

Studies of Ephydrinae
(Diptera: Ephydridae), VII:
Revision of the Genus
Setacera Cresson

WAYNE N. MATHIS

SMITHSONIAN CONTRIBUTIONS TO ZOOLOGY • NUMBER 350

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ABSTRACT

Mathis, Wayne N. Studies of Ephydrinae (Diptera: Ephydriidae), VII: Revision of the Genus *Setacera* Cresson. *Smithsonian Contributions to Zoology*, number 350, 57 pages, 138 figures, 1982.—The genus *Setacera* Cresson is revised on a world basis. *Setacera* is shown to be a monophyletic lineage within the tribe Ephydrini, closely related to *Ephydra* Fallén. Like most ephydrines, the immature stages of *Setacera* inhabit floating algal mats, primarily in fresh-water environments. A hypothetical phylogeny for the genus is proposed in which the species are arranged in five species groups. The cladistic relationships between these groups are indicated by morphological character evidence. Three new species are described: *S. freidbergi* (Israel and Iran), *S. jamesi* (coast of California, Oregon, and Washington), and *S. trichoscelis* (Ecuador). Four synonyms are newly proposed, all of *Ephydra breviventris* Loew: *S. fluxa* Miyagi, *E. glabra* Meijere, *E. laeta* Hendel, and *S. pedalis* Cresson. Keys to species groups and species, illustrations, and distribution maps are provided.

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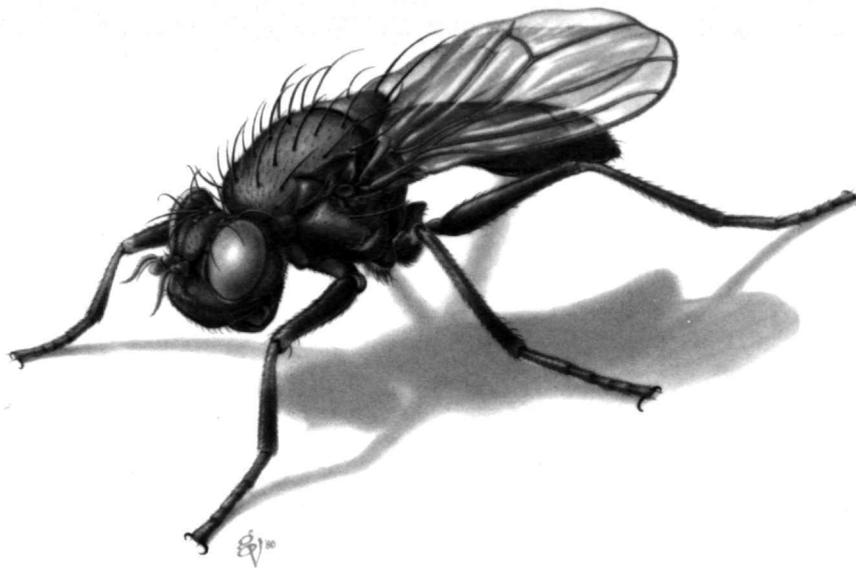


FIGURE 1.—*Setacera freidbergi*, habitus.

Studies of Ephydrinae (Diptera: Ephydridae), VII: Revision of the Genus *Setacera* Cresson

Wayne N. Mathis

Introduction

As a continuing endeavor towards a generic revision and catalog of the subfamily Ephydrinae, this study of the genus *Setacera* Cresson was undertaken. Although my initial intention was to revise the New World species only, it became necessary to expand the coverage to a world-wide basis to understand and characterize the genus properly. This has delayed publication of the New World portion and has markedly increased logistical problems, particularly in dealing with collections from the Old World, but from the perspective of my overall goal, the revision is substantially more valuable.

Setacera is a comparatively new generic name (Cresson, 1930). Species described previously were included in the genus *Ephydra* Fallén, a practice still preferred by a few authors (Soika, 1956; Dahl, 1959; Nartschuk, 1970). Until now no comprehensive study of the genus has been available, and species descriptions were either published singly or as parts of faunal studies of limited geographic scope. Only two major faunal reviews are available. Becker's (1926) monograph of the palaeartic Ephydridae included the de-

scribed species of that region as segregates of the genus *Ephydra*, and Sturtevant and Wheeler's (1954) synopsis of North American species included a review of *Setacera*.

Prior to the present study, 18 names were available. Of these, 13 are now considered to be valid, and five are relegated to junior synonymy. With description of three new species, the genus now comprises 16 species, and each major faunal realm is represented by at least one species. The New World fauna is richest, with nine species, and North America alone has eight. Only two species are known to occur in more than one major faunal realm: *S. micans* (Haliday) is holarctic, and *S. breviventris* (Loew) is found in the Palaearctic, Afrotropical, Oriental, and Australian regions. *Setacera* is primarily a northern temperate genus, with only three species occurring below the Equator, and two of these, *S. breviventris* and *S. multicolor* (Soika), are found in austral temperate areas as well.

The life history of the genus is virtually unknown. References are few and scattered, and the immature stages of only two species have been described (Johannsen, 1935; Foote, 1982). (The immature stages of "*E. micans*" were discussed by Beyer (1939), although I suspect that he was dealing with a species of *Ephydra*.)

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My objective with this revision is to treat all known species in a comprehensive study, with focus also on intrageneric relationships. The tribal and subfamilial framework will be dealt with elsewhere.

METHODS.—The methods and descriptive format used generally in this study were explained in parts I-III and V-VI of the Ephydrinae series (Mathis and Shewell, 1978; Mathis, 1979b, 1980, 1982; Mathis and Wirth, 1981; Mathis and Simpson, 1981), part I of the Notiphilinae series (Mathis, 1979a), and elsewhere (Mathis, 1979c). The following procedures or characters, however, need further explanation.

Velvety tomentose band: At the vertex of the head and immediately adjacent to each compound eye is an area that is densely tomentose, appearing velvety. The extent and shape of this area is a good character, especially for characterizing species groups within *Setacera*.

Facial angle: Angle formed by anterior surface of face (prefrons) and dorsal surface as viewed from a lateral aspect.

Male 5th tergal ratio: Tergal length/tergal width. Both measurements are maximum distances as viewed from a dorsal aspect.

Female ventral receptacle: Use of characters of this structure is of recent development (Clausen and Cook, 1971; Clausen, 1973, 1977; Mathis, 1979a, 1980), and it is appropriate to formalize the terminology for specific parts. The receptacle can be generally divided into two major parts, the operculum and the extending process. The operculum is the usually simple, hatlike structure situated at the dorsum. Directions are arbitrarily selected, operculum dorsad, although they agree with the illustrated aspect most often published (see references listed previously). The extending process, the remainder of the receptacle, exhibits considerable diversity of structure, hence the terminology for the various parts. Extending ventrally from the operculum and ending at the juncture with the ventral, curved portion, is usually a necklike process that I call the cervix. The ventral portion, usually curved, is designated as the corpus. The shape of the various parts of the

extending process, their relative size, etc., are excellent characters, used extensively in this paper to characterize higher taxa, species groups, etc.

ACKNOWLEDGMENTS.—Numerous persons and institutions have cooperated to make this study possible. I wish to express my appreciation for their consideration, especially to the curators and their respective institutions for the loan of specimens (an asterisk indicates collections from which type specimens were borrowed).

AMNH	American Museum of Natural History, New York (Dr. Pedro W. Wygodzinsky)
ANIC	Australian National Insect Collection, CSIRO, Division of Entomology, Canberra, Australia (Dr. D. H. Colless)
ANSP*	Academy of Natural Sciences of Philadelphia (Dr. Daniel Otte)
BMNH	British Museum (Natural History), London, England (Mr. Brian H. Cogan)
CAS	California Academy of Sciences, San Francisco (Dr. Paul H. Arnaud, Jr.)
CNC	Canadian National Collection, Ottawa, Ontario, Canada (Dr. J. R. Vockeroth)
CU	Cornell University, Ithaca, New York (Dr. L. L. Pechuman)
DEI	former Deutsches Entomologisches Institut, collections in the Institut für Pflanzenschutzforschung, Zweigstelle Eberswalde, Abteilung Taxonomie der Insekten, Eberswalde, Germany (DDR) (Dr. Günter Morge)
DLD	personal collection of Dr. D. L. Deonier, Oxford, Ohio
HNHM	Hungarian Natural History Museum, Budapest, Hungary (Dr. L. Papp)
HU*	Museum für Naturkunde, Humboldt Universität, Berlin, DDR (Dr. H. Schumann)
HUS*	Hokkaido University, Sapporo, Japan (Dr. S. Takagi)
ITZA*	Instituut voor Taxonomische Zoologie, Zoologisch Museum, Universiteit van Amsterdam, Amsterdam, Netherlands (Dr. Th. H. van Leeuwen)
KSU	Kent State University, Kent, Ohio (Dr. B. A. Foote)
KU	University of Kansas, Snow Entomological Museum, Lawrence, Kansas (Dr. George W. Byers)
MCSNV	Museo Civico di Storia Naturale de Venezia, Italia (Dr. Silvano Canzoneri)
MRYAC*	Musée Royal de l'Afrique Centrale, Tervuren, Belgium (Drs. R. Jocqué and J. Decelle)

NMW	Naturhistorisches Museum, Wien, Austria (Dr. Ruth Contreras-Lichtenberg)
NRS	Naturhistoriska Riskmuseet, Stockholm, Sweden (Dr. Per Inge Persson)
UCD	University of California, Davis (Dr. Robert O. Schuster)
UCR	University of California, Riverside (Mr. Saul I. Frommer)
UMN	University of Minnesota, St. Paul (Dr. Philip J. Clausen)
UMO	University Museum, Oxford University, Oxford, England (Dr. M.W.R. de V. Graham)
USNM*	former United States National Museum collections in the National Museum of Natural History, Smithsonian Institution
WNM	personal collection of Dr. Wayne N. Mathis, College Park, Maryland
WSU	M. T. James Insect Collection, Washington State University, Pullman (Dr. William J. Turner)
ZIL	Zoological Institute, Lund University, Lund, Sweden (Dr. Hugo Andersson)

Miss Hollis B. Williams prepared all of the maps and organized the locality data; Mr. L. Michael Druckenbrod, Ms. Amy Bartlett, and Ms. M. Ryan rendered the habitus illustrations; the frontispiece was done by Mr. George L. Venable. The manuscript was typed by Ms. Noreen Connell and was critically reviewed by Drs. Willis W. Wirth, B. A. Foote, and Wayne E. Clark. I also wish to thank Dr. S. Dillon Ripley, Secretary of the Smithsonian Institution, for financial support to conduct field work through a Fluid Research Grant.

Tribe EPHYDRINI Zetterstedt

EPHYDRINI Zetterstedt, 1837:48 [as the "family" Ephydri-
nae].—Wirth and Stone, 1956:45 [first use formally as a
tribe].

DIAGNOSIS.—Specimens of Ephydrini may be distinguished from other Ephydridae by the following combination of character states.

Adults: Mesofrons subquadrate, becoming slightly wider posteriorly, with shiny, metallic luster; frequently with convergent intrafrontal bristles inserted near anterior margin of mesofrons; dorsum of interfoveal carina usually shiny, concolorous with mesofrons; fronto-orbital bris-

gles laterocline; facial setae along oral margin usually dense and long; dorsocentral bristles 5 pairs, anterior 1 or 2 pairs presutural, although sometimes weak; intrapostalar bristle well developed, at least equal to one-half length of postalar bristle; supra-alar bristle well developed, subequal to postalar bristle; notopleuron sparsely setulose; propleuron setulose; prosternum setose, usually more evident along posterior margin near forecoxae; mesopleuron with 1 large bristle near middle along posterior margin, several smaller bristles or setae may also be present; hind coxal strap setose; pulvilli rudimentary or lacking; tarsal claws shallowly curved and usually elongate.

Third-Instar Larva: Mouthhooks not joined together basally, each mouthhook spatulate and dentate marginally; anterior spiracles with 2–8 marginal papillae; posterior spiracles borne distally on bifid, retractile respiratory tube, tube one-third to one-sixth total body length; spiracular caps each bearing 4 spiracular openings (or series of openings), openings slitlike, oval, each bordered basally by hydrofuge interspiracular process; segments 5–12 with ventral prolegs bearing crochet-like spines in well-defined rows; dorsal patterns composed of flattened spines usually present; if prolegs and dorsal patterns absent, then spiracular openings subdivided and spiracular caps elongate.

DISCUSSION.—Larvae of most Ephydrini are easily recognized by their elongate respiratory tube, ventral prolegs, and dorsal spine patterns. The larvae of *Dimecoenia* are exceptional but can be distinguished by the shape of their mouth parts, the unique structure of the posterior spiracles, and their habitat distribution (salt marshes).

The monophyly of this tribe is well established, being based on the following synapotypies:

1. *Setal vestiture of prosternum:* in members of this tribe, the prosternum is setose, especially ventrally and posteriorly around the coxal cavities and usually more extensively. The generalized condition in the family is for the prosternum to be bare of setae.

2. *Hind coxal strap:* the hind coxa has a strap that extends around the posterior side. This strap bears four or five setae in members of Ephydrini. Elsewhere in the family it is bare.

3. *Pulvilli:* with few exceptions in the family, the pulvilli

are evident as conspicuous pads beneath the tarsal claws. In members of Ephydrini, however, the pulvilli are either rudimentary or are lacking entirely.

4. *Tarsal claws*: the tarsal claws are shallowly curved and are usually elongate in members of Ephydrini. The generalized condition is for claws to be conspicuously curved and short.

5. *Larval prolegs*: with the exception of a secondary loss in *Dimecoenia*, larvae of Ephydrini have prominent, ventral prolegs that bear crochets. These structures are an adaptation to the algal-mat habitat of the immatures of these flies and assist in grasping the substrate. The secondary loss of prolegs in larvae of *Dimecoenia* apparently occurred as the latter shifted back to a mud-shoreline habitat. Larvae of *Dimecoenia* have creeping welts, similar to those of other mud-inhabiting Ephydridae (Mathis and Simpson, 1981).

