THE NET-WINGED MIDGES
OR BLEPHARICERIDAE OF CALIFORNIA

By
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INTRODUCTION

All of the species in this family of nematocerous Diptera occur in mountainous regions in the immediate vicinity of rapidly flowing streams. The adults rest on vegetation, under fallen logs and overhanging rocks, in hollow trees, and in other protected, shady places. In flight they move swiftly, and during peak emergences numerous individuals may be seen hovering in the spray below waterfalls or darting between perches and capturing prey.

The ability of the adults to emerge from pupae submerged in swiftly flowing water is often cited as an extreme adaptation of insects to an aquatic habitat. Because its wings are fully developed and expanded within the pupa, the emerging imago has but to unfold them to render them functional. Thus it can take flight immediately, even while still in a teneral state, and escape into the air before being captured by the current.

The numerous creases in the perfect wing membrane (from which is derived the term "net-winged") result directly from the folding and compression of the wing into the confinement of the pupal wing case.

The female blepharicerid normally feeds on the blood of other small Diptera. With its long, heavy, serrate mandibles, the female macerates its prey and siphons the exuding body fluids. The females of a few forms lack mandibles; their food and that of the males, which consistently lack mandibles, is probably flower nectar.

The larvae, of which there are four instars, and pupae adhere in groups or singly to smooth rock surfaces in very swiftly flowing water, at the brink, within, or at the base of waterfalls and cataracts. Algae browsed from the substratum comprise the food of the former.

Blepharicerids are easily recognized in all stages. Of the several common types of stream-loving flies, the adults can be confused in the field only with crane flies (Tipulidae), which they somewhat resemble, but from which they may be easily distinguished by their stronger, more directional flight. Structurally they exhibit several characteristics that further identify them, namely, a completely detached vein M, in the wing, divided eyes, and stout hind legs. The ventrally flattened larvae are strongly constricted at the five intersegmental lines giving them a lobulate appearance. Each of the resulting six body divisions possesses hook-like apical prolegs and a ventromedian sucker which serve as holdfasts, enabling the larva to cling to smooth rock surfaces in the face of strong currents. The pupae might be likened to miniature flattened univalve molluscs such as limpets or abalone; they are usually jet black and have an anterior pair of four-leafed, erect, horn-like dorsal respiratory projections, the branchiae.

Because of the great size variation in different indi-
viduals of the same instar, the following criteria are offered to assist in distinguishing between mature and submature larvae:

(a) Presence of adult or pupal structures developing internally. Specimens showing discernible imaginal buds of legs and wings or pupal branchiae in the thoracic region are mature, fourth instar larvae.

(b) Presence of internal flanges representing the developing, strongly sclerotized posterior portion of the head capsule. These structures are apparent in larvae about to molt to a succeeding larval instar, and any specimens exhibiting them belong to a submature instar. Specimens with proportionately large ventral suckers (the latter may be contiguous or nearly so) have recently molted, and it is difficult to determine their instar without recourse to additional data.

(c) If the species or genus is known, the number of antennal segments and/or filaments in the ventrolateral gill tufts serve as indices to the instar number. Table 1 (p. 18) gives the values for these characters in third and fourth instar larvae of the California Blephariceridae.

The blepharicerid fauna of California (table 1, 16 species) is the richest of any state. This fact is due primarily to the great latitudinal extent of the state whose boundaries include portions of most of the major mountain systems of western North America. It is with the histories of these systems that the evolution and dispersal of blepharicerids are correlated. Thus several species which may be regarded as intrusives because their distributions coincide with orogenic provinces mostly lying without the state (Blepharicera jordani—Cascade Ranges; Diptopsis dismalea—Great Basin Ranges) mingle with autochthonous species whose ranges are expanding but have not yet reached beyond the state's boundaries (Blepharicera micheneri—Sierra Nevada and Transverse Ranges) and narrowly restrictive species situated on isolated mountains (Philorus jacinto—Mount San Jacinto).

The most important advance in our understanding of the family's higher classification was made by Alexander (1958). General information on the biology and anatomy of the family is available in the works of Alexander (1963), Bischoff (1928), Hogue (in press), Kitakami (1950) and Mannheims (1935).

This review can only be considered preliminary, being based on relatively few specimens (4,772). Our fauna, especially from the geographical and ecological standpoint, remains very incompletely known. No comprehensive treatment of the North American or California species exists, the works of Kellogg (1903) and Wirth and Stone (1956) being only fragmentary summaries of superficially analyzed and very limited material. Prior to the present study, very few of the immature stages were known and of these practically none correctly associated with the adults. At this time only the immature stages of Bibiocephala nigripes remains undiscovered.

