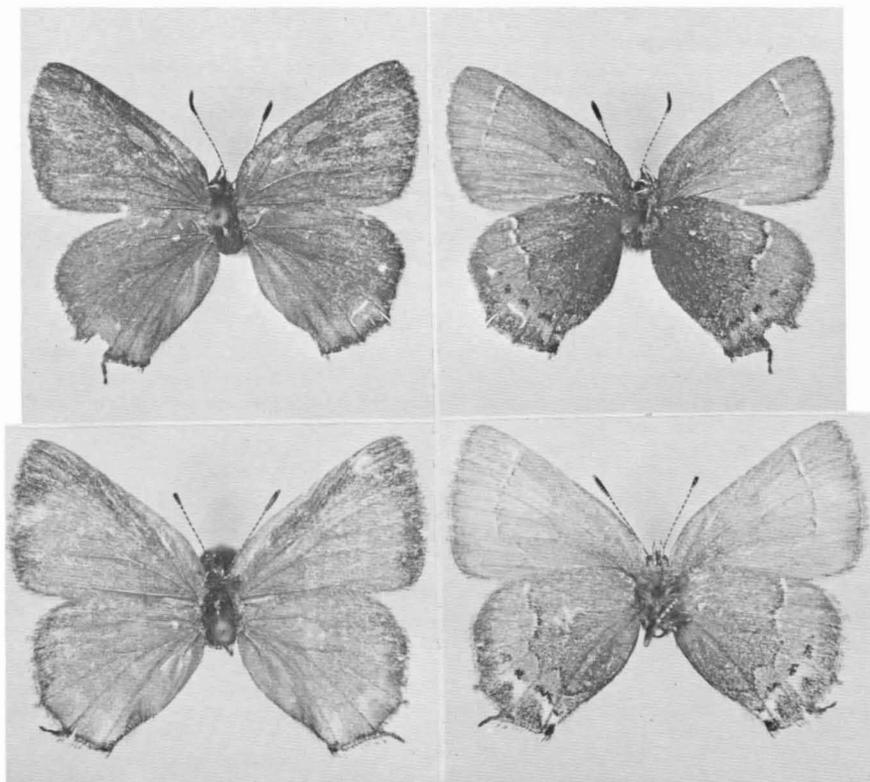


Fig. 7. Holotype and allotype of *Callophrys (Mitoura) barryi barryi*, new subspecies. Top left, upper surface, holotype (AME); right, under surface, same. Bottom left, upper surface, allotype (AMNH); right, under surface, same.

Callophrys (Mitoura) barryi barryi, new subspecies

Figure 7

Diagnosis. This subspecies can be distinguished by the broadly ovate shape of the distinct "wide-rimmed, oval" configuration of the male genitalia, by the tendency of the under surface of the wings to be yellowish brown, and for females to show traces of yellow in the limbal areas of the wings' upper surface. It is limited to the northern Rocky Mountains and directly adjacent montane areas.

Male. Upper surface of the wing: Ground color Prouts Brown to Mummy Brown, Hazel to Tawney in limbal area between veins 2A to M₃ (both wings), some more extensively. Forewing, androconia usually indistinct over ground color. Under surface of the wing: Ground color yellowish brown — Hazel to Tawney; hindwings, basad mesial line only, often heavily flecked with dark scales giving appearance of Prouts Brown overcast. Forewing, submarginal line white distad, ground color or slightly darker brown basad. Hindwing, mesial line continuous, bright (sometimes faded caudad if Prouts Brown overcast heavy), white distad, black centrad, brown basad. Limbal area, usually four (sometimes five) black spots between veins 2A to M₂ (or M₁), then orange, then blue-gray distad these.

Length of forewing: 13.5 mm (holotype); 13.5 mm, 2 paratypes

Female. Upper surface of the wing: Raw Sienna over expanse of wing, except for Prouts Brown outlining margins and at wing base. Some populations noticeably Dull Orange Rufous to Xanthine Orange in limbal area, upper surface, hindwings. Under surface of the wing: same as male.

Length of forewing: 14.0 mm (allotype); 13.5-14.5 (x=14.0) mm, 6 paratypes

Male Genitalia. Fig. 12. Valvae, anterior end, caudad saccus, distinctly "wide-rimmed, oval." Lateral shape — "shouldered, rounded", "irregular." Saccus — "funnel"-shaped.

Female Genitalia. Fig. 15, A. Genital plate — lamellae "mallet"-shaped, lamellae antevaginalis slightly indented at antrum. Ductus — longer than breadth of lamellae, constricted before antrum, without "armed" structures caudad. Signa — two "chevroned"-shaped signa, upper and under surface, corpus bursae.

Early Stages. Unknown.

Foodplant. See comments concerning the species. Populations of *b. barryi* in eastern Oregon occur where Little (1971) records *J. occidentalis* and possibly *T. plicata* to be present. Populations of *b. barryi* in Idaho occur where *T. plicata* is recorded and near scattered occurrences of *J. occidentalis*.