6. *Habitat of immatures*: the generalized habitat for the subfamily Ephydrinae is probably shoreline mud. This is the habitat of most species of Scatellini and of the subfamily Parydrinae; however, members of Ephydrini have adapted to algal mats on the surface of both lentic and lotic water systems.

Although Ephydrini is undoubtedly monophyletic, its companion tribe Scatellini is not. Ephydrini is but one of several monophyletic lineages arising from the ancestral lineage that now comprises the concept of Scatellini (Mathis, 1979c, 1980). The actual sister group of Ephydrini, *sensu stricto*, probably gave rise to the *Paracoenia-Calocoenia* group of genera. This latter lineage plus Ephydrini, as here delimited, is characterized by the following character states (some have become modified secondarily):

7. *Number of dorsocentral bristles*: although other genera of the subfamily Ephydrinae sometimes have five pairs of dorsocentral bristles (e.g., *Notiocoenia* Mathis and *Austrocoenia* Wirth), the anterior pair (or pairs) is weakly developed. Only in members of Ephydrini are there five well-developed pairs (the anterior pair is presutural; specimens of *Cirrula gigantea* have the anterior four pairs of dorsocentral bristles weakly developed, a condition I interpret to be secondary).

8. *Development of intrapostalar bristle*: in most species of the family, the intrapostalar bristle is either lacking or is very much reduced, less than one-half the length of the postalar bristle. In members of this lineage, the intrapostalar bristle is frequently as long.

9. *Setal vestiture of propleuron*: throughout most of the family this pleural region is bare of setae (although frequently it is thinly to densely tomentose). In members of this lineage, there are numerous setulae that are generally conspicuously evident.

A more detailed account of the tribes and genera of Ephydrinae will be forthcoming in a generic revision that is now in progress.

Genus *Setacera* Cresson

Setacera Cresson, 1930:116 [type-species: *Ephydra pacifica* Cresson, by original designation]; 1935:346-349 [new species for Nearctic Region].—Loew, 1860:35-37 [review of palaeartic species, as *Ephydra* (in part)].—Schiner, 1863:261 [review of Austrian species].—Becker, 1896:217, 219 [review of palaeartic species, as *Ephydra* (in part)]; 1905:209 [catalog of palaeartic species, as *Ephydra* (in part)]; 1926:75 [review of palaeartic species, as *Ephydra* (in part)].—Séguy, 1934:434, 435 [review of French species, as *Ephydra* (in part)].—Wirth and Stone, 1956:472 [review of Californian species].—Sturtevant and Wheeler, 1954:201-204 [review of nearctic species].—Collin, 1963:147-149 [review of British species].—Wirth, 1965:754, 755 [catalog of nearctic species]; 1968:24 [catalog of neotropical species].—Miyagi, 1966:138-140; 1977:83, 84 [review of Japanese species].—Cole, 1969:402 [synopsis of Western North American species].—Nartshuk, 1970:387 [review of European species in Russia, as *Ephydra* (in part)].—Dahl, 1974:186 [notes on Scandinavian species].—Papp, 1975:107-109 [review of Hungarian species].—Cogan and Wirth, 1977:338 [catalog of oriental species].—Cogan, 1980:668 [catalog of afrotropical species].

DIAGNOSIS.—Cruciate intrafrontal bristles lacking or weakly developed, not conspicuous; fronto-orbital bristles 2 pairs, laterocline; 3rd antennal segment with prominent bristle inserted laterally, just below arisal insertion; arista with subpectinate to pectinate branching rays along dorsum from between basal one-half to two-thirds of arisal length; fronto-orbits shiny with metallic luster, concolorous with mesofrons; dorsum of interfoveal facial carina nearly flat, sloping very gradually; anterior facial ridge projecting markedly forward in many species, from which anterior surface of face extends ventrally at nearly right angle to oral margin, face receding at obtuse angle to oral margin in other species; genal bristle short, usually less than one-half length of arista; dorsocentral bristles 5 pairs (1 + 4); posthumeral bristles 1 pair, development variable, but generally well developed; structures of male terminalia symmetrical, complicated in most species by ad-

dition of several secondary processes and prongs, especially gonite and hypandrium; epandrium elongate; surstyli well developed, generally fused basomedially, frequently with ventrally projecting lateral arms, see species group and species descriptions for additional details; female terminalia quite variable, see species group and species descriptions; female ventral receptacle with operculum as high as wide, broadly rounded dorsally, wider than high, somewhat angulate, subtrapezoidal, or almost entirely lacking.

DESCRIPTION.—Moderately small to large shore flies, length 2.46 to 5.67 mm; generally dark colored but with considerable grayish tomentose vestiture, subshiny to shiny dorsally, becoming more subdued, usually grayish or slightly olivaceous laterally and ventrally.

Head: Wider than high from cephalic view; slightly longer than high in profile. Frons subrectangular to trapezoidal, wider than long; mesofrons subrectangular, slightly wider than long, shiny with metallic luster, setose, especially anteriorly, sculpturing inconspicuous posteriorly, becoming granulose anteriorly; ocellar triangle equilateral or isosceles, very slightly raised in relief from mesofrons, finely tomentose, dull, frequently concolorous with dull portion of parafrons; parafrons dull, finely tomentose, generally dark colored except for shiny fronto-orbits, which are concolorous with mesofrons. Ocellar bristles 1 pair, large, proclinate, divergent, inserted behind level of median ocellus; postocellar bristles small, 1–2 pairs, inserted directly behind ocellar bristles; fronto-orbital bristles 2 pairs, large, with 1–2 smaller pairs of setae inserted alternately with larger bristles; vertical bristles 2 pairs, large, inner bristle inserted anteromedial of alignment of outer bristle and fronto-orbital bristles; spacing between each fronto-orbital and between inner vertical bristle about equidistant; postocular setae approximately subequal to each other, all small. Antenna mostly black, unicolorous, dull, tomentose to micropubescent; 3rd antennal segment as long as or longer than combined length of first 2 segments; rounded apically, bearing a prominent bristle laterally, inserted just below arista; arista

thickened basally, gradually tapered to apex, with several subpectinate to pectinate dorsal branches along basal one-half to two-thirds. Face broadly arched, protruding, interfoveal facial carina prominent, dorsum of interfoveal carina subshiny to shiny, sparsely tomentose, nearly concolorous with mesofrons, surface nearly flat but inclined anteroventrally; antennal foveae well impressed, shiny, like mesofrons, or dull, tomentose; face below transverse facial ridge extended ventrad perpendicular to oral margin or receding at obtuse angle; facial setae along margin more prominent, especially along dorsal slope; vestiture of face densely tomentose, grayish to almost silvery white, coloration along ridge frequently brownish to golden brown; oral margin slightly emarginate at middle from cephalic view. Eye usually slightly wider than high, suboval, oriented at slight to obvious oblique angle to oral margin; gena wide, eye-to-cheek ratio at least 1 : 0.34; genal bristles usually prominent, 1 pair; remaining postocular area uniformly setose. Oral opening large, gaping; mouth parts large, well sclerotized, prementum bowl-shaped, narrow, dull, finely tomentose, concolorous with posterior portion of gena, sparsely setose; maxillary palp 2–3 times longer than wide, setose.

Thorax: Dark colored, dorsum subshiny or shiny, becoming darker and shinier posteriorly; pleural areas dull, tomentose, becoming progressively lighter toward venter. Chaetotaxy as follows: no prominent acrostichal bristles, small setae, when present, arranged in 2 rows; dorsocentral bristles 5 pairs (1 + 4), large, posteriormost pair displaced laterally from alignment of others; posthumeral bristles generally well developed, 1 pair, sometimes reduced or lacking; presutural bristles 1 pair; supra-alar bristles 1 pair; postalar bristles 1 pair; intrapostalar bristle 1 pair, at least one-half length of postalar bristle; scutellar bristles 2 pairs, lateral, apical pair much longer; humeral bristles usually 1–2 pairs, usually more weakly developed; notopleural bristles 2 pairs; mesopleural bristles 1 pair plus 2–3 pairs of medium-sized setae around larger mesopleural bristle and several uniform, scattered, smaller setae;

sternopleural bristles 1 pair, inserted toward posterodorsal corner, several smaller setae mainly around larger bristle; other pleural sclerites bare, except for patches of dense tomentosity, as on suprspiracular convexity. Halter pale, yellowish. Legs mostly dark, concolorous with pleural areas but with some lighter areas toward apices; males often with tufts of hairs on coxae or toward apices of tibiae; basitarsus almost as long as combined length of remaining tarsomeres; tarsal claws relatively long, with very little curvature; pulvilli reduced or lacking. Wing hyaline to very lightly infumated; costal vein extending to M_{1+2} .

Abdomen: Generally unicolorous, subshiny to shiny, not so dark as posterior portion of mesonotum or scutellum. Female with 6–7 visible segments; male with 5, often 5th triangular, sometimes longer than wide, or trapezoidal, truncate apically. Male terminalia symmetrical; cercal cavity within epandrium near dorsum; surstyli fused medially, broadly attached at ventral margin of epandrium; aedeagus bulbous; gonite highly modified, considerably reduced or bearing well-sclerotized, acutely pointed processes similar to those of hypandrium; hypandrium generally with lateral, paired symmetrical processes, degree of sclerotization variable, usually weak towards middle. Female ventral receptacle longer than wide; operculum as high as wide, rounded dorsally; extending process more or less J-shaped.

GEOGRAPHIC DISTRIBUTION.—Few shore fly genera are as widespread as *Setacera*, and in the tribe Ephydrini, *Setacera* is by far the most widely distributed, with species occurring in all major faunal realms.

NATURAL HISTORY.—The immature stages of *Setacera* closely resemble others of the tribe Ephydrini, and Johannsen (1935) considered them to be the most highly specialized of the family. Like other ephydrines, larvae of *Setacera* have long, terminal respiratory tubes and eight pairs of short, conical, abdominal prolegs that bear crochets. The last pair of prolegs is the largest, and the crochets are opposable to those of the other prolegs. Johannsen (1935) figured the cephalopharyngeal skeleton of *S. needhami* Johannsen, a

species described inadvertently from the immature stages (Cresson, 1935).

Unlike most ephydrines, members of *Setacera* primarily inhabit fresh-water environments, although there are occasional records of species from salty habitats, and *S. pacifica* (Cresson) is regularly found in association with alkaline waters (Foote, 1982). Johannsen (1935) reportedly reared a specimen of *S. atrovirens* (Loew) from a puparium collected in a brine pool near Ithaca, New York, and Karl (1930) and Beyer (1939) stated that *S. micans* is halophilous. Subsequent authors, Frey (1948) and Dahl (1959), however, have discredited these earlier observations and have found *S. micans* to be a fresh-water species. I suspect that the earlier authors' observations were based on misidentifications (see species treatment of *S. micans*, page 15).

Most species seem to prefer lentic aquatic systems, especially where a layer of floating algae has accumulated on the water's surface. This is the typical habitat of most species of Ephydrini, and their crochet-bearing prolegs are apparently an adaptation to this habitat, allowing movement through and attachment to the algae.

PHYLOGENY.—The species now included in *Setacera* were previously placed in the genus *Ephydra* Fallén, and some recent authors still prefer the precedent of *Ephydra*, with *Setacera* as an included subgenus (Soika, 1956; Dahl, 1959). *Setacera* is indeed closely related to *Ephydra*, as evidenced by the similarity of adults and immatures of both genera. *Setacera*, however, can be consistently distinguished in both sexes from all other genera of Ephydrini, and its monophyly corroborated by the following synapotypies (numbers accompanying discussion of characters correspond with those on the cladogram):

10. *3rd antennal segment seta:* aside from the arista, there are usually no other large structures emanating from the 3rd antennal segment. Specimens of *Setacera*, however, have a large seta inserted just below the aristal insertion on the lateral surface.

11. *Vertico-orbits:* within the tribe Ephydrini, the vertico-orbits are generally either shiny or densely tomentose and grayish, appearing dull. This area, in specimens of *Setacera*, is uniquely invested with a dense patch of tomentum that

appears velvety. Velvety areas occur elsewhere in a few species of the tribe (parafrons in *Cirrula gigantea* Cresson; frons and orbits in *Ephydra auripes* Aldrich) but not in the specific area as described for *Setacera*.

12. *Genal seta*: this seta is usually very prominent, arising below the eye. Although this seta is still larger than surrounding ones in specimens of *Setacera*, its comparative size is smaller, and for convenience, I have compared it with the length of the arista.

13. *Cruciate intrafrontal bristles*: although some species of the tribe Ephydrini do not have these bristles, most genera have at least a few species in which they occur. Consequently, my interpretation of the general ground plan of the tribe is for their presence, and their lack in *Setacera* is apparently unique.

14. *Prescutellar acrostichal setae*: as with the preceding characters, these setae are generally present in Ephydrini. I know of no specimens of *Setacera*, however, where they are present, and I interpret this apparent loss to be synapotypic.

I have arranged the genus into six species groups and have attempted to show cladistic relationships between these by forming nested clusters as sister lineages could be identified (Figure 2). The genus is arranged into two major clusters, comprising either two or four species groups. The character evidence to corroborate the monophyly of the species groups and their intrageneric relationships are as follows.

The first major cluster of lineages includes the *micans* and *breviventris* species groups. The monophyly of this stem lineage and of its component species groups is characterized by the following characters:

15. *Length of 5th abdominal tergum of male*: in most ephydrines, this tergum is as long as either the 3rd or the 4th terga and frequently almost as long as wide, occasionally longer. In males of these two species groups this tergum is conspicuously shorter than either the 3rd or 4th, a synapotypic character for this lineage.

The *micans* group is monophyletic, with character evidence as follows:

17. *Configuration of aedeagus*: the aedeagus among most ephydrines is nearly as wide as long, and its apex is broadly rounded. In males of the *micans* group the aedeagus is three to four times longer than wide, and its apex is acutely pointed. I interpret this to be an synapotypic character, being unique to this species group.