ACKNOWLEDGMENTS

All sizable insect collections were canvassed for specimens, and for the loan of their holdings I am indebted to the following institutions and their entomology curators:

C. P. Alexander, personal collection (ALEX); P. H. Arnaud, Jr., California Academy of Sciences (CAS); J. L. Bath, University of California, Riverside (UCR); J. N. Belkin, University of California, Los Angeles; G. E. Byers and N. Marston, University of Kansas (UK); J. G. Edwards, San Jose State College (SJS); P. H. Freytag, Ohio State University (OSU); the late H. J. Grant, Jr., Academy of Natural Sciences of Philadelphia (ANSP); M. T. James, Washington State University (WSU); J. D. Lattin, Oregon State University (OSU); A. T. McClay and R. O. Schuster, University of California, Davis (UCD); L. L. Pechuman, Cornell University (CU); B. V. Peterson, Canada Department of Agriculture, Canadian National Collection (CNC); J. A. Powell, University of California, Berkeley, California Insect Survey Collection (CIS); H. H. Ross and R. T. Allen, Illinois Natural History Survey (INHS); G. B. Wiggins, Royal Ontario Museum (ROM); P. Wygodzinsky, American Museum of Natural History (AMNH); and A. Stone, Agricultural Research Service, USDA, United States National Museum (USNM). (LACM) denotes material in the Los Angeles County Museum of Natural History. Thanks also are due to D. Jamieson and R. Blair, Santa Clara Health Department, and R. L. Westcott for special allocations of specimens.

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Finally, to C. P. Alexander, Amherst, Massachusetts, the dean of blepharicerid taxonomists, I express particular appreciation for his special help on this project in providing material and a wealth of helpful suggestions and articles of information on these flies which, in his words, are the "aristocrats of the Diptera."
KEY TO THE NORTH AMERICAN GENERA OF BLEPHARICERIDAE

ADULTS

1. Radius with 4 branches, the second (R₃) fused apically with R₄, forming vein R₁,₃ and a closed cell (R₄) (figs. 1, 34) .................................................. 2
   Radius with 3 branches, no closed cell formed by radial branches (fig. 45) .................................................................................. 3

2. Vein R₃ long, much exceeding the terminal fusion of R₁,₃ (fig. 34). Fore femur strongly curved upward. Male genitalia with extremely large basistyles (at least 3 times the length of dististyle). Thoracic pleurites setose, hairs often black pilose ........................................... Bibiocephala
   Vein R₃ shorter than R₁,₃ (fig. 1). Fore femur straight. Male genitalia normal, histyles and dististyles about of same length. Thoracic pleurites largely glabrous . . Agathon

3. Basal sector of M₃,₄ present, falsely simulating cross vein M-Cu (figs. 78, 136) .................................................. 4
   Basal sector of M₃,₄ absent, no apparent cross vein M-Cu (fig. 45) .................................................. Blepharicera

4. Cell R₃ sessile (fig. 78). Smaller species (6 mm body length or less) .................................................. Dioptopsis
   Cell R₃ long-petiolate (fig. 136). Mostly larger species (8-10 mm body length) .................................................. Philorus

PUPAE

1. Branchial lamellae spreading, consisting of thin, translucent, flexible, leafy projections (figs. 143, 152) .................................................. Philorus
   Branchial lamellae contiguous or nearly so, consisting of heavy, darkly opaque, rigid, erect hornlike projections (figs. 20-21) .................................................. 2

2. Body form ellipsoid, strongly convex dorsad. Size large (length approximately 9-10 mm). Antennal cases short, barely exceeding base of wing case, and strongly incurved. Vestigial gills present ventrad on abdomen (fig. 43) .................................................. Bibiocephala
   Body form ovate, moderately or only slightly convex dorsad. Size smaller (length usually not exceeding 7 mm). Antennal cases longer, extending approximately one-fourth the length of wing case, their apices paralleling margin of wing case, i.e., not strongly incurred. Gills entirely absent .................................................. 3

3. Alar sclerite and scutum rugose; branchial lamellae short, lengths never more than 1.5 widths .................................................. Dioptopsis
   Alar sclerite and scutum smooth, if rugose, branchial lamellae long (lengths twice widths) .................................................. 4

4. Cephalic sclerite triangular (figs. 20, 31) .................................................. Agathon
   Cephalic sclerite hemispherical, dorsal apex broadly rounded (figs. 53, 64) .................................................. Blepharicera

MATURE LARVAE

1. Dorsal pseudopods absent (at least, clearly from anal division of abdomen) (figs. 51-52) .................................................. Blepharicera
   Dorsal pseudopods present .................................................. 2

2. Ventral gill tufts composed of 6 filaments, arranged in a plane, hemi-rosette pattern (fig. 49) .................................................. Bibiocephala
   Ventral gill tufts usually composed of 3-5 or 7-8 filaments, spreading and all directed generally cephalolaterad (figs. 7, 51) .................................................. 3

3. Dorsal sclerotized plates or tubercles present on abdominal segments, or if absent, at least a small dorsolateral tubercle above dorsal pseudopod on abdomen .................................................. 4
   No dorsal sclerotized processes of any kind, or if present as conical processes, 2 transverse series of minute plates,
also across thoracic region of cephalic division.