Types. Holotype, ♂, Union Co., Oregon, 11 May 1933 ["5-11-33"]. Genitalia KJ # 605. Allotype, ♀, same locality, 5 June 1938 ["5-vi-38"]. Genitalia KJ # 606. Collector unknown (exchanged from R. W. Dawson Collection [Pullman, Washington] to K. Johnson Collection [AMNH]). Deposited, holotype AME; allotype, AMNH. Paratypes. LACM: 2♂, 4♀, Austin Hot Springs, Grant County, Oregon, 16 June 1957, S. J. Jewett; 1♀, Eagle Fern Park, Union-Wallowa counties, Oregon, 12 April 1958, S. J. Jewett, Jr. AMNH: 1♀, Austin Hot Springs, Grant County, Oregon, 16 June 1958, S. J. Jewett; 1♀, Eagle Fern Park, Union-Wallowa counties, Oregon, 17 May 1958, S. J. Jewett, Jr.

Distribution. Known from Union, Grant, and Wallowa counties in eastern Oregon, the Blue Mountains area extending westward from the Rocky Mountains. Also known from the Rocky Mountains of Idaho from Moscow Mountain, Latah County, where it is sympatric with the species described below. *C. b. barryi* should occur southward perhaps to Idaho County and northward into Canada.

Flight Period. Dates on specimens range from 12 April to 29 June.

Remarks. Other known specimens of *b. barryi* include 1♂ and 1♀ from Moscow Mountain, Latah County, Idaho, 29 June 1960, and 1♀, same locality, 13 June 1961, all collected by R. E. Miller and deposited in his collection.

***Callophrys (Mitoura) barryi acuminata*, new subspecies**

Figure 8

Diagnosis. Distinguishable from *b. barryi* by the more pointed (less ovate) shape of the characteristic broad and wide-rimmed anterior valval structure, dorsal and ventral view, and by the lack of yellow coloration on the under surface of the wings, or in the limbal area on the upper wing surface of females. Distribution limited to the Cascade Mountains or adjacent montane areas northward along the Pacific Coast.

Male. Like *b. barryi* but specimens uniformly smaller and not noticeably as yellow brown, but brown or red brown.

Length of forewing: 13.0 mm (holotype), 13.5 mm, 1 paratype.

Female. Very similar to *b. barryi* but no representatives known with yellow coloration in limbal area, upper surface, hindwing. Ground color, under surface, not as noticeably yellow brown, but often brown or red-brown.

Length of forewing: 13.0, 12.5 mm, 2 females western Deschutes Plateau, Oregon.

Male Genitalia. Fig. 13. Valvae, anterior end, caudad saccus "wide-rimmed, oval" but not as broadly rounded, more pointed and tapered cephalad. Lateral shape — "shouldered, rounded," "irregular". Saccus — "funnel"-shaped, but less distinctly.

Female Genitalia. As on *b. barryi*, but female not figured since all specimens known are from variant population not characterizing phenotype.

Early Stages. Unknown.

Foodplant. See comments concerning the species. Populations of *b. acuminata* correspond with western range of *T. plicata* but also with disjunct ranges of *J. occidentalis* (with one exception — Victoria, British Columbia).

Types. Holotype, ♂, Butte Falls, Jackson Co., Oregon, 22 May 1931, F. Lawrence. Genitalia KJ # 245. Deposited AMNH. Paratype. AME: 1♂, Butte Falls, Oregon, 25 May 1946.

Distribution. Known from the Cascade Mountains from Butte Falls, Oregon, northward toward Columbia River Gorge on western edge of Deschutes Plateau. Also known from Victoria, British Columbia, so should occur northward along Cascade range in Washington.

Flight Period. Dates on specimens range from 23 April to 9 June, also 11 July (second brood?).

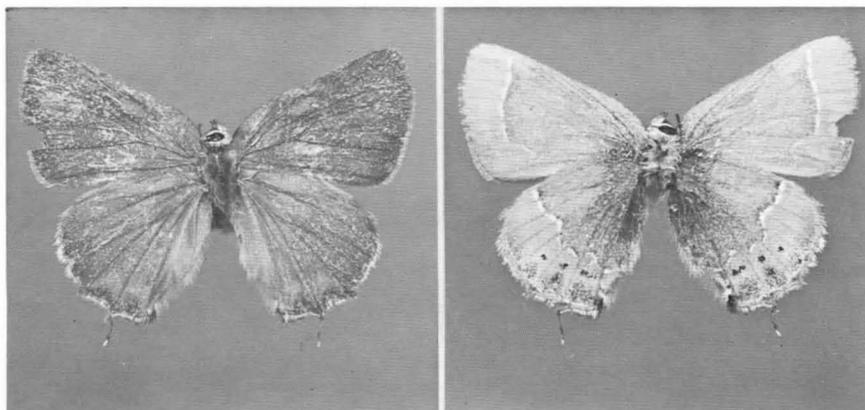


Fig. 8. Holotype of *Callophrys (Mitoura) barryi acuminata*, new subspecies. Left, upper surface; Right, under surface (AMNH).

Remarks. Other known specimens of *b. acuminata* are: LACM, 1♂, 16 mi. E. Prineville, Oregon, 7 June 1958, S. J. Jewett; 1♀, same locality, 9 June 1958, same collector (variant population); 1♀, 3 mi. E. Culver, Oregon, 23 April 1954, S. J. Jewett (variant specimen); USNM, 1♂, 2♀, Ochoco Pass, Ochoco National Forest, Oregon, 11 July 1955, J. F. G. Clarke (variant population); CM, 1♂, Victoria, British Columbia, 12 May 1897. The occurrence of a variant population eastward on the Deschutes Plateau more like *b. acuminata* than *b. barryi* suggests the need for more exact foodplant knowledge and for more knowledge of any northward extension of *b. barryi* in the Rocky Mountains. Such information would resolve whether there are two basic gene pools in *barryi* as in *rosneri*, as is assumed here. *C. barryi acuminata* is known to be sympatric with *C. nelsoni* at the type locality, and with *C. siva* at Prineville, Oregon, on the western Deschutes Plateau. It is also sympatric with *C. rosneri* at Victoria, British Columbia.