18. *Configuration of the female ventral receptacle*: generally the operculum of this structure is nearly as high as the extending process, sometimes more so, and its width is subequal to its

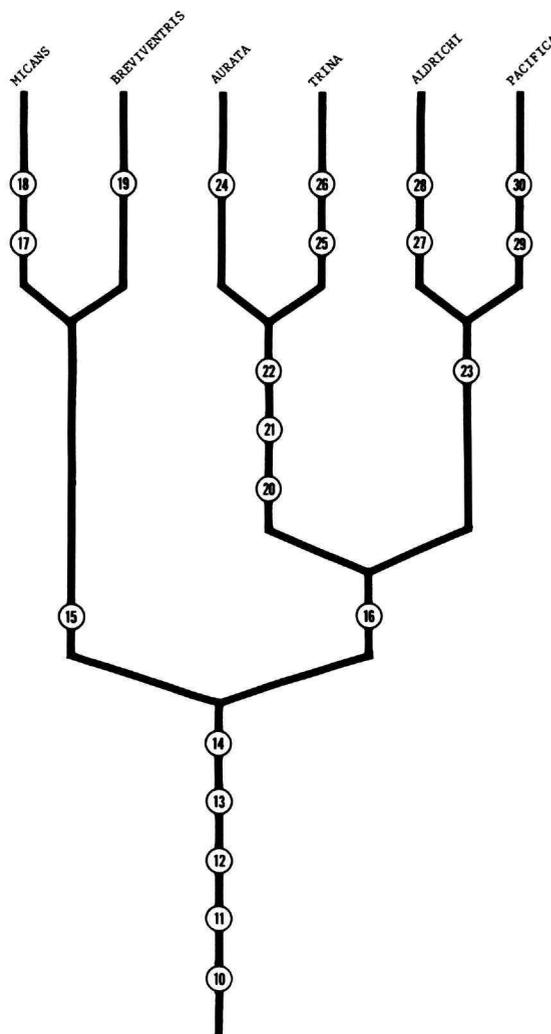


FIGURE 2.—Hypothetical phylogeny of species groups of *Setacera*.

height. In females of the *micans* group the operculum is relatively small, both its width and height, especially as compared to the size of the extending process (see illustrations of included species).

The sister group of the *micans* group is the *breviventris* group. The monophyly of the latter is established as follows:

19. *Development of posthumeral bristle*: one of the apotypic characters of the tribe Ephydrini is the well-developed

posthumeral bristle. For most ephydrines this bristle is as strong as the presutural bristle. In members of the *breviventris* group, however, the posthumeral bristle is comparatively weak and is considerably smaller than the presutural bristle, if it is existent at all.

The second major lineage comprises the remaining species groups and is divided into two sublineages, each of which gives rise to two species groups. The monophyly of the second major lineage is established as follows:

16. *Vestiture of 3rd and 4th sterna of male*: typically these sterna bear a few scattered, generally small setae. In males of this lineage, however, the unique condition exists of a dense patch of large setae, usually more conspicuous toward the posterior portion of the sternum. I interpret this character to be apotypic.

The monophyly of the first stem lineage, which gives rise to the *aurata* and *trina* species groups, is established as follows:

20. *Distance between cerci and 9th sternal bristles of female*: the distance between the ventral margin of the cerci and the base of the 9th sternal bristles in females is generally not greater than the height of the cerci. In females of this lineage, the 9th sternal bristles are situated farther ventrad, making the distance between them and the cerci conspicuously longer than the cercal height. This character is unique to this lineage.

21. *Length of 8th sternites of female*: generally, each sternite is five or more times longer than wide, but in females of this lineage, the length is at most three to four times its width, an apotypic character.

22. *Length of 8th tergites of female*: this character is somewhat correlated with character no. 20. The 8th tergites in females of this lineage are very long and partially account for the ventral position of the 9th sternites. This is best seen by comparing the figures of the female terminalia accompanying the species treatments. The longer 8th tergites are an apotypic character.

The *aurata* and *trina* groups are the two species groups of this sublineage. The monophyly of the *aurata* group is established as follows:

24. *Configuration of epandrium*: although it is not uncommon for the epandrium to have appendages of various sorts, this is the only lineage to have a bluntly rounded, parallel-sided, posterolateral process arising from each side. This unique condition is interpreted to be apotypic.

The *trina* species group is characterized, and its monophyly is established, as follows:

25. *Configuration of the male gonite*: this is a difficult character to assess, as the generalized condition is not known. The configuration of the gonite in males of this group is unique, however, and for the present I am interpreting it as an apotypic character.

26. *Configuration of epandrium* (see no. 24): although the shape of the epandrium, particularly of the ventral surstyli, differs quite markedly throughout the genus, that of this group is uniquely similar. The ventrolateral angles are explanate and slightly recurved (see illustrations accompanying species treatments). This character is apparently apotypic for this group.

The sister group of the stem lineage of the *aurata* and *trina* groups is the stem lineage that gives rise to the *aldrichi* and *pacifica* groups. This lineage is characterized and its monophyly is corroborated by the following:

23. *Vestiture of antennal fovea*: for most ephydrines, the antennal foveae are invested with tomentosity and give the appearance of being relatively dull as compared with the dorsum of the interfoveal carina. The latter and the mesofrons are usually bare of tomentosity and have a metallic luster. The antennal foveae of these groups are shiny, with a metallic luster and color similar to the interfoveal carina. As this character is unique to members of these groups, I interpret it to be apotypic.

The *aldrichi* group is the sister group of the *pacifica* group, and it is characterized, and its monophyly established, by:

27. *Configuration of aedeagus* (see no. 17): as before, the aedeagus is typically broadly rounded apically and almost as wide as long. Males of the *aldrichi* group have a somewhat pointed aedeagus that I interpret to be apotypic.

28. *Configuration of epandrium* (see nos. 24, 26): males of the *aldrichi* group have an anteroventral, digitiform process, apparently a unique condition, and one that I interpret to be apotypic.

The monophyly of the *pacifica* group is established by:

29. *Configuration of vertico-orbits* (see no. 11): in *Setacera* this band is more or less broad and usually has a subanterior swelling, but in members of the *pacifica* group this band is very narrow and is sometimes difficult to detect. The narrowed aspect of this character is interpreted to be apotypic.

30. *Configuration of female ventral receptacle* (see no. 18): for most ephydrines, the operculum is typically wider than high. For females of the *pacifica* group, however, the height is subequal to its width, an apotypic character.

In addition to the characters just enumerated

to distinguish *Setacera* and the included species groups, *Ephydra* is characterized by the presence of three latero-clinate, fronto-orbital bristles. *Setacera* has only two.

DISCUSSION.—Some members of *Setacera* have

secondarily sexually dimorphic features. Males of these species bear prominent hair-tufts of varying length at the tibial apices and often on the coxae. The extent and length of the tufts, or their absence, are excellent species-level characters.

Key to New World Species of *Setacera*

1. Arista with dorsally branching rays at most slightly longer than arista width at base 2
 Arista with dorsally branching rays conspicuously longer than arista width at base, nearly twice 4
2. Antennal foveae concolorous with dorsum of interfoveal carina, shiny; vertico-orbits mostly shiny, concolorous with fronto-orbits; facial prominence in profile angulate, abruptly rounded; 5th tergum of male longer than 4th, about as wide at base as long 12. *S. jamesi*, new species
 Antennal fovea pollinose, whitish gray, contrasting with dorsum of interfoveal carina; vertico-orbits appearing velvety, contrasting with shiny fronto-orbits; facial prominence in profile gently rounded, obtuse; 5th tergum of male considerably shorter than 4th, much wider at base than long 3
3. Surstyli, in posterior view, more widely separated medially along apical half; lateral margins curved, not conspicuously angulate; with medial, shallowly pointed process between surstyli 1. *S. atrovirens* (Loew)
 Surstyli, in posterior view, closely opposed medially along apical half, almost touching; lateral margins angulate; lacking medial process between surstyli 2. *S. micans* (Haliday)
4. Facial prominence in profile with dorsal slope longer than height of lower portion of face; 5th tergum of male broadly truncate, width of posterior margin more than half basal width 10. *S. aldrichi* Cresson
 Facial prominence in profile with dorsal slope short, less than height of lower portion of face; 5th tergum of male rounded or truncate, if truncate, width of posterior margin not over half basal width 5
5. Supraspiracular convexity with a papilla-like prominence toward anterodorsal margin; epandrium with a medial longitudinal sulcus 14. *S. pacifica* (Cresson)
 Supraspiracular convexity evenly rounded, lacking any distinct prominence; epandrium at most with only faint indication of a sulcus 6
6. Midtibia of male lacking long hairs along posterodorsal surface subequal in length to tibial width near apex; female with 6 visible abdominal segments from dorsal view 15. *S. pilicornis* (Coquillett)
 Males with a patch of long hairs along posterodorsal surface subequal in length to tibial width near apex of midtibia; females with 7 visible abdominal terga from dorsal view 7

7. Midfemur of male lacking posteroventral row of long setae equal in length to greatest width of femur; 3rd and 4th abdominal sterna of male with dense patch of well-developed, conspicuous setae posteromedially; cerci of female not unusually prominent, height greater than length 11. *S. durani* Cresson
- Midfemur of male with posteroventral row of 4–7 long setae near base subequal in length to greatest width of femur; 3rd and 4th abdominal sterna of male lacking dense patch of well-developed setae posteromedially; cerci of female conspicuously prominent, length equal to height 8
8. Fused surstyli distinctly wider at basal one-third; lateral margins of basal two-thirds of surstyli broadly and more or less evenly rounded (western North America) 13. *S. needhami* Johannsen
- Fused surstyli as wide apically, or nearly so; lateral margins of basal two-thirds of surstyli somewhat angulate (Peru) 16. *S. trichoscelis*, new species

Key to Old World Species of *Setacera*

1. Male 5th abdominal tergum shorter than 3rd or 4th tergum; male 3rd and 4th sternum without dense patch of stout setae toward posterior margin; base from which spinelike setae of female ovipositor arise not farther from cerci than length of cerci 2
- Male 5th abdominal tergum as long as or longer than 4th tergum; male 3rd and 4th sternum with dense patch of stout setae toward posterior margin; base from which spinelike setae of female ovipositor arise more distant from cerci than length of cerci 5
2. Posthumeral bristle strong, larger than largest humeral bristle and generally subequal to posterior notopleural bristle; anterior margin of face in profile shallowly arched and forming a more or less right angle with oral margin; front tibia mostly dark colored; larger species (northern Europe) 2. *S. micans* (Haliday)
- Posthumeral bristle weaker or absent, if present not stronger than largest humeral bristle; anterior margin of face in profile straight and forming an obtuse angle with oral margin; front tibia with basal one-half yellowish in most specimens; smaller species 3
3. Surstyli acutely corniform apically, median surface not conspicuously setose (Old World, except for northern Europe) 3. *S. breviventris* (Loew)
- Surstyli bluntly rounded apically, not corniform, median surface more or less densely setose 4
4. Width of gap separating surstyli about equal to length of surstyli (Madagascar, South Africa) 4. *S. multicolor* (Soika)
- Width of gap separating surstyli less than length of surstyli (Japan, Korea) 5. *S. viridis* Miyagi
5. Surstylus in profile with slender, parallel-sided, apically truncate, lateral process that projects anteroventrally; gonite broad throughout most of its length, lacking secondary process (northern Europe) 6. *S. aurata* (Stenhammar)

- Surstylus in profile with posteriorly curved, ventrolateral process that is subapically enlarged; gonite conspicuously narrowed apically and with secondary process 6
6. Gonite with secondary process triangular, broad basally, tapered at more or less constant angle to apex 9. *S. trina* Collin
- Gonite with secondary process more bandlike than triangular, taper at base gradual, becoming more abrupt toward apex 7
7. Surstyli in posterior view with acutely pointed process between; surstylus with recurved, lateral apex distinctly explanate, rounded; gonite with secondary process broader, about twice as long as wide 8. *S. meneghini* Canzoneri
- Surstyli in posterior view with truncate process between; recurved, surstylus with lateral apex less flared and more angulate; secondary gonite with process narrower, width 3 times length ... 7. *S. freidbergi*, new species

The *micans* Group

SPECIES INCLUDED.—*Setacera atrovirens* (Loew); *S. micans* (Haliday).

DIAGNOSIS.—Specimens of the *micans* group may be distinguished by the following combination of characters: antennal foveae densely tomentose, contrasting distinctly with subshiny to shiny dorsum of interfoveal carina; arista with longest dorsally branching rays about equal to arisal width at base; vertico-orbits with velvety tomentose band moderately wide, widest subanteriorly at vertex; posthumeral bristle well developed, subequal to posterior notopleural bristle, distance between it and presutural bristle nearly equal to that between notopleural bristles; supraspiracular convexity evenly convex; legs and coxae of males lacking dense patches or rows of setae; fore- and midtibiae mostly dark colored, concolorous with femora, only tibial-femoral articulation pale; 5th tergum of male rounded apically, apical width less than length, length less than that of 3rd or 4th tergum, anteroventral corner lacking process; 3rd and 4th sterna of male lacking dense patch of setae toward posterior margin.

Male Terminalia: Epandrium lacking median sulcus, greatest width subdorsally in posterior view, dorsum rounded if complete, frequently weak or lacking above cercal cavity; surstyli

broadly fused basally, apical one-half separated, apices tapered more in posterior view, evenly so in lateral view, more setose submedially in posterior view; aedeagus 3–4 times longer than wide, tapered gradually to apex, apex acutely pointed, relatively simple; gonite lacking processes or prongs, simple, posterodorsal portion angulate, angle of about 90° in lateral view; hypandrium poorly sclerotized, formed by 2 symmetrical plates, more or less fused anteriorly.

Female Terminalia: 7th tergum complete; 8th tergites 2–3 times higher than wide, widest at venter in lateral view, venter broadly rounded, tapered dorsally to dorsal point, anterior margin more or less straight, posterior margin rounded and tapered; 8th sternites moderately elongate, 5–6 times longer than wide; 9th sternum well sclerotized, more or less quadrate although irregular, compact, lacking lateral or dorsal extensions; 9th sternal bristles approximate but not aligned, more or less clumped; distance between bristle insertions and venter of cerci at most equal to height of cerci, usually less; cerci higher than wide, posterior margin rounded in lateral view; female ventral receptacle with operculum greatly reduced, less than width of extending process, papilla-like; extending process broadly J-shaped, lacking marked distinction between cervix and corpus.