4. Dorsal pseudopods double, each with a subequal, elongate dorsal branch (fig. 151), or ventral gill tufts with 3 filaments (fig. 141).

**Dioptopsis**

Dorsal pseudopods single, each with only a small proximo-dorsal mammilate process or setate swelling (fig. 8). Ventral gill tufts with 5-8 filaments.

**Philorus**

**KEY TO THE CALIFORNIA SPECIES OF BLEPHARICERIDAE**

**ADULTS**

**Agathon**

1. **General:** R₄ long, fusing with R₁₂ well beyond fork of R₄ and R₅ (fig. 9). **Male genitalia:** Eighth abdominal tergite strongly modified forming two mesally approximate lobes (fig. 4). **Female genitalia:** Apex of oviscapt acutiform (fig. 6). *Agathon comstocki* (W0).

**Key:**

- Male genitalia: Eighth sternite lobes shorter (less than one-third surface area) (figs. 46, 57).
- Female genitalia: Outer dististyle diminutive, apex trilobate. Paramere broad, flattened, apically rounded (fig. 59).

2. **General:** Male: Penultimate antennal segment diminutive, diameter less than that of adjoining segments (fig. 57).

**Biibocephala**

*Only one species presently recognized in California, nigripes.*

**Blepharicera**

1. **General:** Small species (wing length 4.3 to 5.5 mm). **Male:** Upper eye division slightly larger than lower (fig. 68). Ultimate antennal segment ovoid (only about 2 times length penultimate) (fig. 68). **Female:** Upper eye division very small. Mandibles absent (fig. 69). **Male genitalia:** Inner dististyle bilobed; outer dististyle simple, apex broadly rounded (fig. 70). **Female genitalia:** Spermatacetheae with sclerotized, obversely bulbous neck (fig. 72).

**Dioptopsis**

Medium-sized species (wing length 8.5 mm or greater). **Male:** Upper eye division decidedly smaller than lower (less than one-third surface area) (figs. 46, 57). Ultimate antennal segment elongate (4-5 times length penultimate). **Female:** Upper eye division at least one-half the size of lower. Mandibles present. **Male genitalia:** Inner dististyle simple; outer dististyle variously lobed, apex lobed, or acute. **Female genitalia:** Spermatacetheae simple, without obversely bulbous neck.

**Philorus**

**2. General:** Male: Penultimate antennal segment elongate, greater than lower (less than one-third surface area) (fig. 57).

2. **General:** Male: Upper eye division at least one-fifth to one-fourth the area of lower in males (at least 11-12 rows of ommatidia), greater than lower in females.

**Blepharicera**

**3. Male genitalia:** Paramere with conspicuous mesal spur (fig. 93). **Male genitalia:** IX tergite lobe produced into a nude flange (i.e., without micro- or macrochaetae) (fig. 92). **Female genitalia:** Spermatacetheae ovoid (fig. 94).

**Key:**

- Male genitalia: Paramere simple, without spur. Mesal margin of IX tergite lobe not produced. **Female genitalia:** Spermatacetheae elongate-ovoid (fig. 129).

3. **General:** Antenna with 15 segments. Midtibial spur present though minute. **Male genitalia:** IX tergite lobe short, length only 2 times width (fig. 81). **Female:** Lobe of outer dististyle short and projecting dorsosmed (fig. 81). **Alpina**

4. **General:** Antenna with 14 segments or less. Midtibial spur entirely absent. **Male genitalia:** IX tergite lobe elongate, length 5-6 times width. Lobe of outer dististyle elongate and projecting subparallel to dististyle face.

**Blepharicera**

**5. General:** Ultimate antennal segment smaller than penultimate. Female mandible reduced to absent. **Male genitalia:** Paramere with spur. **Female genitalia:** Spermatacetheae pear-shaped.

5. **General:** Ultimate antennal segment longer than penultimate. Female mandible normal-sized. **Male genitalia:** Paramere simple. **Female genitalia:** Spermatacetheae ovate (fig. 117).

**Agathon**

**1. General:** Wing membrane infuscated. Palpus four-segmented.

**Dioptopsis**

**1. General:** Wing membrane hyaline. Palpus five-segmented.

**Blepharicera**

**2. General:** Upper eye division at least one-fifth to one-fourth the area of lower in males (at least 11-12 rows of ommatidia), greater than lower in females.