Etymology. The name is taken from the Latin *acumen* ("the pointed end of anything"), *acuminata* meaning "pointed or sharpened". It refers to the distinctive more tapered shape of the anterior structure of the valvae, caudad the saccus.

Callophrys (Mitoura) byrnei, new species

Figure 9

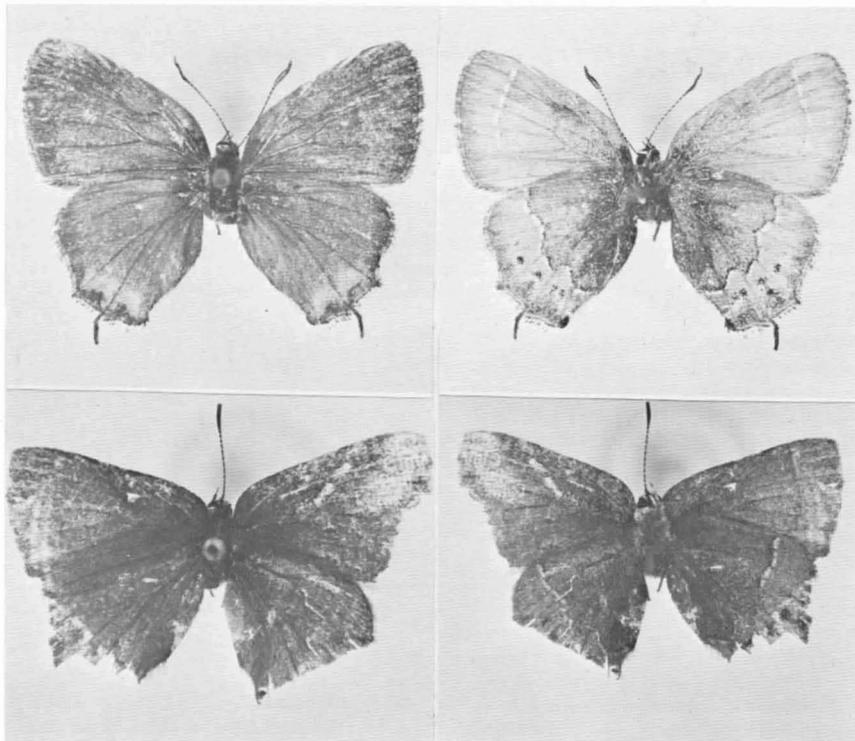


Fig. 9. Holotype and allotype of *Callophrys (Mitoura) byrnei*, new species. Top left, upper surface, holotype (AMNH); right, under surface, same. Bottom left, upper surface, allotype (AMNH); right, under surface, same.

Diagnosis. Easily distinguishable by unique genitalia in both sexes. Female configuration is reminiscent of traits extreme in *C. johnsoni*, and two large signa occur on the upper and under surface of the bursae, as characteristic in the *Thuja* group. Males, anterior ends of valvae, caudad saccus, are "narrow-rimmed, parabolic, and unindented" as in *C. siva* but lateral shape is obviously highly "shouldered, rounded" and "irregular" like rest of the *Thuja* group. Saccus is pointed (like *C. siva*) but deep notched caudad (like *C. johnsoni*). Recognizable by wing traits by tendency of populations to produce deep black-brown upper surface (dark Raw Umber), and darkened dull under surface.

Male. Upper surface of the wing: Very dark — Raw Umber to Fuscous, with chevron-shaped Zinc Orange patches, limbal area, hindwings, veins 2A to Cu₁. Forewing androconia quite distinct over ground color. Under surface of the wing: ground color yellowish browns most often extremely dark-flecked giving appearance of being smoked to Prouts Brown or Raw Umber, sometimes obscuring submarginal line, forewing, or mesial line, hindwing. Forewing, submarginal line white basad, vaguely black centrad, brown basad. Hindwing, mesial line continuous, outstanding unless obscured by dark overcast, white distad, widely black centrad, usually not noticeably browner than ground color basad. Limbal area, usually four (sometimes five) black spots between veins 2A to M₂ (or M₁), then vague orange, then blue-gray distad these, all sometimes obscured by dark "smoked" effect.

Length of forewing: 13.5 mm (holotype); 12.5-14.5 (\bar{x} =13.5) mm, 4 paratypes

Female. Upper surface of the wing: Hazel to Tawney over entire wing except Fuscous or dark Raw Umber along margin and extensively at wing base. Fuscous or dark Raw Umber often flecking entire wing over ground color. Under surface of the wing: same as males except for tendency of mesial line to be more obscured by dark overcast.

Length of forewing: 13.0 mm (allotype); 13.0 mm, 1 paratype

Male Genitalia. Fig. 14. Labides distinctively "high crowned" with "crowns" widely separated. Valvae, anterior structure, caudad saccus — "narrow-rimmed, parabolic and unindented"; lateral shape — very "shouldered, rounded", "irregular." Anterior of saccus deeply notched beneath anterior of valvae. Saccus — "Pointed."