DISTRIBUTION.—Holarctic; northern North America above 38° north latitude and generally east of the Rocky Mountains and European Palearctic Region north of 50° north latitude.

DISCUSSION.—Although this species group is easily distinguished, the included species are presently separable only by examining the male terminalia. In Europe there is no problem, as there is only one species occurring there, but in North America, females are identified tentatively either from being associated with identified males and/or from distributional data.

1. *Setacera atrovirens* (Loew)

Figures 3–12

Ephydra atrovirens Loew, 1862:169.—Osten Sacken, 1878:203 [nearctic catalog].—Aldrich, 1905:629 [nearctic catalog].

Setacera atrovirens.—Cresson, 1930:116 [listing].—Johannsen, 1935:53 [description of immature stages].—Wirth, 1965:755 [nearctic catalog, in part].

Setacera atrovirens [sic].—Sturtevant and Wheeler, 1954:202, 203 [key and locality data].

DESCRIPTION.—Medium-sized to moderately large shore flies, length 3.5 to 4.7 mm; dorsum dark olivaceous brown to green, becoming duller, grayer ventrally.

Head (Figures 3–5): Head width-to-height ratio averaging 1 : 0.68; frons width-to-length ratio averaging 1 : 0.48; mesofrons, fronto-orbits, and dorsum of interfoveal carina deep bluish green to mostly bluish, dorsum of interfoveal carina fre-

quently sparsely tomentose; dorsal surface of face shorter than height of anterior surface; angle formed by anterior surface and dorsal surface obviously obtuse, about 135°; anterior surface of face usually lightly yellowish brown, especially dorsally, sometimes becoming almost whitish ventrally. Eye height-to-width ratio averaging 1 : 0.95; eye-to-cheek ratio averaging 1 : 0.40.

Thorax: Costal vein ratio averaging 1 : 0.29; M_{1+2} vein ratio averaging 1 : 0.79.

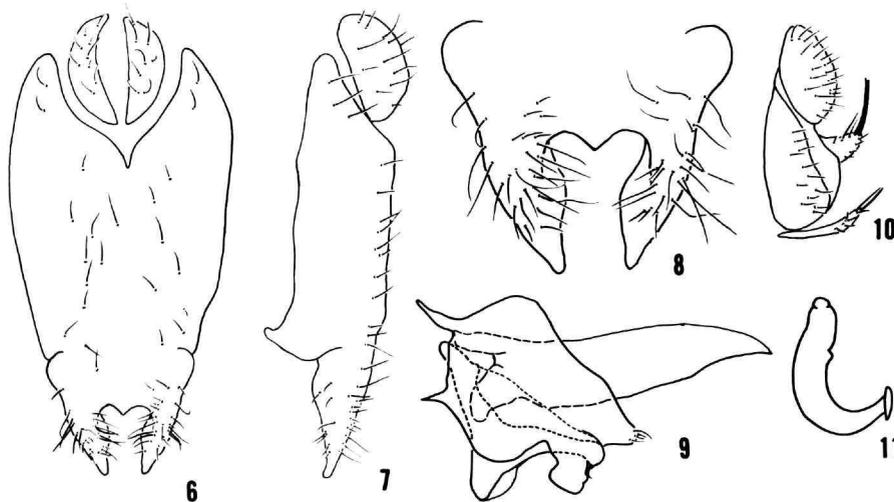
Abdomen: Male terminalia (Figures 6–9) with epandrium usually poorly sclerotized dorsally if at all evident; surstyli with lateral margin more or less evenly rounded, not angulate, median surfaces separated, distance approximately equal to surstyler width in posterior view, with pointed projection medially between surstyli toward base. Female terminalia (Figures 10, 11) as in species-group description.

TYPE MATERIAL.—The male lectotype, herein designated, is labeled “Mittel St. [mid-Atlantic states of the United States]/Loew Coll[ection]./atrovirens/50/Type 11179 [red].” The lectotype is in the Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts, type number 11179.

OTHER SPECIMENS EXAMINED.—CANADA. *Nova Scotia:* Petite Riviere, 2 Jul 1935, J. McDunnough (1♀; CNC). *Ontario:* Black Sturgeon Lake, 28 Jun 1962 (1♀; CNC); Grand Bend, 8 Jul 1939, G. E. Shewell (1♂; CNC); Guelph, 1 Nov 1955, J. R. Vockeroth (1♀; CNC); Kingston, 10 Jul 1938, A.



FIGURES 3–5.—*Setacera atrovirens*: 3, right antenna, lateral aspect; 4, right vertex and vertico-orbits of head, dorsal aspect; 5, right vertico-orbit showing velvety tomentosity, dorsal aspect.



FIGURES 6-11.—*Setacera atrovirens*: 6, male terminalia, posterior aspect; 7, same, lateral aspect; 8, surstyli, posterior aspect; 9, internal male genitalia, lateral aspect; 10, female terminalia, lateral aspect; 11, female ventral receptacle, lateral aspect.

L. Melander (1♀; USNM); Ottawa, 25 Apr-30 Jul, 1922-1965, A. R. Brooks, C. H. Curran, J.E.H. Martin (15♂, 49♀; ANSP, CNC); Ottawa, Mer Bleue, 26 May 1923, C.H. Curran (1♀; ANSP). *Quebec*: Abbotsford, 1 Jul-26 Sep, 1935-1936, G. E. Shewell (2♀; CNC); Old Chelsea, 9 Oct 1955, J. R. Vockeroth (1♂; CNC). UNITED STATES. *Delaware*: Sussex Co., Rehoboth, 25 Jun 1939, A. L. Melander (1♀; USNM). *District of Columbia*: A. L. Melander (1♂; USNM). *Illinois*: Mason Co., Havana, river shore, 16 Nov 1913 (1♀; ANSP). McHenry Co., 21 Aug 1903, 1927, A. L. Melander (4♂, 2♀; ANSP, USNM). *Indiana*: LaGrange Co., Pigeon River Fish and Wildlife Area, 30 Jul 1977, M. Minno (1♂, 2♀; USNM). *Iowa*: Boone Co., Boone, 1.5 mi W, 4 Aug 1960, D. L. Deonier (1♀; DLD); Ledges State Park, 30 Jul 1971, R. M. Miller (1♂; USNM); Little Wall Lake, 14 Jul-22 Sep, 1960-1962, D. L. Deonier (14♂, 13♀; DLD). Greene Co., Spring Lake Recreational Reserve, 19 Sep 1961, D. L. Deonier (5♀; DLD). Hamilton Co., Goose Lake, 2 Jul 1961, D. L. Deonier (1♂; DLD). Louisa Co., Lake Odessa, 9 Aug 1960, D. L. Deonier (1♂, 4♀; DLD). Winneshiek Co., Siewers Spring State Park near

Decorah, 9 Sep 1961, D. L. Deonier (1♂, 1♀; DLD). *Kansas*: Douglas Co., 900 ft (1♀; KU). *Maine*: Penobscott Co., Old Town, Lake Pushaw, 1 Aug 1966, W. W. Wirth (1♂; USNM). *Michigan*: Cheboygan Co., 10 Aug 1932, J. D. Nottingham (1♂; KU). Ingham Co., East Lansing, 27 Jun 1936, C. Sabrosky (1♀; ANSP). Livingston Co., E. S. George Reserve, 24 Jul 1943, G. C. Steyskal (1♂, 1♀; USNM). *Minnesota*: Clearwater Co., Itasca State Park, 15 Jun-3 Aug 1937, A. R. Barr, D. Keith, K. C. Kim, M. E. Rueger (13♂, 43♀; UMIN). Itasca Co., Grand Rapids, 30 Jun 1966, B. C. Ahlm (1♂, 8♀; UMIN). La Sueur Co., 28 Aug 1923, W. E. Hoffmann (1♀; UMIN). Polk Co., Crookston, 27 Jun 1937, D. G. Denning (1♀; UMIN). Ramsey Co., St. Paul, 22 April 1922, W. E. Hoffmann (1♀; UMIN). Waseca Co., Waseca, 3 Jul-11 Sep, 1941-1967, R. E. Carlson, H. T. Peters (1♂, 2♀; UMIN). *Montana*: Lake Co., Polson, 2.3 mi E, 24 Jul 1973, B. A. Foote (2♂, 1♀; KSU). *Nebraska*: Cherry Co., Pelican Lake, 2 Jun 1969, W. W. Wirth (2♀; USNM). *New York*: Jefferson Co., Picton Island, Clayton, 18 Aug 1960, B. Heineman (1♀; AMNH). Tompkins Co., Keyden Lake, 8 Aug 1961, D. L. Deonier (4♂, 2♀;

DLD); Ithaca, 4 Sep 1973 (2♀; CU); McLean Reserve, 29 Mar 1962, L. V. Knutson (1♀; CU). *North Dakota*: Burleigh Co., Long Lake, 4 Jun 1969, W. W. Wirth (2♀; USNM). Ramsey Co., Devils Lake, 5 Jun 1969, W. W. Wirth (1♀; USNM). *Ohio*: Portage Co., Kent, 9 Apr 1969, R. Miller (1♂; KSU); Kent, 1 mi E, 11 Sep 1972, B. A. Foote (40♂; KSU); Kent, 4.5 mi E, 1 May 1969, W. Eastin (1♀; KSU); Ravenna, 15 mi E, 28 Sep-11 Oct 1971, B. A. Foote (1♂, 3♀; KSU). Wayne Co., Rittman, 0.5 mi S, 18 Sep 1969, B. A. Foote (1♂, 2♀; KSU). *South Dakota*: Hand Co., Burdette, 20 Jul 1937, R. H. Beamer (1♀; KU). *Wisconsin*: Dane Co., 20 Jul 1900 (2♀; USNM).

DISTRIBUTION (Figure 12).—East central North America, primarily around the Great Lakes, between 55° and 105° west longitude and 38° and 49° north latitude.

NATURAL HISTORY.—Foote (1979; 1982) has recently published detailed studies on the life history and immature stages of *S. atrovirens*. In particular, he reported the feeding preferences of this species, using both field and laboratory studies. Most of the information to follow is paraphrased from his observations and analysis.

The life cycle of *S. atrovirens* takes approximately 25 days and is divided among the stadia as follows:

Egg incubation	2.3 days
Larval period (3 instars)	10 days
Pupal period	7 days
Adult preoviposition period	6-9 days

The fly apparently overwinters as an adult, probably in a state of reproductive diapause. During the warm season, from May to September in the northern states, four or more generations are produced.

In the field, Foote discovered eggs in floating mats of primarily blue-green algae. Along the marshy shores of Flathead Lake, Montana, the fly preferred growths of *Nostoc*, but near Kent, Ohio, they were usually found in mats of *Oscillatoria* or a mixed mat of *Anabaena* and *Spirogyra*. Foote's laboratory experiments showed that larvae of this species would develop readily in algae of the genera *Anabaena*, *Cylindrospermum*, *Lyngbya*, *Nostoc*, and *Navicula*. In contrast, however, larvae were apparently unable to use species of *Anacystis*, *Gloeocapsa*, and *Chlorella*. Interestingly, utilization experiments between two species of *Oscillatoria* clearly showed that larvae of *S. atrovirens* can discriminate between the two algal species. Foote found that 80% of the larvae reached the pupal stage when fed *O. tenuis*, but no larvae formed

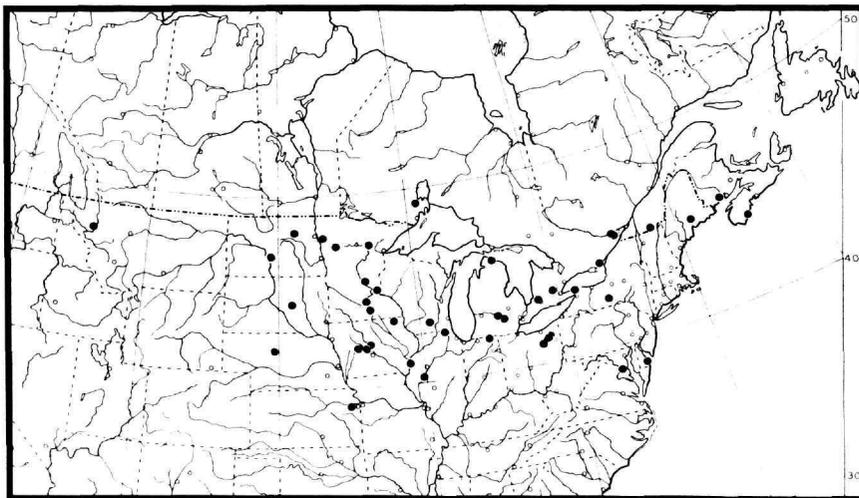


FIGURE 12.—Distribution map of *Setacera atrovirens*.

puparia in cultures of *O. chalybea*. From larval gut dissections, Deonier (1972) found that the algae ingested by larvae of *S. atrovirens* included about one-half diatoms and one-half other algae.

In part, larval age also determined food preference. Newly hatched larvae appeared to prefer small unicells, whereas older larvae utilized a broader range of algal species, frequently trichomes of blue-green algae. Larvae can feed completely submerged, but return to the water's surface periodically for respiration.

Just prior to forming puparia, larvae left the algal colonies and sought out stems or narrow leaves of aquatic macrophytes, to which they became attached using the last prolegs. Puparia were frequently formed below the water's surface, and submergence apparently had no effect on subsequent development.

Foote observed several successful attacks on *Setacera* larvae by larvae of water-scavenger beetles (Hydrophilidae), which are probably the primary predator of the larval stages. Foote also reared a chalcidoid parasitoid from a few field-collected puparia.

REMARKS.—Females of this species are not presently separable from those of *S. micans* and are identified only by direct association with a male or by distributional data. Males are distinguishable by the shape and position of their terminalia, particularly the surstyli.

2. *Setacera micans* (Haliday)

FIGURES 13–22

Ephydra micans Haliday, 1833:175.—Nartschuk, 1970:387 [key].

Setacera micans.—Cresson, 1930:116.—Collin, 1963:147 [lectotype designation, figure of male terminalia].—Dahl, 1974:186 [distribution, figure of male terminalia].—Papp, 1975:108 [distribution, figure of male terminalia].