**2. General:** Upper eye division at least one-fifth to one-fourth the area of lower in males (at least 11-12 rows of ommatidia), greater than lower in females.
Philorus

1. General: Wing vein R₅ branching off from continuous vein R₄ (figs. 145, 164) .................................................................................. 2
   General: Wing veins R₄ and R₅ forming a symmetrical fork and petiole (R₄₊₅) (figs. 138, 154) ............................................. 3
2. General: Male: Basal half of wing infuscated. Female: No reliable characters presently known. Male genitalia:
   Dorsal lobe of outer dististyle small, not reaching apex of dististyle (fig. 167). Female genitalia: Oviscapt tapering caudad (fig. 169) .......................................................... yosemite
   General: Male: Wing membrane entirely hyaline. Female: No reliable characters presently known. Male genitalia:
   Dorsal lobe of outer dististyle large, extending well beyond apex of dististyle (fig. 148). Female genitalia: Oviscapt quadrangular (fig. 149) ............................ jactino

3. General: Larger species, wing length 9.0 mm. Scutellum with patches of bristles restricted to lateral corners. Fore
tibia 1.5 length of basitarsus. Male genitalia: Dorsal lobe of outer dististyle broadly expanded, tip narrowed and curving with numerous normal bristles at apex (fig. 157). Female genitalia: Spermataceae elongate-ovoid (fig. 159) ......................... vandusseii
   General: Smaller species, wing length 6.7 mm. Scutellum with short bristles all along posterior border, connecting the calciolateral patches. Fore tibia 1.9 length of basitarsus. Male genitalia: Dorsal lobe of outer dististyle bifurcate, posterior fork tipped with two large bristles, anterior fork with two spiniforms (fig. 139). Female genitalia: Spermataceae pear-shaped (fig. 140) ................. californicus

PUPAE

Agathon

1. Branchial sclerite strongly lobed beneath branchia (fig. 9), the latter projecting cephalad, the lamellae oval in outline, numbers 1 and 4 much more strongly developed than 2 and 3 and enclosing them (fig. 10) .... comstockii
   Branchial sclerite weakly lobed or unlobed, branchia projecting dorsad and lamellae elongate and subequal (figs. 20–21, 31–32) ......................................................... 2
2. Integument of alar sclerite and scutum smooth (figs. 31–32) .......................................................... elegantulus
   Integument of alar sclerite and scutum rugose (figs. 20–21) .......................................................... doanei

Bibiocephala

Only one species presently recognized in California, nigripes.

Blepharicera

1. Outline of whole pupa oval, width of abdomen at segment 3 distinctly greater than width of thorax (fig. 76). Small, length 3 to 4 mm ..................................................... ostensackeni
   Outline of whole pupa ovoid, width of abdomen at segment 3 equal or slightly less than width of thorax (figs. 54, 65). Larger, length 4 to 6 mm ..................................................... 2
2. Branchial lamellae gently incurved, those of two sides well separated (fig. 64) ........................ micheneri
   Branchial lamellae strongly incurved, convergent, number 4 of two sides often overlapping (fig. 53) .................. fordani

Dioptops

1. Branchial sclerite strongly lobed, projecting well beyond cephalic sclerite in lateral aspect (fig. 88) ...... alpina
   Branchial sclerite weakly lobed, cephalic sclerite visible from lateral aspect .......................................................... 2
2. Branchial lamellae spreading, caudal pair strongly convergent, often overlapping (fig. 121) ........ markii
   Branchial lamellae all subparallel ............................................. 3
3. Length/width of anteriormost branchial lamella 1.1 or larger .......................................................... damales
   Length/width of anteriormost branchial lamella 1.0 or smaller ........................................................................... 4
4. Interbranchial index (=interbranchial distance at base of lamellae/width of anteriormost lamella) less than 0.7. Rugae of posterior region of scutum forming a line running parallel to hind margin of sclerite (fig. 134) .......................................................... sequoiaorum
   Interbranchial index greater than 1.0. Rugae of posterior region of scutum random, not forming a line (fig. 99) ......................... aylmeri

Philorus

1. Branchial lamellae flat, numbers 2 and 3 deeply incised (fig. 143). Color in life, brown ............................................. californicus
   Branchial lamellae convoluted, all entire (figs. 152, 169, 171). Color in life, black .......................................................... 2
2. Branchial lamellae small, anteriormost barely projecting cephalad as far as cephalic sclerite (fig. 171) ........ yosemite
   Branchial lamellae large, anteriormost projecting well beyond anterior margin of pupa (figs. 152, 162) ............. 3
3. Branchial lamella 2 oval in outline, lateral margins convex (fig. 162) ............................................. vandusseii
   Branchial lamella 2 rhomboid in outline, lateral margins straight or concave (fig. 152) ............................................. jactino

MATURE LARVAE

Agathon

1. Dorsal sclerotized processes entirely absent ........ comstockii
   Dorsal sclerotized processes present .................................. 2
2. Dorsal sclerotized processes in the form of transverse rectangular plates (figs. 18–19) ........ doanei
   Dorsal sclerotized processes in the form of conical protuberances (figs. 29–30) .......................................................... elegantulus

Bibiocephala

Only one species presently recognized in California, nigripes.