Female Genitalia. Fig. 14, B. Genital plate — lamellae nearly ovate in structure, lamellae postvaginalis about half size of lamellae antevaginalis, deeply notched above antrum, and lipped with sclerotizations. Ductus long and joined flush to corpus bursae ventrally, dorsally with "fan" shaped structure without sclerotized midrib.

Early Stages. Unknown

Foodplant. The limited known range of this species corresponds with the disjunct southeastern populations of *Thuja plicata*, and not with any known occurrence of any species of *Juniperus*. *C. siva* is found in eastern Oregon and southeastern Washington on *J. occidentalis* and in southern Idaho on *J. osteosperma*.

Types. Holotype, ♂, 5.6 mi. S. Emida, Benewah Co., Idaho, 18 July 1971, R. Zweifel. Genitalia KJ # 302. Allotype, ♀, same data. Genitalia KJ # 234. Deposited AMNH. Paratypes. AMNH: 1♂, 1♀, same data as holotype. AME: 1♂, 8.9 miles southwest of Clarkia, Latah Co., Idaho, 12 July 1972, S. Ellis; Scott Ellis Collection (Hotchkiss, Colorado): 1♂, same data as above.

Distribution. Known from Benewah, Latah, and Wallace counties in Idaho, all in disjunct ranges of *Thuja plicata*. Could extend southward to Idaho County and northward in the Rocky Mountain *Thuja* belt into Canada.

Flight Period. Dates on specimens range from 18 May to 18 July.

Remarks. Other known *C. byrnei* include 2♂, Wallace, Wallace Co., Idaho, 18 May 1920-1930 (*sic.*), O. Huellemann; LACM: 1♀, same data. The Wallace Co. segregation in this species varies considerably in wing pattern from the Benewah and Latah County populations, providing a good example of variance in degree of characters while preserving categorical characters (in this case the genitalia). All known male and female specimens were dissected and compared to the afore-

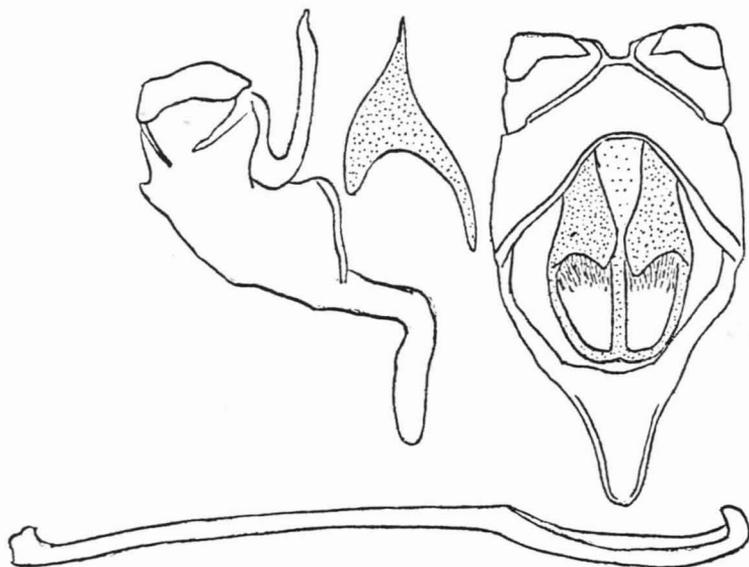


Fig. 10. Male genitalia, holotype, *Callophrys (Mitoura) rosneri rosneri*, new subspecies. Left, lateral view; Right, dorsal view; Bottom, aedeagus.

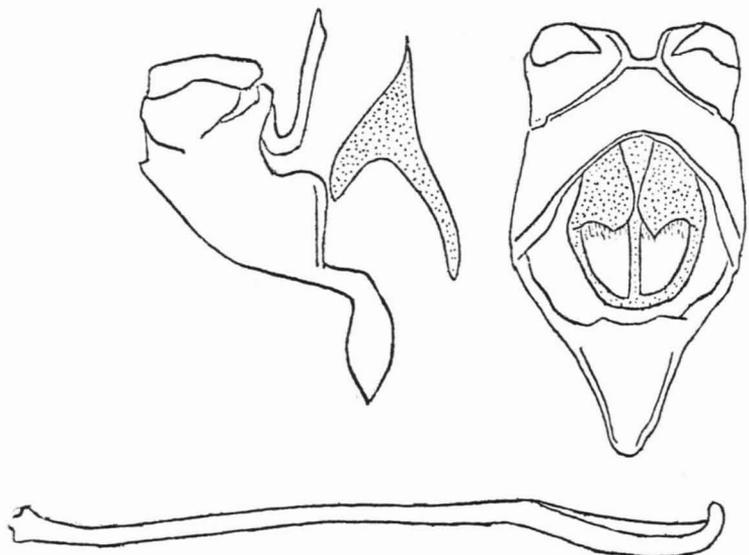


Fig. 11. Male genitalia, holotype, *Callophrys (Mitoura) rosneri plicataria*, new species. Left, lateral view; Right, dorsal view; Bottom, aedeagus.

mentioned material in this study.

Etymology. I am happy to name this species for Fr. Shawn Byrne, priest and member of the Unification Church in New York in thanks for his friendship and personal support.

The distribution of these new taxa in western North America, and the distribution of populations in relation to occurrence of signa in the corpus bursae of females, are shown in Figures 16 and 17 respectively.