Setacera atrovirens of North American authors [misidentification in part].—Sturtevant and Wheeler, 1954:203 [review].—Wirth, 1965:755 [nearctic catalog].

DESCRIPTION.—Medium-sized to moderately large shore flies, length 3.9 to 4.5 mm; generally

dark olivaceous brown to green dorsally, pleural areas and venter becoming lighter, duller gray.

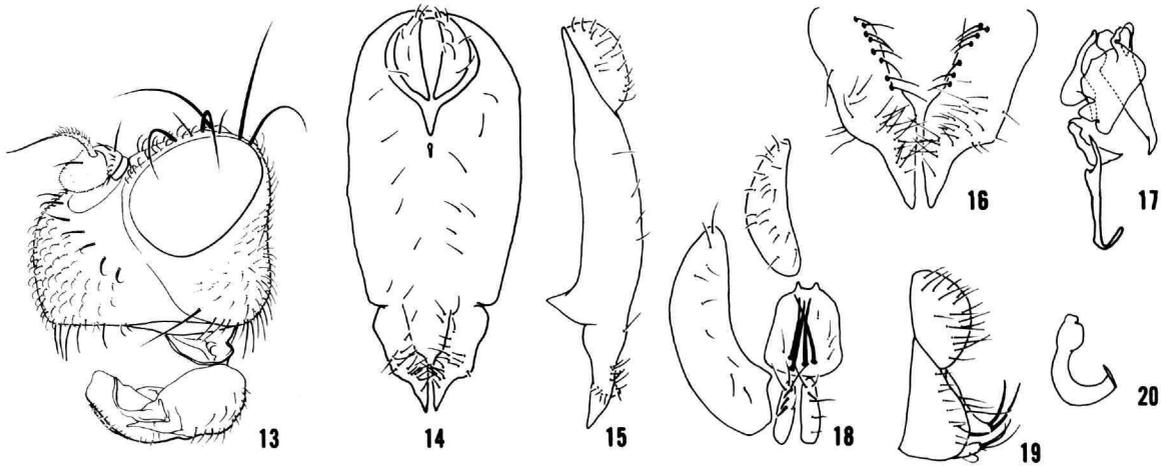
Head (Figure 13): Head width-to-height ratio averaging 1 : 0.62; frons width-to-length ratio averaging 1 : 0.48; mesofrons, fronto-orbits, and dorsum of interfoveal carina deeply greenish blue to mostly greenish; dorsal surface of face shorter than anterior surface; angle formed by anterior and dorsal surfaces obtuse, approximately 120°; face mostly silvery whitish, sometimes dorsum of anterior surface darker, lightly brownish to golden. Eye height-to-width ratio averaging 1 : 1; eye-to-cheek ratio averaging 1 : 0.42.

Thorax: Costal vein ratio averaging 1 : 0.29; M_{1+2} vein ratio 1 : 0.88.

Abdomen: Male terminalia (Figures 14–17) with epandrium usually complete dorsally around cerci although very narrow; surstyli in posterior view with lateral margins angulate toward apices, median margins approximate, much closer than surstyliar width, lacking basal median pointed projection. Female terminalia (Figures 18, 19) as in species-group description.

TYPE MATERIAL.—The male lectotype, designated by Collin (1963), is labeled “Holywood/Lectotype.” I have not examined the lectotype, and the label data I have quoted were taken from Collin (1963). The lectotype is presumably in Haliday's collection, National Museum of Ireland, Dublin.

OTHER SPECIMENS EXAMINED.—ENGLAND. Botten, Issoy, 11 Jul 1908, Verrill-Collin collection (1♀; UMO). Surrey, Kew, 4 Aug 1868 (1♂; UMO). NETHERLANDS. Ankeveen, 1943, D. Piet (1♀; ITZA). Hilversum, 3 Mar 1912, Meijere (1♀; ITZA). SWEDEN. (1♀; NRS). Ostergötland (1♂, 3♀; NRS). *Stockholm*: (4♂, 5♀; NRS). *Skane*: (1♀; NRS). Lilla Viken, Höör, 3 Jul–14 Aug 1954, R. Dahl (2♀; ZIL). Lomma N flytveg (Kivik), 24 Aug 1954, R. Dahl (1♂, 2♀; ZIL). Fyleoset, Ystad, 17 Jun 1954, R. Dahl (1♀; ZIL). CANADA. *Manitoba*: Aweme, 13 Jun–17 Oct, 1922–1927, N. Criddle, H. A. Robertson, R. M. White (1♂, 10♀; CNC); Birtle, 21 Jul 1928, R. D. Bird (1♂; AMNH); Brandon, 17–21 Jul 1958, J. G. Chillcott (3♂, 4♀; CNC); Churchill, 2 May–30 Aug, 1918–1952, C.



FIGURES 13–20.—*Setacera micans*: 13, head, lateral aspect; 14, male terminalia, posterior aspect; 15, same, lateral aspect; 16, surstyli, posterior aspect; 17, internal male genitalia, lateral aspect; 18, female terminalia, posterior aspect; 19, same, lateral aspect; 20, female ventral receptacle, lateral aspect.

D. Bird, Bryant, W. R. Richards (5♀; CAS, CNC); Douglas, 2 mi E, 27 Jul 1958, J. G. Chillcott (1♀; CNC); Treesband, 18 Oct 1927, N. Criddle (5♂, 3♀; CNC); Winnipeg Beach, 2 Jul 1923, A. J. Hunter (1♂; CNC). *New Brunswick*: Chamcook, Glebe Road, 26 Jun 1965, G. E. Shewell (1♀; CNC). *Northwest Territories*: Yellowknife, 19 May–11 Jul, 1949–1953, E. F. Cashman, J. G. Chillcott (2♂, 2♀; CNC, USNM). *Saskatchewan*: Saskatoon, 12 Jul–24 Oct, 1924–1948, K. M. King, J. R. Vockeroth (1♂, 3♀; CNC). *Yukon Territory*: Rampart House, 5–20 Jun 1951, J.E.H. Martin (1♂, 5♀; CNC, USNM); Takhini Hot Springs, 2400 ft, 16 Aug 1962, P. J. Skitsko (1♂; CNC). UNITED STATES. *Alaska*: Greater Anchorage Area Borough, Anchorage, Eagle River Flats, 9 May 1948, F. S. Blanton (1♂, 1♀; USNM); Lower Yukon River, 3–19 Jul 1951, C. O. Berg (1♂, 2♀; CU); Tonsina, 18 May 1954, W. C. Frohne (1♂; USNM).

DISTRIBUTION (Figures 21, 22).—Holarctic. Northern North America between 49° and 68° north latitude (Canada and Alaska) and between 94° and 149° west longitude. Northern Europe in the Palearctic Region, with confirmed distri-

bution in the British Isles and Baltic countries but probably occurring more widely into Siberia.

Collin (1963) recorded this species from the following counties in England and Wales (mostly unverified): Glamorganshire, Herefordshire, Huntingdonshire, Norfolk, Suffolk, and Surrey, from June to September.

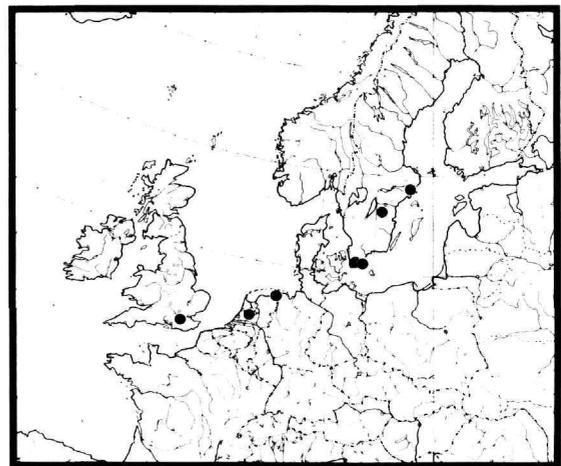


FIGURE 21.—Distribution map of *Setacera micans* in Europe.

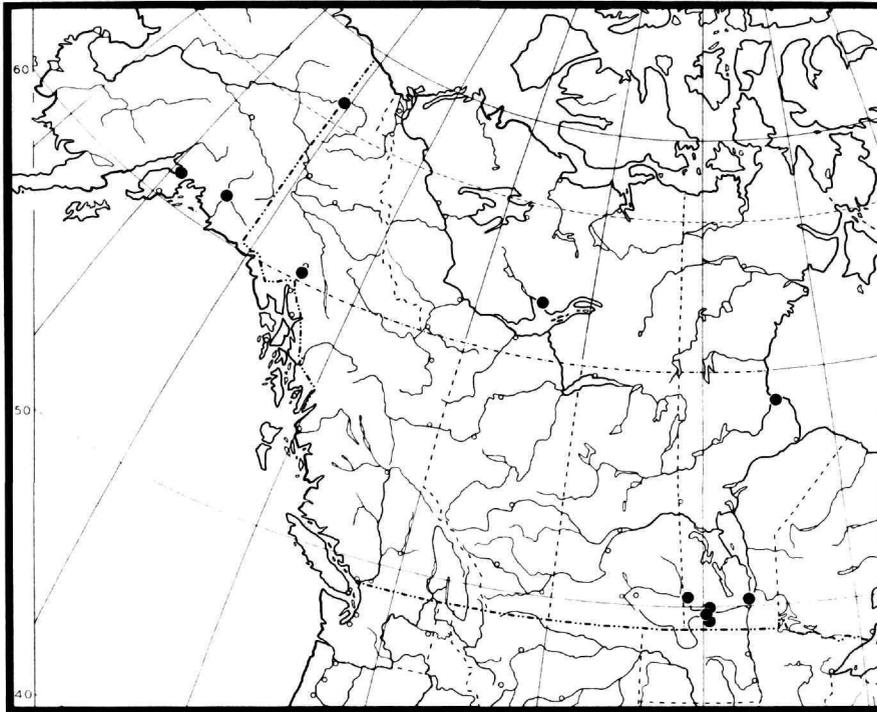


FIGURE 22.—Distribution map of *Setacera micans* in North America.

NATURAL HISTORY.—Considerable confusion exists in the literature with regard to the natural history of this species, due apparently to misidentifications. Whereas some authors reported the species to be halophilous (Karl, 1930; Beyer, 1939), others found no preference toward salty environs (Frey, 1948; Dahl, 1959). To the contrary, the latter found this species in association with a *Lemna* pool biotope. As none of the North American records of this species is from salty habitats, I suspect that the first authors were dealing with a species of the closely related genus *Ephydra*, of which several species are halophilous (Wirth, 1971, 1975).

Thieneman (in Beyer, 1939) suggested that the adult season for *S. micans* is during the autumn. Dahl (1959), however, found adults more commonly during the "height-of-summer."

REMARKS.—Cresson (1930) apparently misidentified this species in his review of the subfam-

ily Ephydrinae in the Naturhistorischen Museum, Vienna. In his discussion of this species, Cresson mentioned that the male terminalia are turgid. In fact, the male terminalia of true *S. micans* are unique among Old World species of this genus in not being turgid; rather, they become smaller in size toward their apices. The other character states Cresson cited would characterize most of the other Old World species of *Setacera*, which leaves me without clues as to which species Cresson identified as *S. micans*. I would guess, however, that he had specimens of either *S. aurata* or *S. freidbergi*, or perhaps a combination of both. The epandrium and surstyli in males of both of the latter species are turgid, particularly near their apices.

The *breviventris* Group

SPECIES INCLUDED.—*Setacera breviventris* (Loew); *S. multicolor* (Soika); and *S. viridis* Miyagi.

DIAGNOSIS.—Specimens of the *breviventris* group may be distinguished by the following combination of characters: antennal fovea densely tomentose, contrasting distinctly with subshiny to shiny dorsum of interfoveal carina; arista with longest dorsally branching rays at most slightly longer than arista width at base; vertico-orbits with velvety tomentose band narrow but conspicuous, slightly enlarged subanteriorly; posthumeral bristle lacking or weakly developed, if present distance between it and presutural bristle equal to about one-half distance between notopleural bristles; supraspiracular convexity evenly convex; legs of male lacking conspicuous tufts of rows of large setae; foretibia, and to a lesser degree midtibia, with basal one-half pale; 5th tergum of male truncate posteriorly and short, apical width greater than length, length less than either 3rd or 4th terga; 3rd and 4th sterna of male lacking dense patch of stout setae toward posterior margin.

Male Terminalia: Epandrium subrectangular in posterior view, lateral margins more or less parallel sided, dorsum very broadly rounded to subtruncate, with median sulcus extending from cercal cavity ventrally to just before base of surstyli; surstyli, in posterior view, formed as 2 ventrally extending arms or projections of various shapes, with U-shaped pocket between; gonite with extending process, narrow to moderately wide; aedeagus rounded apically; hypandrium usually with median and lateral prongs.

Female Terminalia: 7th tergum complete, occasionally with sclerotization weakened dorsolaterally; 8th tergite subtriangular in lateral view, height less than cercal height; 8th sternite moderately long, length subequal to height of 8th tergite; 9th sternite dorsoventrally compressed, wider than high, sclerotization limited to 3 conical bases from which bristles arise; 9th sternal bristles with lateral and median bristles separated, lateral bristle inserted singly on conical base, median bristles (1 from each side) approximate, both inserted on a median base; cercus in lateral view with posterodorsal cleft and with anteroventral projection; female ventral recepta-

cle with operculum wider than high, and extending process longer than height of operculum.

DISTRIBUTION.—This strictly Old World species group is widely distributed in all of the included zoogeographic regions. *Setacera breviventr* is apparently the most widespread species of the genus.

NATURAL HISTORY.—Unlike the other species groups, the species of the *breviventris* group are apparently more commonly encountered along the banks of lotic aquatic systems, especially small streams with exposed, mud banks. The specimens I collected were all found in such habitats.

DISCUSSION.—Although the species group is easily recognized in both sexes from assessment of external characters, its component species are difficult to distinguish without reference to characters of the male terminalia. The female terminalia, like external features, are apparently reliable only at the species-group level, making their identification problematic without direct association with males. Distribution data are not totally reliable, as some of the species are at least partially sympatric.