Blepharicera

1. Pseudopods large, over two-thirds visible in dorsal view (figs. 73–74). Dark dorsal pigmentation forming a distinct variegated pattern .......................................................... ostensackeni
   Pseudopods small, rarely only the extreme tips visible in dorsal view (figs. 51, 62). No distinct pattern of pigmentation .......................................................... 2
2. Cephalolateral corners of body divisions produced into a tubular projection resembling a dorsal pseudopod. Antenna with extensive median membranous area. Anterior
ventral gill tufts composed of 5 filaments (figs. 51–52)
jordanii.

Cephalolateral corners of body divisions only slightly produced, resembling caudalolateral corners. Antenna with very small median membranous area. Anterior ventral gill tufts composed of 7 filaments (figs. 62–63) micheneri.

Dioptris

1. Dorsal tubercles and plates present
   Dorsal integument without tubercles or plates
2. Antenna indistinctly segmented, basal ¼ membranous.
   Ventral gill tuft of segment 6 diminutive, with only 2 filaments. Dorsal pseudopods gently curving cephalolaterad (fig. 119) markii.
   Antenna clearly 3-segmented, middle segment much smaller than others. Ventral gill tuft of segment 6 subequal to others, with 5 filaments. Dorsal pseudopods angular, tips project ventrolaterad (fig. 96) apicener, sequoiarum, dismae.

Philorus

   Dorsal sclerotized processes in the form of projecting tubercles (figs. 151, 161, 170). Ventral tufts composed of 5 filaments.
2. Dorsal processes elongate, similar in size and shape to lateral processes; two on cephalic division (fig. 180) vanesceae.
   Dorsal processes conical, much shorter and dissimilar in shape to lateral processes; four on cephalic division.
3. Dorsal tubercles of abdominal segments subquadrate in position (nearly equidistant from each other, the distance between each anterior pair 4–5 times the tubercle diameter at its base) (fig. 169). Lateral processes of hindmost abdominal segment unequally bifurcate (fig. 169) yosemitae.
   Dorsal tubercles of abdominal segments trapezoidal in position (each anterior pair much closer together than the posterior pair, the distance between the former slightly less than 2 times the tubercle diameter at its base) (fig. 150). Lateral processes of hindmost abdominal segment equally bifurcate (fig. 150) facinto.

Family BLEPHARICERIDAE

Genus Agathon von Röder

All three North American species in this genus occur in California. They form a heterogeneous group, sharing only the dubiously homologous common presence of a short vein R₃ in the wing. Future comparative studies in the higher taxa of the family may very well indicate a revision in the generic placement of doanei and comstocki.

Map 1. California distribution of Agathon comstocki (Kellogg).

Agathon comstocki (Kellogg)
(Figs. 1–11; Map 1)


"New California larva" Kellogg, 1903, loc cit.: 196, Pl. XXII, figs. 1–2. This is the third instar of Agathon comstocki.

Bibiocephala (=Agathon) comstocki; Kellogg, 1907, Genera Insectorum, 56:13.


This ubiquitous species is by far the most common and widely distributed blepharicerid in California and western North America.

**Agathon doanei** (Kellogg)

(Figs. 12-22; Map 2)

**Liponeura doanei** Kellogg, 1900, Psyche, 9:39-41, figs. 1-2.


**Geographic range.—California.**

A species so far known only from California, *A. doanei* appears to be restricted to the Coast Ranges.

**Agathon elegantulus** von Röder
(Figs. 23-33; Map 3)


This widely distributed species barely enters the extreme northeastern corner of the state having been found so far only in the Warner Mountains, Modoc County.

**Genus Bibiocephala** Osten Sacken

This genus above all others in North America needs taxonomic revision. It consists of a complex of very similar species (subspecies ?) which are devoid of clear-cut characters. Probably a statistical analysis will be necessary to set the limits of namable entities, but this must await the accumulation of much more material than is presently available. At this time most specimens should be referred to by the specific name *grandis* Osten Sacken, 1874. This is the oldest of three names applying to the most commonly encountered form from which are clearly separable only *nigripes* (by its melanic legs) and an undescribed species from New Mexico (by hairy eyes and other features). The immatures of none of the forms are definitely associated with the adults. So far, all adult specimens I have seen from California most clearly resemble the type of *nigripes* from Idaho.
Bibiocephala nigripes Alexander

(Figs. 34-44; Map 4)


Geographic range.—California, Idaho.