Summary and Conclusions

The discovery of four distinct species formerly lumped within the taxon *Callophrys (Mitoura) nelsoni* suggests the need for careful dissection of males and females of Lycaenidae in taxonomic studies. There may be more instances in traditional taxonomic concepts of many Nearctic butterflies where upon lack of study of characters other than wing color and maculation, distinct taxa have not only been overlooked, but convenient biological "catch-all" species inadvertently created. A good example of the latter is *C. nelsoni* prior to this study, which since it contained anything that was ventrally brown, included populations utilizing three genera of Cupressaceae. Other species were known to use no more than one.

The three new entities add additional examples that the genus *Callophrys* (if indeed the present usage of this genus with several sugenera is preferable) has evolved a number of regional species suggesting long periods of evolution dominated by extreme local isolation of populations. Particularly notable in the new species is the degree of interspecific variation in the genitalia. It is greater than

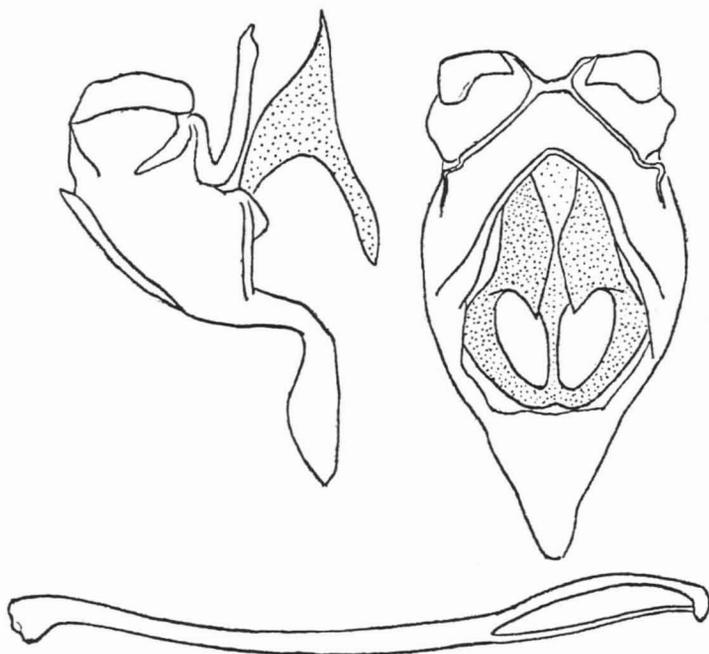


Fig. 12. Male genitalia, holotype, *Callophrys (Mitoura) barryi barryi*, new subspecies. Left, lateral view; Right, dorsal view; Bottom, aedeagus.

in most of the previously described congeners. *Callophrys (Callophrys) dumetorum* (Boisduval), *C. (C.) comstocki* Henne, and *C. (C.) lemberti* are other regional *Callophrys* which have been described as species. Scott (in Howe, 1975) lumped the latter two taxa as subspecies of *C. (C.) sheridanii* (Carpenter) on the basis of intergradation reportedly discovered by David Bauer. However, no other rationale is given for this, Bauer's observations have not been published (or at least are not cited), and genitalia are not mentioned. They may have not been studied. Having studied male and female genitalia of *Callophrys (Mitoura)* from the western Nearctic in detail, I find it difficult to accept such a lumping. The status of regional taxa must be considered within the context of the taxonomic traits of (at least) the subgenus as a whole. Otherwise, entities may be lumped which actually represent differences more major than those found in widely distributed taxa the same worker may assume are species. A similar situation has been pointed out in the status of the name *Mitoura sweadneri* Chermock and its supposed conspecificity with *C. gryneus* (Johnson, 1976c). Generally, the genitalia of *Callophrys (Mitoura)*, when males and females are both considered, are quite consistent in diagnostic characters where the wing traits either are not, or would indicate intergradation.

These segregations of speciation in the northwestern United States and western Canada suggest the importance of recognizing that long term, varied, and fluctuating influences in geology and paleobotany have been at work. Workers studying taxa with a methodology including subspecies should be aware that numerous relict aggregations of populations frequently occur here. Care is needed not only in discovering which of these comprise important centers of speciation but which aggregations have important historical relationships to each other. The danger is that the worker may skip over unique local populations thinking that such local speciation might not be possible. In doing so, the significance of such a study to the historical biology of a region may be seriously lessened.

Because of the recent discovery of the new species described in this paper, local knowledge concerning them is as yet incomplete. It will be important to discover the northern limits of *C. rosneri* and *C. byrnei* and especially their relationship

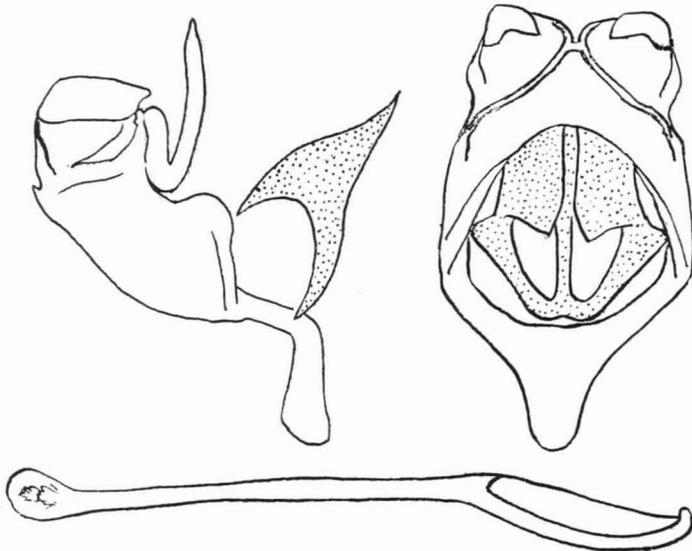


Fig. 13. Male genitalia, holotype, *Callophrys (Mitoura) barryi acuminata*, new subspecies. Left, lateral view; Right, dorsal view; Bottom, aedeagus.