3. *Setacera breviventr* (Loew)

FIGURES 23–29

Ephydra breviventr Loew, 1860:37.

Ephydra laeta Hendel, 1913:99. [New synonym.]

Ephydra glabra Meijere, 1916:272. [New synonym.]

Setacera breviventr.—Cresson, 1930:117 [review].—Collin, 1963:147 [review].

Setacera pedalis Cresson, 1930:117. [New synonym.]

Setacera fluxa Miyagi, 1966:139; 1977:83 [review]. [New synonym.]

Setacera glabra.—Cogan and Wirth, 1977:338 [oriental catalog].

Setacera laeta.—Cogan and Wirth, 1977:338 [oriental catalog].

DESCRIPTION.—Moderately small to medium-sized shore flies, length 2.46 to 3.74 mm; dorsum generally olivaceous green with some brownish to grayish coloration, becoming duller, grayish to whitish gray ventrally.

Head: Head width-to-height ratio averaging 1 : 0.65; frons width-to-length ratio averaging 1 : 0.49; mesofrons, fronto-orbits deeply bluish to

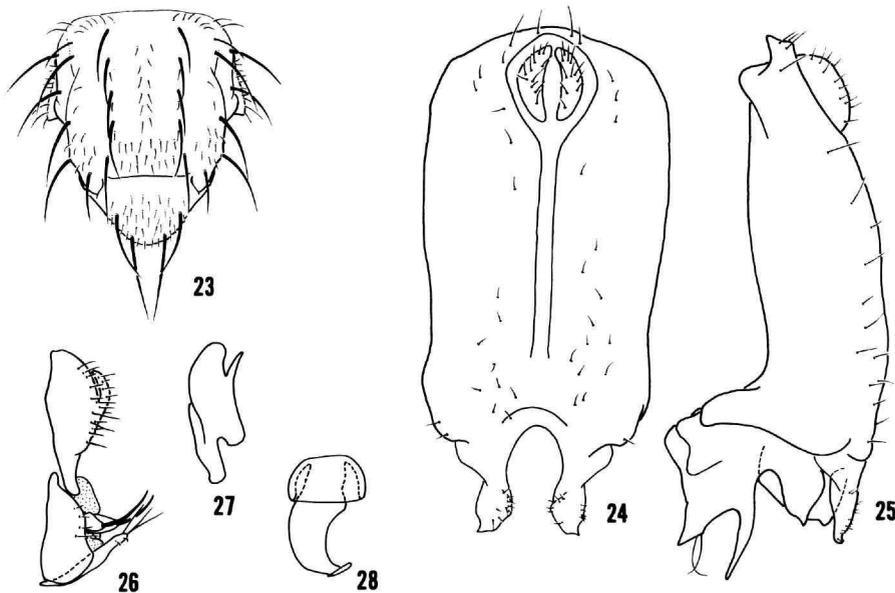
greenish blue, dorsum of interfoveal carina concolorous or frequently more greenish; dorsal surface of face shorter than height of anterior surface; angle formed by dorsal surface and anterior surface moderately angulate, approximately 105° ; face with anterior surface silvery white, frequently facial angle darker, golden to yellowish brown. Eye height-to-width ratio averaging 1 : 1.1; eye-to-cheek ratio averaging 1 : 0.44.

Thorax (Figure 23): Costal vein ratio averaging 1 : 0.30; M_{1+2} vein ratio averaging 1 : 0.75.

Abdomen: Male terminalia (Figures 24, 25) with surstyli in posterior view with lateral and median margins irregular, apices with shallowly mucronate, obliquely oriented point, slightly upturned in lateral view; gonite in lateral view with moderately wide posterior process, sides very shallowly sinuate, apex mucronate, median prong narrow, parallel sided until just before apex, apex acutely pointed, curved anteroventrally, anterior process shorter than others, truncate, posteroventral angle with 2-3 long setae, situated medi-

ally to other 2 processes; aedeagus rounded in lateral view, very broadly rounded in dorsal view; hypandrium with 2 pairs of prongs, lateral pair stouter and sinuate, median pair very slightly curved, more slender. Female terminalia (Figures 26-28) as in species group description; female ventral receptacle with extending process shallowly curved along inner curvature of corpus.

TYPE MATERIAL.—The male lectotype of *Ephydra breviventris* Loew, herein designated, is labeled "268 [handwritten]/Coll. H. Loew/14473/Ephydra breviventris m. [handwritten]/Typus [red]/LECTOTYPE *Ephydra breviventris* Loew by W. N. Mathis [handwritten; red]." The lectotype is in the Zoologisches Museum, Humboldt-Universität, Berlin, Germany [DDR]. The lectotype is pinned directly and is in good condition. As Loew (1860) did not specify a holotype specimen, I have designated the only male from Loew's type series as the lectotype. Loew's original description indicated that both male and female specimens were in the type series, although how many spec-



FIGURES 23-28.—*Setacera breviventris*: 23, thorax, dorsal aspect; 24, male terminalia, posterior aspect; 25, same, lateral aspect; 26, female terminalia, lateral aspect; 27, cerci, posterior aspect; 28, female ventral receptacle lateral aspect.

imens of each sex was not cited. I assume that the specimens, other than the lectotype, have been lost or have lost their identity as being part of Loew's original type series. Fortunately, the remaining male specimen is in good condition and is easily identified.

The male lectotype of *Ephydra laeta* Hendel, herein designated, is labeled "Tainan Formosa H. Sauter 11. 09. (9 Nov 1909)/TYPUS [red]/Hendel det./Ephydra laeta Hendel/LECTO-TYPE Ephydra laeta Hendel by W. N. Mathis [handwritten; red]." The lectotype is in the Naturhistorisches Museum, Vienna, Austria. The specimen is double mounted (minute nadel in foam block) and is in only fair condition, being teneral, missing several setae, and both wings removed (the left wing is glued to the form block). The abdomen has been removed and dissected (total length of specimen before dissection 2.97 mm); the structures are in an attached microvial. Hendel (1913) did not mention a type series nor did he specify a holotype specimen in the original description. Because several specimens of this species exist that bear label data indicating that they were collected during the same expedition from which Hendel obtained the specimen(s) he described, it is appropriate to select a lectotype to avoid any confusion as to which specimen the name should be associated. Accordingly, from that series I have selected the only known male, which is also the only specimen to bear a "TYPUS" label. The "TYPUS" label may have been placed on the pin by Hendel.

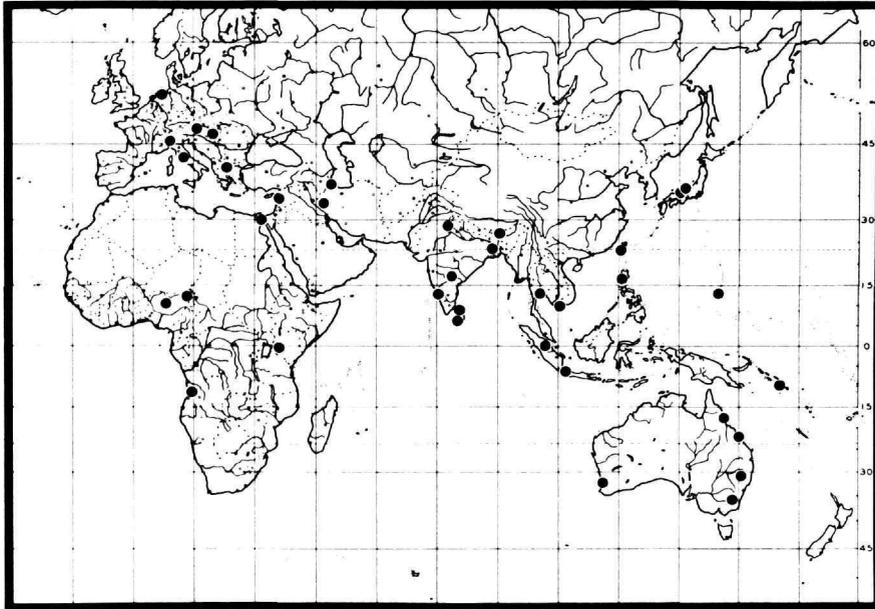
The male holotype of *Ephydra glabra* de Meijere is labeled "Batavia [Jakarta] VIII 07 [Aug 1907] Jacobson [handwritten; collector]/Ephydra glabra det. de Meijere Type [scientific name and "Type" handwritten; black bordered]/HOLO-TYPE [red with black border]/HoloTYPE Ephydra glabra de Me. ♂ det B. H. Cogan 1971. [species' name handwritten]/Setacera glabra de Meij det B. H. Cogan 1971. [species' name handwritten]." The holotype is in the Instituut voor Taxonomische Zoologie, Zoologisch Museum, Amsterdam, Netherlands. The specimen is double

mounted (minute nadel in foam block) and is in good condition.

The male holotype of *Setacera pedalis* Cresson is labeled "Austr[ia]. inf. Wien 9-68 Mik/TYPE no. 6372 Setacera PEDALIS ♂ E. T. Cresson, Jr, [red]." The holotype is in the Academy of Natural Sciences of Philadelphia, type 6372. The specimen is double mounted (minute nadel in cork block) and is in good condition. Cresson's original description also lists two male and nine female paratypes from "Austria, Alte Sammlung." One of the latter specimens is in the Academy and is labeled "ALLO-TYPE 6372 Setacera Pedalis ♀ [red]."

The male holotype of *Setacera fluxa* is labeled "Fukui 26, Aug. 1963 [yellow]/Japonia Honshu I[chiro]. MIYAGI [yellow]/-type Setacera fluxa I. Miyagi [name and author handwritten; red]." The holotype is in the Entomological Institute, Hokkaido University, Sapporo, Japan. The specimen is double mounted (minute nadel) and is in good condition. There is considerable disagreement between the label data accompanying the presumed holotype and paratypes and the published data in Miyagi's (1966) paper. According to the published data, the type-locality and date are "Wajima, Ishikawa-ken, Honshu, 27-vi-63." The same type of error is encountered in the paratype series. I have been assured by the curator of the insect collection of the Hokkaido University, Dr. S. Takagi, that the specimens I was sent for study are the holotype and paratypes, which would mean that the publication contained several errors of transcription.

OTHER SPECIMENS EXAMINED.—ANGOLA. *Provincia do Cuanza Sul*: Chachoeiras, 20 mi SW Gabela, 18-19 Mar 1972 (1♀; BMNH). AUSTRALIA. *Australian Capital Territory*: Black Mountain, 2 Jan-30 Dec, 1955-1968, I.F.B. Common (30♂, 43♀; ANIC); Fyshwick, 29 Oct-24 Nov, 1961-1966, P. W. Geier, R. Pilfrey (1♂, 1♀; ANIC, USNM). *New South Wales*: Gunnedah, 26 Dec 1964, M. I. Niti-kin (1♂, 1♀; BMNH). *Queensland*: Cunnamulla, Nov 1937 (2♂, 2♀; USNM); Gilruth Plains, Cunnamulla, J. H. Ricks (3♀; USNM); Ingham, 9 Aug 1960, K. L. Harley (1♀; USNM); Marlbor-

FIGURE 29.—Distribution map of *Setacera brevientris*.

ough, 63 mi N, 9 May 1955, K. R. Norris (1♂; USNM). *Western Australia*: Cannington, 30 Jan 1935, K. E. Norris (1♀; USNM). *AUSTRIA*. Klosterneueberg (1♂, 1♀; NMW, USNM); "Alte Sammlung" (1♂, 1♀; ANSP, USNM). Kreyenberg, 22 May 1911–1912, Jentschoufu, Schant (2♀; DEI). *BANGLADESH*. Rajshahi, 1–6 Feb 1917 (1♂; USNM). *EGYPT*. Cairo, Nov (1♂; USNM). Faiyum, Mar (1♀; USNM). *GREECE*. *Macedonia*: Struma Vall., Jun 1934, Shannon and Hadjincalaou (1♂; USNM). *GUAM*. 18 Aug 1938, R. G. Oakley (1♂; USNM). *HUNGARY*. Hodmezgova-sarhely, 27 Jul 1963, fenycsapda (1♀; HNHM); Szaszka, 22 Jul 1899, Kristen (1♀; HNHM); Tarkos, 25 Aug 1963, fenycsapda (1♂; HNHM). *INDIA*. *Amdrah Pradesh*: Hyderabad, 28 Oct–4 Nov 1971, J. C. Deeming, A. C. Pont (1♀; BMNH); Tirupati, 132 m elevation, 18 Apr 1962, D. Q. Cavagnaro, E. S. Ross (1♂; USNM). *Karnataka*: Mudigere, 19 km W, W. N. Mathis, A. Freidberg (9♂, 16♀; USNM). *Union Territory of Delhi*: New Delhi, 5–30 Nov, 1967–1968, K. E. Gibson (12♂, 29♀; USNM). *INDONESIA*. *Java*: Batavia [Jakarta],