California records.—Shasta Co.: Pit River, Dam 5, V-14-53, 1 female (H. P. Chandler, CAS). Siskiyou Co.: Dunsmuir, 1 female (Wickham, USNM).

The figures referred to here are drawn from material probably of a species other than the nigripes, since the latter was not available in all stages. They will serve, however, to characterize the genus.

Genus Blepharicera Macquart

This is the only genus of the family with species in eastern North America (Alexander, 1963). All the known western forms save zionensis Alexander from Utah occur in California. Probably several new species await discovery.

Blepharicera jordani (Kellogg)

(Figs. 45-55; Map 5)

B. jordani occurs only in the northern half of the state (the southernmost record being in Fresno County) where it overlaps the broader distribution of micheneri. The close external similarity of the females of the two species make genitalia dissections necessary for correct determinations of specimens from sympatric areas.

Very few larvae of jordani are available and my association, based on geography and the process of elimination, could be in error. The close similarity of its presumed larva with that of Dioptopsis markii should be pointed out (figs. 51 and 118).

Blepharicera micheneri (Alexander)

(Figs. 56-66; Map 6)


Geographic range.—California.


The difficulty of separating the females of this species from those of the preceding has already been noted (see the discussion under jordani).

This is the only Blepharicera in southern California. The size of the subanal pouch and apodeme of the penis
bulb in the male genitalia is variable, and two males from Hell's Half Acre, Tuolumne County, exhibit somewhat differently proportioned genitalia (extra-long inner lobe of the dististyle and long median finger on the outer lobe), possibly representing a subspecifically distinct population.

A partial account of the biology in the San Gabriel Mountains is given by Gibo (1964).

**Blepharicera ostensackeni** (Kellogg)

(Figs. 67-77; Map 7)


Geographic range.—California, Oregon.


This species finds its closest relatives among the eastern _Blepharicera. _With them it forms a distinct complex separable from _B. micheneri_ and _jordani_ as follows:

<table>
<thead>
<tr>
<th>Species</th>
<th>Male Genitalia</th>
<th>Larvae Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>B. micheneri</em></td>
<td>Dististyle secondarily lobed and enlarged</td>
<td>Prolegs small, at most barely visible in dorsal view beyond lateral margin of segment.</td>
</tr>
<tr>
<td><em>B. jordani</em></td>
<td>Dististyle triangular, fused</td>
<td>Prolegs large, extending well beyond lateral margin of segment.</td>
</tr>
<tr>
<td><em>B. ostensackeni</em></td>
<td>Dististyle small and simple</td>
<td>Integument with pigmentation pattern.</td>
</tr>
</tbody>
</table>

Like _jordani_, this species inhabits only the northern and central parts of the state. I have examined specimens studied by C. P. Alexander from Mt. Shasta and
considered by him to represent a distinct species, *shastensis*, and have compared them with the small portion of the type series of *ostensackeni* still extant (in USNM from Stanford Collection) and have found them to be identical. One male specimen, particularly, exhibits the genitalia and head in good condition and all significant characteristics of both match those of the holotype of *shastensis*. This slide-mounted specimen, which I here formally designate as the LECTOTYPE¹, bears the following data: "creek near Castella, Shasta Co. CALIF. 28 Aug. 1901 Coleman col." It was dissected from a mature pupa, portions of the case of which accompany the imago under the same coverslip.

Alexander originally described his species without having seen the type material of *ostensackeni* (then presumed lost) and not critically questioning Kellogg's description, which I believe to contain a gross error. It is clear to me, on the basis of the following reasoning, that Kellogg transposed the sexes when writing his description, i.e., he described the male as the female and vice versa.

In the only definitive part of Kellogg's description (the remainder except size could apply to any *Blepharicerai*), he states, "Eyes of female contiguous, and bisected by an unfacetted stripe; eyes of male separated by a considerable space, and bisected by a line, the upper or large-facetted portion including a much larger part of the eye in the females than in the males, this part in the female (Pl. XVIII, fig. 2) being unusually small (as compared with other species)." After having studied many specimens of adult *Blepharicerai* from California, I can find no insect that fits this set of characteristics. However, if the references to the sexes are transposed, Alexander's species and the lectotype designated above both agree perfectly.

The females of Alexander's *shastensis* exhibit the unusual features among North American *Blepharicerai* of lacking mandibles and having small upper eye divisions while the males have very large upper eye divisions (see figures 68 and 69). Since the opposite conditions occur in the heads of all other *Blepharicerai* with which Kellogg was familiar, it is plausible that he confused the sexes when setting down his remarks, perhaps writing them while referring to his figure (Pl. XVIII, fig. 2) of the "male" which clearly shows an absence of mandibles and is actually the head of a female. His correct larval and pupal descriptions plus the all-important existence of some of his original material show conclusively that he made this error.