in any sympatric locality. Likewise, knowledge is needed at the habitat level concerning the sympatric relations of *C. barryi* and its congeners. Certainly more knowledge of its distribution will be important. The fact that its genitalia are so extreme, but consistent in males and females over its disjunct ranges, suggests it has an earlier and more widely distributed origin which has undergone subsequent disturbance. It may be that *C. barryi* feeds on *Juniperus occidentalis* or *Thuja plicata*, but now only survives in the scattered small populations of these species northward and westward. Many of these scattered plant populations may be relicts. If females with the two signa (and other characteristic traits) did not occur where the distinctive genitalia of the males are found, one might suppose that *C. barryi* represents an extremely bizarre variation of *C. nelsoni* or *siva*. However, no such aberrations occur in other Nearctic *Callophrys* (*Mitoura*), no intermediates with *C. barryi*'s extreme genitalia are known, and certain wing traits (e.g. the yellowing of the limbal area above, in females) also help distinguish it. Thus, concluding that *C. barryi* is a species disjunctly distributed throughout the ranges of several congeners describes a situation reminiscent of *C. hesseli*. *C. hesseli*'s wing traits were only recognized as distinct in 1950, but its genitalia are quite divergent.

It will eventually be important to construct a phylogeny for the *Callophrys* (*Mitoura*), especially because of the genitalic similarities of these new species to the Loranthaceae-feeder *C. johnsoni* on the one hand, and the Cupressaceae-feeders *C. nelsoni* and *siva* on the other. Such a study cannot be made successfully until work on the Mexican *Callophrys* (*Mitoura*) is completed. Studies in progress or in press by H. K. Clench and me include no fewer than six new Mexican species whose genitalic characters are of utmost importance to such a concept.

I realize that the nature of the diagnostic differences in these new species may cause hardship for the amateur collector who is not familiar with genitalia. Therefore, I particularly invite correspondence and exchange or loan of specimens concerning unstudied populations of *Callophrys* (*Mitoura*) in the northwestern

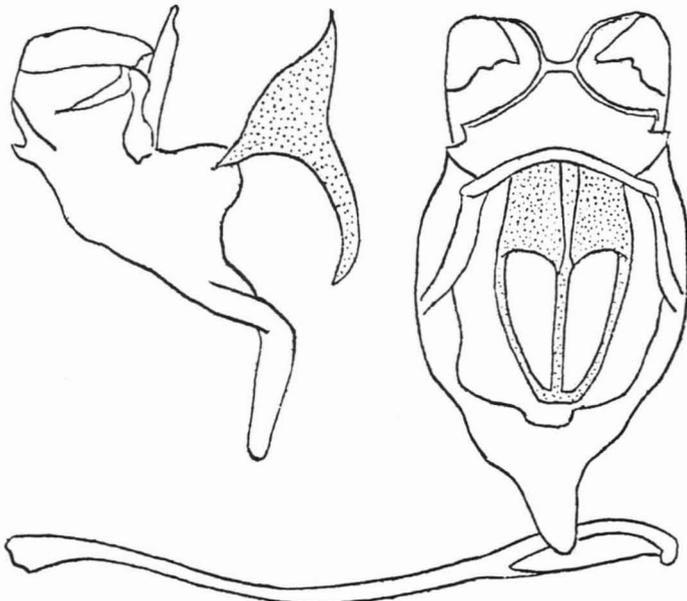


Fig. 14. Male genitalia, holotype, *Callophrys* (*Mitoura*) *byrnei*, new species. Left, lateral view; Right, dorsal view; Bottom, aedeagus.