1907, Jacobson (1♂; ITZA). *Sumatra*: Fort de Kock, 920 m elevation, 1925, E. Jacobson (3♀; BMNH). *IRAN*. *Bisotun Kermanshah*: Camp 26, 24–25 Jun 1964, J. Neal (2♂; USNM). *Gilan*: Camp 30, Bandar Pahlavi, 10–12 Jul 1964, J. Neal (16♂, 19♀; USNM). *ISRAEL*. Mt. Carmel, 22 Aug 1941 (1♀; USNM). *ITALY*. *Lombardy*: Pavia, 15 Aug 1895 (2♂, 1♀; HNHM, USNM). Bagni di Tivoli, 27 Oct 1974, W. Rossi (1♂; MCSNV). *JAPAN*. *Honshu*: Fukui, 26 Aug 1963, I. Miyagi (1♂; HUS); Kyoto, Taiza, 1 Aug 1963, I. Miyagi (3♀; HUS); Omac-zaki, 22 Jul 1963, I. Miyagi (2♂; HUS); Wada Fukui, 27 Jun 1963, I. Miyagi (2♂, 1♀; HUS). *KENYA*. Taveta Forest, Aug 1947, M. Steele (1♂; BMNH). *NEPAL*. Birganj Lothar, near, 450 ft elevation, 3 Sep 1967 (1♀; BMNH); Godavari, 5000 ft elevation, 5–15 Aug 1967 (5♂, 2♀; BMNH); Simra Adhabhar, near, 600 ft elevation, 25 Aug 1967 (2♀; BMNH). *NIGERIA*. Lake Chad, 5 mi W, oxbow lake near Komadugu, Yobe River, 12 Apr 1967, J. C. Deeming (1♂; BMNH); Zaria, Sumaru, 6 Feb–6 Mar, 1967–1972, J. C. Deeming (1♂, 4♀; BMNH). *PHILIPPINES*. *Luzon*: Mt. Makel-

elen, Baker (3♂, 1♀; USNM). SOLOMON ISLANDS. *Guadalcanal*: Honiara, 8–16 Nov 1953, J. D. Bradley (7♂, 10♀; BMNH). SRI LANKA. *Anuradhapura*: Wilpattu, Hunuwilagama, Wildlife Society Bungalow, 200 ft elevation, 10–19 Mar 1970, D. Davis, W. Rowe (1♀; USNM); Padaviya, Irrigation Bungalow, 180 ft elevation, 27 Feb–9 Mar 1970, D. Davis, W. Rowe (4♂, 3♀; USNM). *Colombo*: Ratmalana, 28–29 Feb 1968, T. F. Halstead (3♂, 11♀; CAS). *Jaffna*: Chundikkulam Sanctuary, 25 ft elevation, 7 Nov 1976, G. F. Hevel, R. E. Dietz (1♀; USNM). *Mannar*: Mannar, 4 mi NW, 100 ft elevation, 3 Nov 1976, G. F. Hevel, R. E. Dietz (1♂, 2♀; USNM). TAIWAN. Tainan, Feb 1909, H. Sauter (5♀; NMW, USNM). THAILAND. Bangkok, Huay Kwang, Huai Khwang Sathani, Aug–Sep 1962, J. Scanlon (1♂; USNM); Bangkok, Bang Pho, Aug–Sep 1962, J. Scanlon (1♂; USNM); Bangkok, Plukchit, Aug–Sep 1962, J. Scanlon (1♀; USNM); Bangphra, Cholburi, Oct 1962, J. Scanlon (3♂, 2♀; USNM). VIET NAM. Long Bihn, 1969, W. H. Pierce (1♂; USNM).

DISTRIBUTION (Figure 29).—This is the most widespread species of the genus, occurring in four of the major zoogeographic regions of the Old World: Australian, Oriental, Palaearctic, and Afrotropical. The distribution falls between 7° and 162° east longitude and between 37° south lati-

tude and 57° north latitude.

NATURAL HISTORY.—I have collected this species in southern India along the exposed and muddy banks of small streams. Although lentic aquatic systems occurred in the same area, the species occurred more commonly along lotic systems.

REMARKS.—As indicated in the synonymy, several names have been found to be junior synonyms of *S. breviventris*. In each case, I have examined the appropriate type material to confirm the conspecificity of the included taxa.

4. *Setacera multicolor* (Soika)

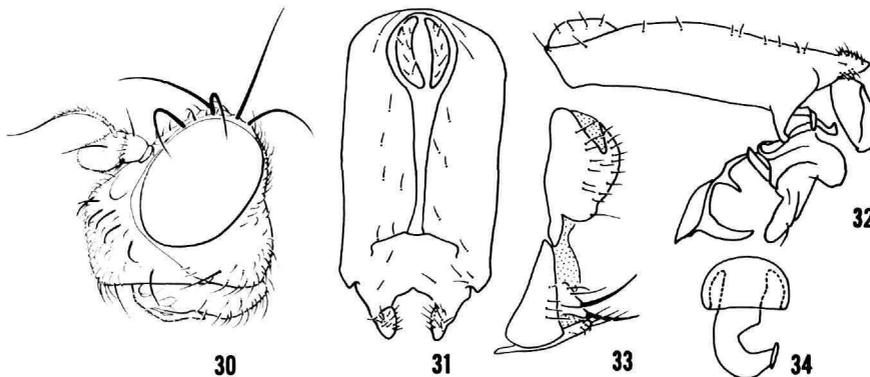
FIGURES 30–35

Ephydra (*Setacera*) *multicolor* Soika, 1956:128.

Setacera multicolor.—Cogan, 1980:668 [afrotropical catalog].

DESCRIPTION.—Moderately small shore flies, length 2.86 to 2.94 mm (based on 2 females); dorsum generally dark, olivaceous green with some greenish and grayish coloration, becoming duller and grayer ventrally.

Head (Figure 30): Head width-to-height ratio averaging 1 : 0.59; frons width-to-length ratio



FIGURES 30–34.—*Setacera multicolor*: 30, head, lateral aspect; 31, male terminalia, posterior aspect; 32, same, lateral aspect; 33, female terminalia, lateral aspect; 34, female ventral receptacle, lateral aspect.

averaging 1 : 0.48; mesofrons, fronto-orbits, and dorsum of interfoveal carina concolorous, deeply bluish with some greenish tinges; dorsum of face shorter than anterior surface; angle formed by dorsal surface and anterior surface moderately angulate, approximately 105°. Eye height-to-width ratio averaging 1 : 1.06; eye-to-cheek ratio averaging 1 : 0.42.

Thorax: Costal vein ratio averaging 1 : 0.29; M_{1+2} vein ratio averaging 1 : 0.90.

Abdomen: Male 5th tergum with anteroventral angle drawn out to form posteriorly curved, narrow projection; male terminalia (Figures 31, 32) with surstyli in posterior view with apices rounded, ovate, setose along median margin, pocket formed between surstyli moderately wide, width subequal to depth; gonite with a posterior wide, blunt projection, broadly rounded apically, median projection mostly fused with anterior one, forming narrow, posterior process of about one-half length of anterior process, anterior process long, moderately narrow, more or less parallel sided, rounded apically; aedeagus wider than long, broadly rounded dorsally; hypandrium with 2 pairs of prongs, posteromedian pair approximate, short, less than one-half length of other pair, anterolateral pair robust, curved apically posteriorly. Female terminalia (Figures 33, 34) as in species group description; female ventral receptacle with inner surface of corpus curvature compressed, angulate.

TYPE MATERIAL.—The female holotype is labeled “HOLOTYPUS [light orange with submarginate black border]/MUSEE DU CONGO Katanga:Mulongo 12-III-1926 Dr. H. Schouteden/HOLOTYPUS Ephydra multicolor n. sp. A. G[iordani]. S[oiika]. [handwritten; red].” The male allotype has the same locality label data as the holotype. Both are in the Musée Royal de l’Afrique Centrale, Tervuren, Belgium. The holotype is double mounted (minute nadel in foam block) and is in fair condition (several setae of the head are missing). Soika’s original description states that the holotype is a male, but the specimen labeled “HOLOTYPUS” is definitely a fe-



FIGURE 35.—Distribution map of *Setacera multicolor*.

male. Fortunately the allotype is a male that I dissected to confirm its identity.

OTHER SPECIMENS EXAMINED.—MADAGASCAR. Sangoritelo, 11 May 1965, Blgor (1♂; BMNH). SOUTH AFRICA. Cape of Good Hope, Nature Reserve, 7 Mar 1968, P. J. Spangler (1♂; USNM). TANZANIA. Mpanda, Jun 1960, N. Leleup (2♀; MRYAC, USNM). ZAIRE. *Kivu*: Kavivira (Uvira), Dec 1954, G. Marlier (1♂, 1♀; MRYAC).

DISTRIBUTION (Figure 35).—Afrotropical; between 3° and 35° south latitude and between 18° and 44° east longitude.

NATURAL HISTORY.—See species group treatment.

REMARKS.—Both species of *Setacera* occurring in the Afrotropical Region are members of the *breviventris* group, *S. multicolor* being the southern counterpart of *S. breviventr*is.

5. *Setacera viridis* Miyagi

FIGURES 36-42

Setacera viridis Miyagi, 1966:138; 1977:83 [review].

DESCRIPTION.—Moderately small to medium-

sized shore flies, length 2.93 to 3.52 mm; generally olivaceous dark brown to greenish blue dorsally, becoming grayer and duller ventrally.

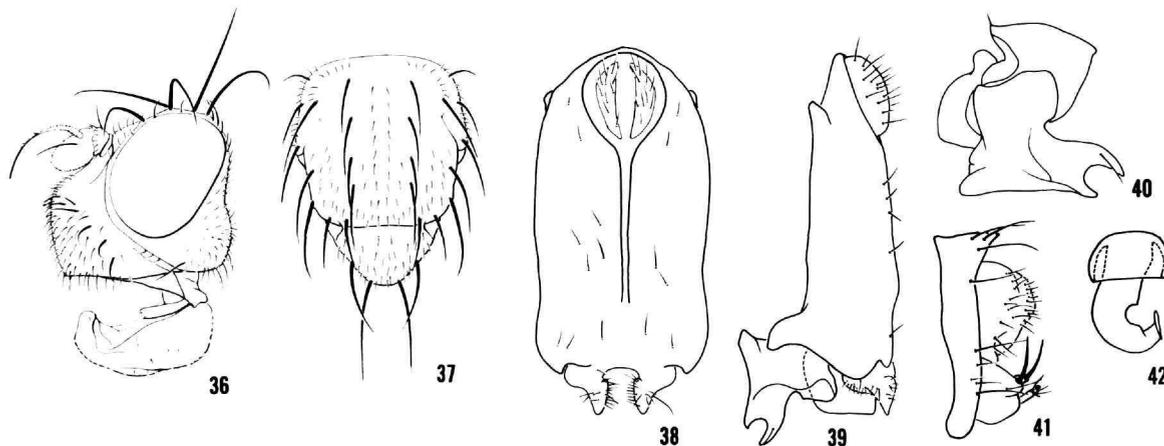
Head (Figure 36): Head width-to-height ratio averaging 1 : 0.65; frons width-to-length ratio averaging 1 : 0.48; mesofrons, fronto-orbits, and dorsum of interfoveal carina metallic green, bluish green, or mostly bluish. Face in profile much higher than wide, anterior surface and oral surface forming an obtuse angle; facial angle moderately angulate, approximately 100°; face with anterior surface mostly light golden to brown white, ventrally nearly silvery white. Eye height-to-width ratio averaging 1 : 1; eye-to-cheek ratio averaging 1 : 0.36.

Thorax (Figure 37): Costal vein ratio averaging 1 : 0.25; M_{1+2} ratio averaging 1 : 0.74.

Abdomen: Male 5th tergum with anteroventral angle formed into narrow, posteriorly curved, acutely pointed projection; male terminalia (Figures 38–40) with surstyli in posterior view short, rounded apically, median margin conspicuously more setose than lateral margin, with dorsomedian, angulate notch, apices tapered evenly to acutely pointed apex in lateral view; gonite with posterior projection broad and truncate, width twice length, median and anterior projections

united basally, forming 2 pointed projections apically, posterior margin curved anteriorly on apical half, deeply U-shaped emargination formed between apical points; aedeagus broadly rounded in posterior view, angulate apically in lateral view; hypandrium with 1 pair of prongs, arising from anterior one-third along median margin, curved anteriorly. Female terminalia (Figures 41, 42) as in species group description; female ventral receptacle with inner curvature of corpus moderately compressed.

TYPE MATERIAL.—The male holotype is labeled “Sapporo: 1961-vi-10/Japonia Hokkaido I. Miyagi/-type *Setacera viridis* I. Miyagi [19]66 [name, author, and date handwritten; red].” The holotype is in the Entomological Institute, Hokkaido University, Sapporo, Japan. The specimen is double mounted (minute nadel) and is in good condition. Of the paratypes Miyagi (1966) listed, I have examined only three males and one female, all with the same locality data as the holotype. Other paratypes Miyagi listed are from the following localities. JAPAN. *Hokkaido*: Numata, 14 Jun 1961 (2♂, 2♀; HUS); Oki-Tokachi, 12 Jun 1961 (4♂, 5♀; HUS); Mashike, 24 Jul 1964 (1♂, 4♀; HUS); Yakijirijima, 12 Aug 1961 (2♂, 3♀; HUS); Abashiri, 25 Jul 1962, S. Takagi (1♂;



FIGURES 36–42.—*Setacera viridis*: 36, head, lateral aspect; 37, thorax, dorsal aspect; 38, male terminalia, posterior aspect; 39, same, lateral aspect; 40, internal male genitalia, lateral aspect; 41, female terminalia, lateral aspect; 42, female ventral receptacle.

HUS); Toyotomi, Wakkanai, 2 Jul 1961 (2♂, 3♀; HUS).

OTHER SPECIMENS EXAMINED.—JAPAN. *Hokkaido*: Tomamae, 12 Aug 1961, I. Miyagi (1♂, 3♀; HUS). *Honshu*: Wada Fukui, 27 Jun 1963, I. Miyagi (1♂; HUS). KOREA. Seoul [near], Jun 1955, light trap (1♂, 1♀; USNM).

DISTRIBUTION.—Eastern Palaearctic; Japan (Hokkaido and Honshu Islands) and Korea.

NATURAL HISTORY.—Miyagi (1966) reported that this species occurs on the shores of fresh-water lakes and pools where no alkalinity exists.

REMARKS.—*Setacera viridis* is like other species of the *breviventris* group in that I can distinguish only male specimens to species. The females listed above were directly associated with males.

Although *S. viridis* is closely related to *S. breviventris* and apparently has similar habitat preferences, Miyagi (1966) usually did not find these two species together in Japan. All of his collections of this genus from Hokkaido were *S. viridis*, while those of Shikoku, Kyushu, and the Ryukyu Islands were *S. breviventris*. Only on Honshu (Wada Fukui) were the two species encountered together.