¹ All of Kellogg's species were based originally on syntype series, most of which are now incomplete or totally lost. Lectotypes or neotypes need to be selected for these. In this work, only the lectotype of *ostensackeni* has been selected in order to clarify a case of synonymy.

Genus *Dioptopsis* Enderlein

All of the North American species in this genus except *arizonica* Alexander occur in California.

*Dioptopsis alpina* Hogue

(Figs. 78-88; Map 8)


Geographic range.—California.

California records.—ALPINE Co.: Lake Alpine, VII-15-50, holotype male, allotype female (L. W. Quate, USNM), 1 male, 1 female, 13 pupae and pupal skins (CIS, LACM). El Dorado Co.: Fred's Place, VII-5-50, 15 pupal skins (L. W. Quate, CIS). LOS ANGELES Co.: South fork Big Rock Creek, 2.9 mi. e. junction highway 39-Angeles Crest highway, 7,300 ft., VI-1-68, 4 larvae, 3 pupae (G. Challet, LACM). Little Rock Creek, Buckhorn Flats, 6,600 ft., VII-8-68, 2 pupae (J. Honey, LACM). SAN BERNARDINO Co.: O-ongo Creek, near Running Springs, San Bernardino Mountains, 6,000 ft., VIII-28-69, 1 pupa (C. L. Hogue, LACM). Snow Crest Camp, VII-18-52, 1 male (W. V. Garner, CIS). Vivian Creek, Mt. San Corgonio, 6,800-7,000 ft., VII-2-68, 2 males, 6 females, 78 pupae and pupal skins, 181 larvae (C. L. Hogue, LACM). San Antonio Creek, 6,200-6,400 ft., VI-20-68, 1 female, 66 pupae and pupal skins, 3 larvae (C. L. Hogue, LACM).

This species' closest relative is *D. arizonica*, known only from the type male. The two species constitute a distinctive division of the genus characterized by
nearly undivided eyes in both sexes, IX tergite lobes of the male genitalia apically truncate and very short (nearly as broad as long), spermathecae elongate and midtibia with only one, tiny apical spur (Hogue, 1966b:5).

*Dioptopsis aylmeri* (Garrett)  
(Figs. 89-100; Map 9)  

NEW SYNONMY.  

Geographic range.—California, Washington, Wyoming, British Columbia.  


All female specimens of this species from the eastern slope of the Sierra Nevada lack mandibles and exhibit other modifications of head structure (most notably reduced upper eye divisions) that parallel the type of head found in normal female *Blepharicera ostensackeni* and *Dioptopsis dismalea*. In other respects, these specimens and the males and immatures are indistinguishable from typical *aylmeri* from other localities with the exception of one female from the Grand Tetons of Wyoming which is likewise amandibulate.

The larva of this species is presently indistinguishable from those of *sequoiarum* and *dismalea*. The sclerites (head and prolegs) of *aylmeri* larvae tend to be yellow as opposed to brown or black in *sequoiarum* and *dismalea*, but there are exceptions. Detailed study of the chaetotaxy may yield reliable characters when long series of definitely associated specimens become available.

Through the kindness of B. V. Peterson and C. P. Alexander the types of *aylmeri* (male, CNC) and *cheaini* (female, ALEX) were made available for study. I
found them to bear characteristics agreeing with males and females dissected from pupae collected together in a single location (s. fork Sacramento River) as well as with similar material collected by me in several streams draining the eastern slopes of the Sierra Nevada in Inyo and Mono counties. Including details of genitalia structure, all females in the latter collections, apart from the aberrant head anatomy discussed above, agree with typical *aylmeri* discussed above. These, I feel, are not indicative of a genotype sufficiently different from that of typical *aylmeri* (normal heads) to isolate them reproductively.

**Dioptopsis dismalea** Hogue

(Figs. 101-111; Map 10)


**Geographic range.**—California, Nevada.


The females of *dismalea* lack mandibles as do those of only one other North American species, *Blephariceru ostensackeni*, and populations of *Dioptopsis aylmeri* from the eastern drainage of the Sierra Nevada.

**Dioptopsis markii** (Garrett)

(Figs. 115-123)


**Geographic range.**—California, Montana, Idaho, British Columbia.

**California Records.**—? County: Elizabeth Lake, VII-2-34, 2 larvae, 1 pupa (R. H. Torbutan, INHS).

Unfortunately, the collector of the few immatures representing this species in California neglected to specify which of the ten California lakes named Elizabeth was involved. Probably the specimens come from a very northerly part of the state.

The similarity of the larva to that of *Blephariceru jordani* has already been noted.

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2 Garrett's tibial spur formula "0-1-2" is in error. The type actually bears two spurs on the midtibia, making the correct formula 0-2-2.
for this disjunct distributional pattern are not known but are probably in large part due to lack of collecting in areas where it might be expected. A review of the regional species has been published by Hogue (1966a).