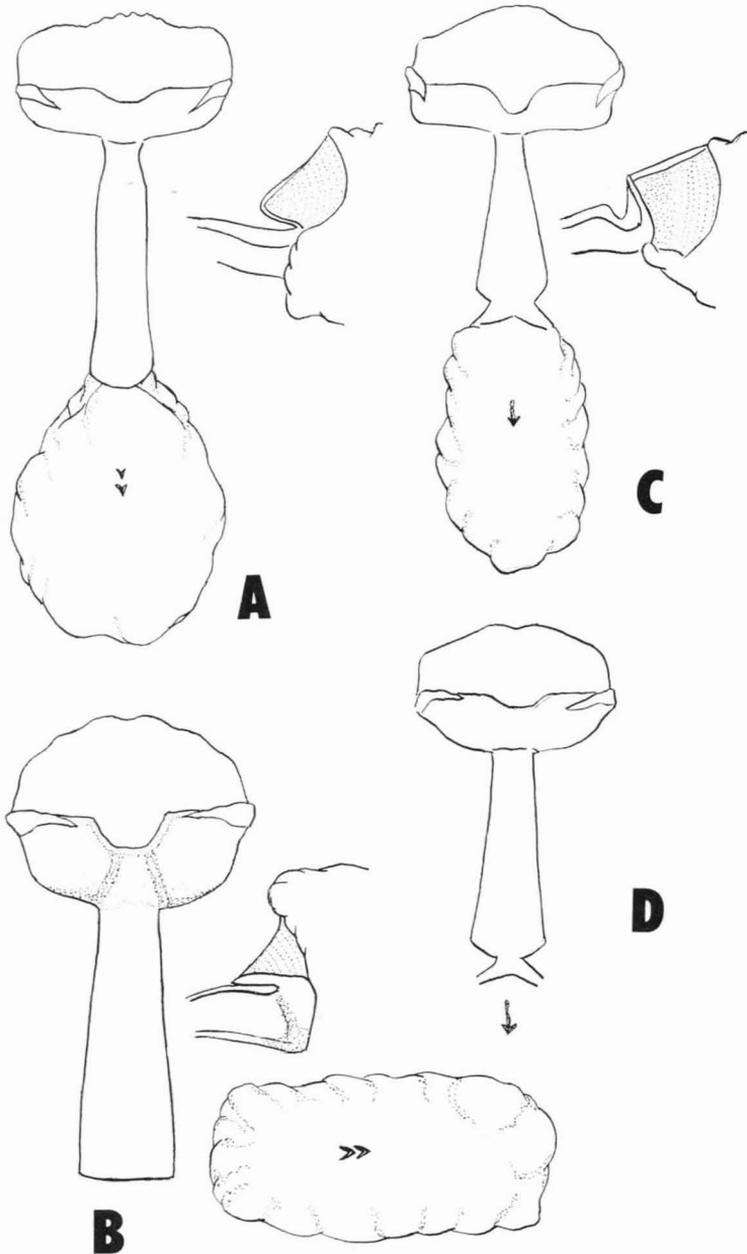


Fig. 15. Female genitalia, allotypes of new *Callophrys* (*Mitoura*) taxa. A. Allotype, *C. (M.) barryi barryi*, new subspecies: left, ventral view, genital plate and corpus bursae; right, lateral view, caudal end, ductus bursae as it joins corpus bursae. B. Allotype, *C. (M.) byrnei*, new species: same views as above, but corpus bursae placed off at right. C. Allotype, *C. (M.) rosneri rosneri*, new subspecies: same views as A. D. Allotype, *C. (M.) rosneri plicataria*, new subspecies: showing genital plate only, and shape of signa, corpus bursae.

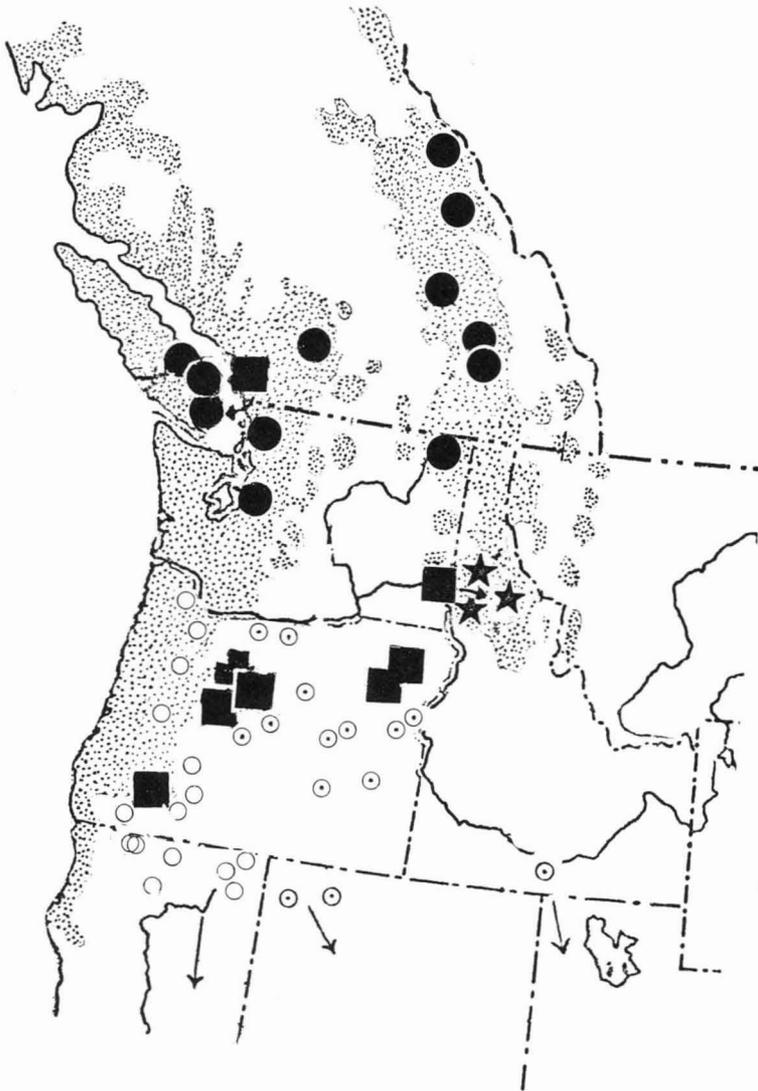


Fig. 16. Distributions of new *Callophrys (Mitoura)* species in the northwestern United States and western Canada in relation to the range of *Thuja plicata* (stipled areas). Black dots: known range of *C. (M.) rosneri*, new species: western range of *T. plicata* - *r. plicataria*, eastern range of *T. plicata* - *r. rosneri*. Black stars: known range of *C. (M.) byrnei*, new species: southeastern range of *T. plicata*. Black squares: known range of *C. (M.) barryi*, new species: eastern edge of Deschutes Plateau, Oregon - *b. barryi*; Cascade Range and western edge Deschutes Plateau - *b. acuminata*. Small white dots: populations of *C. (M.) nelsoni* on *Libocedrus decurrens*. Small white dots centered with black: populations of *C. (M.) siva* on *Juniperus occidentalis*. Both of these species range southward from area shown; for more exact distributions see Johnson, 1975d.