**Philorus californicus** Hogue

(Figs. 136-144; Map 12)


**Philorus jacinto** Hogue

(Figs. 145-153; Map 13)


*California records.*—RIVERSIDE CO.: Idyllwild, V-14-39, 1 larva (T. Aitken, USNM). Strawberry Creek, 3,000 ft., San Jacinto Mountains, VI-29-65, holotype male, allotype female, 3 paratype males, 3 paratype females (F. A. Rauch, UCR, LACM); IV-14-66, 221 pupae, 135 larvae (C. L. Hogue; No. CLH 158, LACM); V-19-66, 24 males, 59 females, 14 pupae, 2 larvae (C. L. Hogue; No. CLH 165, LACM).

**Philorus canduzeei** Alexander

(Figs. 154-163; Map 14)


*California records.*— ORANGE CO.: San Juan Creek, 1,600 ft., II-8-67, 4 larvae (G. Challet and J. Caton, UCR). RIVERSIDE CO.: Long Canyon Creek nr. jct. San Juan Canyon Creek, Santa Ana Mountains, IV-16-66, 31 pupae and skins, 66 larvae (J. Dixon, LACM); IV-29-67, 21 pupae, 45 larvae (C. L. Hogue,


Philorus yosemite (Osten Sacken) (Figs. 164-172; Map 15)


A partial account of the biology in the San Gabriel Mountains is given by Gibo (1964).
TABLE 1
List of California Species of Blephariceridae and Numbers of III and IV Larval Instar Antennal Segments and Gill Filaments

<table>
<thead>
<tr>
<th>Species</th>
<th>Number of filaments in ventrolateral gill</th>
<th>Number of antennal segments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Instar III</td>
<td>IV</td>
</tr>
<tr>
<td>Agathon comstocki (Kellogg, 1903)</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>A. douani Kellogg, 1900</td>
<td>3</td>
<td>6-7</td>
</tr>
<tr>
<td>A. elegantulus von Röder, 1890</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Bibiocephala nigripes Alexander, 1965</td>
<td>4*</td>
<td>6*</td>
</tr>
<tr>
<td>Blepharicera jordani Kellogg, 1903</td>
<td>4(3)**</td>
<td>6(4)</td>
</tr>
<tr>
<td>B. micheneri Alexander, 1959</td>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td>B. ostensackeni Kellogg, 1903</td>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td>Diaptopsis alpina Hogue, 1966</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>D. dismalea Hogue, 1970</td>
<td>unavailable</td>
<td>5(4)</td>
</tr>
<tr>
<td>D. aglomeri (Garrett, 1923)</td>
<td>3(2)</td>
<td>4-5(3-4)</td>
</tr>
<tr>
<td>D. markii (Garrett, 1923)</td>
<td>2(1)</td>
<td>3-4(2-3)</td>
</tr>
<tr>
<td>D. sequoarum (Alexander, 1952)</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Philorus californicus Hogue, 1966</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>P. jacinto Hogue, 1966</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>P. vandusseii Alexander, 1966</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>P. yosemite (Osten Sacken, 1877)</td>
<td>3</td>
<td>5</td>
</tr>
</tbody>
</table>

* From Bibiocephala sp.
** Values in parentheses for gill tuft on abdominal division 6 only.
LITERATURE CITED

ALEXANDER, C. P.

BISCHOFF, W. C. M.

GIBO, D. L.

HOGE, C. L.


KELLOGG, V. L.

KITAKAMI, S.

MANNHEIM, B. T.

WIRTH, W. W. and A. STONE
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PLATE I

Figs. 1–6. *Agathon comstocki*, adult. 1, wing; 2, 3, male and female head; 4, 5, male genitalia; 6, female genitalia.
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Agathon

Thorax 1
11
111
Abdomen 1

Dorsal pseudopod
Abdomen 6
7-10

Pseudopod

Branchial sclerite
Cephalic sclerite

Abdomen 7

♀

♂

comstocki
PLATE III
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Agathon

31

32

elegantulus

33

30

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Blepharicera

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54

55

jordani
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Blepharicera

73

1.0

2.0

75

♀

76

77

ostensackeni
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Dioptopsis

84

85

86

87

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alpina
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Dioptopsis

101

102

103

104

105

dismalea

106
PLATE XX

Dioptopsis

107

109

110

108

dismalea
PLATE XXI
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 Dioptopsis

124

125 ♂

126 ♀

127

128

129

sequoiarum
PLATE XXIV

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Philorus

136
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138
139
140

californicus
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Philorus

californicus
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Philorus

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Philorus

164

165

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167

168

yosemite
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Philorus

169

170

2.0

171

2.0

172

Yosemite