United States and western Canada. Such specimens should be properly placed in this taxonomy and their significant data concerning the origin and relationships of these taxa discerned.

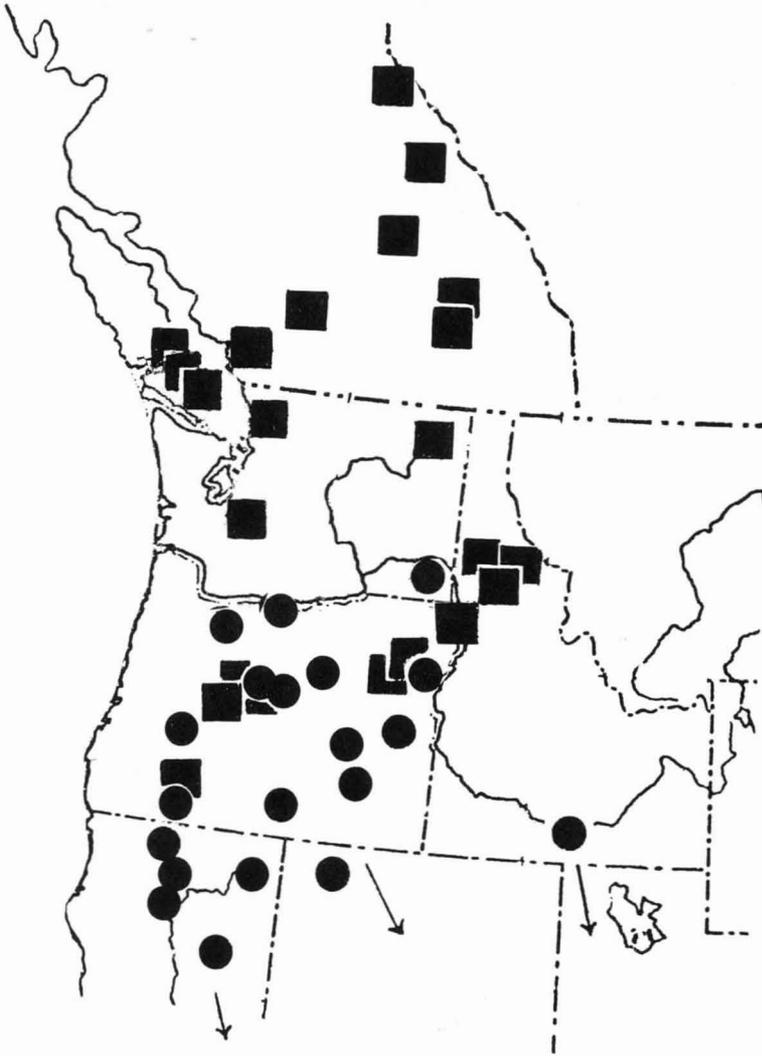


Fig. 17. Same region of the Nearctic showing distribution of the occurrence of signa in the corpus bursa of *Callophrys (Mitoura)* populations. Populations represented by black dots (and arrow indicating southward distribution) have no signa and are species *C. (M.) nelsoni* or *C. (M.) siva*. Populations represented by black squares have two signa on the upper and under surfaces of the corpus bursa and represent species of the new species complex as defined in Fig. 16.

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I am especially grateful to Dr. Frederick H. Rindge (The American Museum of Natural History, New York) for providing facilities for study of Nearctic *Callophrys*. I am also thankful to him and Drs. Paul A. Opler (Office of Endangered Species, United States Department of Interior, Washington) and Lee D. Miller (Allyn Museum of Entomology, Sarasota, Florida) for editorial assistance. Dr. F. Martin Brown (Colorado Springs, Colorado), Mr. William D. Field (United States National Museum of Natural History, Washington), and Dr. Opler gave advice during the study which was most helpful. All of these persons and Mr. Julian P. Donahue (Los Angeles County Museum of Natural History), Dr. Jerry A. Powell (Collection of the University of California at Berkeley), Mr. Harry K. Clench (Carnegie Museum of Natural History, Pittsburgh), and Mr. Scott Ellis (Hotchkiss, Colorado) kindly loaned specimens for study.

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Table of Ridgway Colors and Colloquial Colors

- Prouts Brown = a dark dull fuscous with a brown cast.
- Sanfords Brown = a bright, medium brown
- Amber Brown = as above, but more yellowish
- Vinaceous Russet = distinctly red-violet brown, approaching burgundy
- Cameo Brown = a medium brown, but dull
- Mummy Brown = like Prouts Brown but not as dull, more obviously brown
- Hazel = a bright brown, somewhat yellowish
- Tawney = as above, but more yellowish
- Raw Sienna = a bright brown, somewhat yellowish, but not hazel
- Dull Orange Rufous = distinctly orange, but dull
- Xanthine Orange = distinctly orange-yellow
- Raw Umber = very dark, smoked black-brown
- Zinc Orange = distinctly orange, more orange than yellow