The *aurata* Group

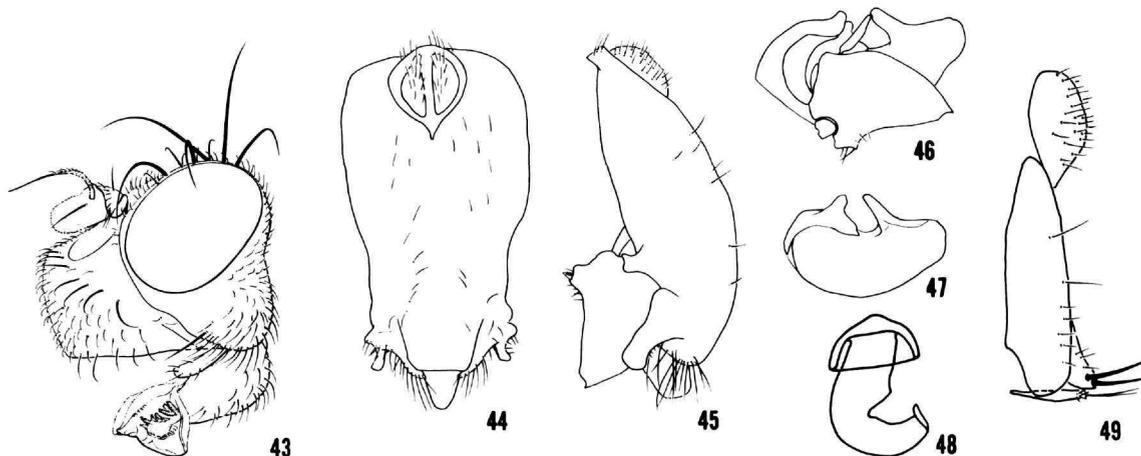
SPECIES INCLUDED.—*Setacera aurata* (Stenhammar).

DIAGNOSIS.—Specimens of the *aurata* group may be distinguished by the following combination of character states: antennal foveae densely tomentose, contrasting distinctly with subshiny to shiny dorsum of interfoveal carina; longest dorsally branching rays of arista at most slightly longer than arista width at base; vertico-orbits with velvety tomentose band moderately wide, conspicuous, lacking subanterior enlargement; posthumeral bristle well developed, subequal to posterior notopleural bristle, distance between it and presutural bristle about equal to that between notopleural bristles; supraspiracular convexity evenly convex; legs lacking conspicuous rows or tufts of larger setae; fore- and midtibiae

dark, concolorous with femora, at most with tibial-femoral articulation pale; 5th tergum of male subtruncate apically, length approximately equal to that of 4th, much longer than apical width, anteroventral margin not produced into narrow process; 3rd and 4th sterna of male with dense patch of stout setae toward posterior margin.

Male Terminalia (Figures 44–47): Epandrium lacking median furrow, greatest width subdorsal in posterior view, dorsum subtruncate; surstylus in lateral view with a parallel-sided, lateral projection that is subtruncate apically and oriented anteroventrally, lateral margin in posterior view with subbasal lateral swelling on lateral process, ventromedian process with lateral margin setose; gonite irregularly subtriangular, higher than wide, posterior margin very shallowly emarginate along basal half, thereafter tapered, rounded to acutely pointed apex, anterior margin more or less straight to just before apex, apical one-fourth or less curved inwardly more abruptly to form point, basal anterior margin with blunt short anterior projection, setulose; aedeagus broadly rounded apically; hypandrium lacking prongs or narrow process, formed by 2 nearly semicircular plates, each poorly sclerotized.

Female Terminalia (Figures 48, 49): 7th tergum complete; 8th tergite long and moderately narrow, 3 times higher than wide, more or less parallel sided, venter and dorsum evenly and narrowly rounded; 8th sternites short, 3 to 4 times longer than wide; 9th sternum oriented vertically, generally poorly sclerotized, especially dorsally, narrowly U-shaped in posterior view, each lateral arm setulose basally, more so along median margin; 9th sternal bristles evenly spaced, approximate, median 2 aligned slightly more ventrally than lateral ones, base from which bristles arise protruded posteroventrally, distance between bristle insertions and ventral margin of cerci greater than cercal height; cercus in lateral view higher than wide, posterior margin broadly rounded; female ventral receptacle with operculum comparatively small, wider than high, shallowly papillate dorsally, extending process



FIGURES 43-49.—*Setacera aurata*: 43, head, lateral aspect; 44, male terminalia, posterior aspect; 45, male terminalia, lateral aspect; 46, internal male genitalia, lateral aspect; 47, aedeagus, lateral aspect; 48, female ventral receptacle, lateral aspect; 49, female terminalia, lateral aspect.

long, cervix about one-half total length, corpus compressed.

DISTRIBUTION.—See treatment of only included species (page 27).

6. *Setacera aurata* (Stenhammar)

FIGURES 43-50

Ephydra aurata Stenhammar, 1844:167.—Zetterstedt, 1846:1810 [review].—Nartschuk, 1970:387 [key].

Ephydra micans [in part] of authors [not Haliday, 1833:175].—Loew, 1860:36 [review].—Schiner, 1863:261 [review].—Becker, 1896:218 [review]; 1905:209 [palaeartic catalog]; 1926:75 [review].—Dahl, 1959:111 [review].

Setacera aurata.—Collin, 1963:148 [review].—Dahl, 1974:186 [distribution, figure of male terminalia].—Papp, 1975:109 [distribution, figures of head, male and female terminalia].—Karnecká, 1980:421 [list, Czechoslovakia].

Setacera micans [in part] of authors [not Haliday, 1833:175].—Canzoneri, 1978:28, 29 [figure of male terminalia].

DESCRIPTION.—Medium-sized to moderately large shore flies, length 3.52 to 4.76 mm; generally olivaceous brown with some faint greenish to bluish coloration dorsally, becoming grayer and duller ventrally.

Head (Figure 43): Head width-to-height ratio averaging 1 : 0.63; frons width-to-length ratio averaging 1 : 0.48; mesofrons, fronto-orbits, and

dorsum of interfoveal carina with metallic luster, blue to bluish green, dorsum of interfoveal carina also with sparse tomentose vestiture, slightly duller; dorsal surface of face shorter than anterior surface, angle formed by these surfaces obtuse, about 110°, anterior surface mostly silvery white, often with some yellowish to yellowish brown coloration dorsally; eye height-to-width ratio averaging 1 : 1; eye-to-cheek ratio averaging 1 : 0.43.

Thorax: Legs, except for tibial-femoral articulation mostly dark colored, gray to blackish, articulation pale. Costal vein ratio averaging 1 : 0.26; M_{1+2} vein ratio averaging 1 : 0.90.

Abdomen: Male and female terminalia (Figures 44-49) as in species group description.

TYPE MATERIAL.—The male lectotype, designated by Dahl (1959) as a "holotype," is labeled "[a green diamond, white on underside]/Holotypus aurata Stenh R Dahl [species epithet and "R Dahl" handwritten, red]." The lectotype is double mounted (clipped pin in plastic tube), is in poor condition (lower portion of head and numerous setae are missing, wings are torn, terminal segments of abdomen have been removed, dissected, and are in an attached microvial), and is in the Zetterstedt collection, Zoological Institute,

Lund, Sweden (the specimen is temporarily in the custody of Dr. Richard Dahl, Helsingborg, Sweden).

OTHER SPECIMENS EXAMINED.—ENGLAND. *Essex*: Pitsea, 24 Sep 1926, Richards (3♀; USNM). *Norfolk*: Ring Mere, north of Thetford, 5 Aug 1953 (1♂; UMO); Roudham Heath, 1 Sep 1937 (1♀; UMO). FRANCE. La Panne, 8 Aug 1923, M. Goetghebuer (1♂, 1♀; USNM). NETHERLANDS. Amsterdam, Mar–Oct, Meijere (2♂, 2♀; ITZA). Diemen, 9 Jul 1905, Meijere (1♀; ITZA). Hilversum, 5 Mar–16 Oct, 1907–1911, Meijere (2♂, 4♀; ITZA). Zerbrug, Feb 1908, Gillary (1♀; ITZA). NORWAY. Bergen, 2 Mar 1952, H. Wiering (1♀; ITZA). SWEDEN. *Ostergötland*: (1 ♂; NRS). *Scania*: Fyleoset, Ystad, 17 Jun–8 Jul, 1951–1954, R. Dahl (4♂, 5♀; ZIL); Lilla Viken, Höör, 3 Jul 1954, R. Dahl (2?; ZIL). N. Tvarminne strand, 19 Jul 1960, R. Dahl (1♂; USNM). GERMANY (DDR). Berlin (Jungfhd) (1♀; NRS). W. GERMANY. Borkum, Jul 1895 (1♀; NRS). FINLAND. Jakobstad (Pietarsaari), 1952, Sotra (1♂; USNM). Locality unspecified (6♂, 3♀; HU, ITZA, NMW, ZIL).

Collin (1963) also recorded this species from the following counties in England and Wales: Cambridgeshire, Essex, Glamorganshire, and Norfolk. Dahl (1974) examined specimens of *S. aurata* from the following localities in Sweden (unverified and all collected by him). *Skane*: Forslovsholm, 20 Jul 1971; Höör, 1 Aug 1966; Ystad, Fylean, 8 Jul 1954, Lomma, 24 Aug 1954. *Blekinge*: Karlshamn, 3 Aug 1968. Karnecká (1980) listed this species from Bohemia and Moravia in Czechoslovakia.

DISTRIBUTION (Figure 50).—Palearctic. Northern Europe from Norway and European Russia south to France and Hungary.

REMARKS.—Except for Zetterstedt (1846) and a few recent workers (see synonymical bibliography), most authors have confused this species with *S. micans*. The misidentification began when Loew (1860) listed *S. aurata* as a synonym of *S. micans*, a precedent that was followed by several European authors (see synonymy). Dahl (1959) further complicated the misidentification of Loew and others by stating that he had “examined the

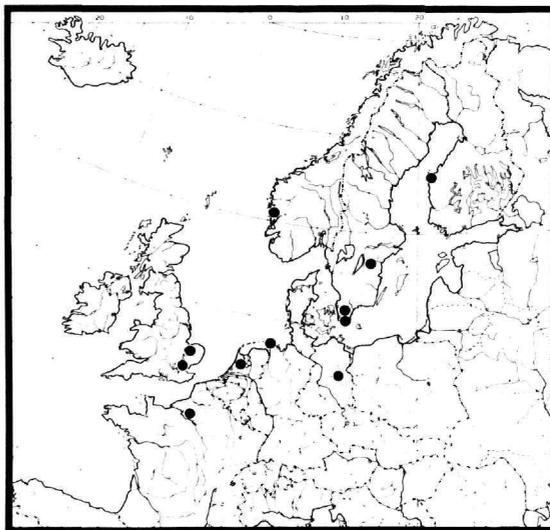


FIGURE 50.—Distribution map of *Setacera aurata*.

male genitalia of the holotype of that species [*S. aurata*] in Stenhammar's Collection. The examination revealed the identity with *micans*." Dahl could not have studied the “holotype” of *S. aurata*, as Stenhammar did not designate one; however, Dahl's statement is sufficient for a lectotype designation. Collin (1963) correctly identified both species, designated a lectotype for *S. micans*, illustrated the male terminalia of a probable syntype of *S. aurata* from Stenhammar's collection, noted several differences between the male terminalia of *S. micans* and *S. aurata*, and specified the identity of specimens in several collections he had examined from Scandinavia. Dahl (1974) corrected his earlier misidentification and cited additional locality data for *S. aurata*; he also figured a surstylus of male *S. micans* and *S. aurata*. Canzoneri (1978), however, perpetuated the confusion with these two species by publishing figures of *S. aurata* under the name of “*S. micans*.”

This species is distinguished from congeners by the characters noted in the species group diagnosis.

The trina Group

SPECIES INCLUDED.—*Setacera freidbergi*, new species; *S. meneghini* Canzoneri; *S. trina* Collin.

DIAGNOSIS.—Specimens of the *trina* group may be distinguished by the following combination of characters: antennal foveae densely tomentose, contrasting distinctly with subshiny to shiny dorsum of interfoveal carina; arista with longest dorsally branching rays at most slightly longer than aristal width at base; vertico-orbits with velvety tomentose band moderately narrow but conspicuous, slightly enlarged subanteriorly at vertex; posthumeral bristle moderately well developed, subequal to largest humeral bristle to slightly weaker than posterior notopleural bristle, distance between it and presutural bristle slightly more than one-half that between notopleural bristles; suprspiracular convexity evenly convex; legs of male lacking conspicuous tufts or rows of large setae; fore- and midtibiae with up to basal one-third pale, although frequently considerably less; 5th tergum of male subtruncate apically, length approximately equal to that of 4th, anteroventral margin not produced into narrow process; 3rd and 4th sterna of male with dense patch of stout setae toward posterior margin.

Male Terminalia: Epandrium lacking median sulcus, greatest width subdorsal in posterior view, dorsum subtruncate; surstyli broadly fused with ventral margin of epandrium, lateral margin in posterior view rounded, gradually tapered inwardly to just before apices, thereafter recurved laterally, apex in lateral view slightly flared posteriorly; gonite in lateral view with posterior and anterior process, anterior process with angulate margin, curved apically, inner surface of curvature setulose; aedeagus broadly rounded apically; hypandrium formed by 2 narrowly triangular, poorly sclerotized plates, lacking prongs or extended processes, attached anteriorly to 5th sternum.

Female Terminalia: 7th tergum complete; 8th tergites long and narrow, over 3 times higher than wide, widest subdorsally, dorsum angulate, narrowest at midheight, from there to venter gradually becoming wider, venter evenly rounded; 8th sternites short, about 3 times longer than wide; 9th sternum oriented vertically, generally poorly sclerotized, broadly U-shaped in posterior view,

as high as wide, each dorsally extending arm slightly turgid, lateral margin rounded; 9th sternal bristles evenly spaced, approximate, and more or less aligned horizontally, base from which bristles arise not protruding; distance between bristle insertion and ventral margin of cerci greater than cercal height; cercus in lateral view higher than wide, posterior broadly rounded; female ventral receptacle with operculum comparatively small, about twice as wide as high, broadly trapezoidal in shape, extending process comparatively long, cervix less than one-half length, corpus moderately compressed.

DISTRIBUTION.—The composite distribution of the *trina* group occupies an area from Great Britain through Germany, Italy, and Israel to Iran. Nearly all specimens I have examined are from type-localities only.

DISCUSSION.—The monophyly of this species group is well established. The unique shape of the gonite of the male terminalia, especially the anterior process, is an apotypic character. The anterior process is narrow and recurved apically, and the inner curvature is setulose.

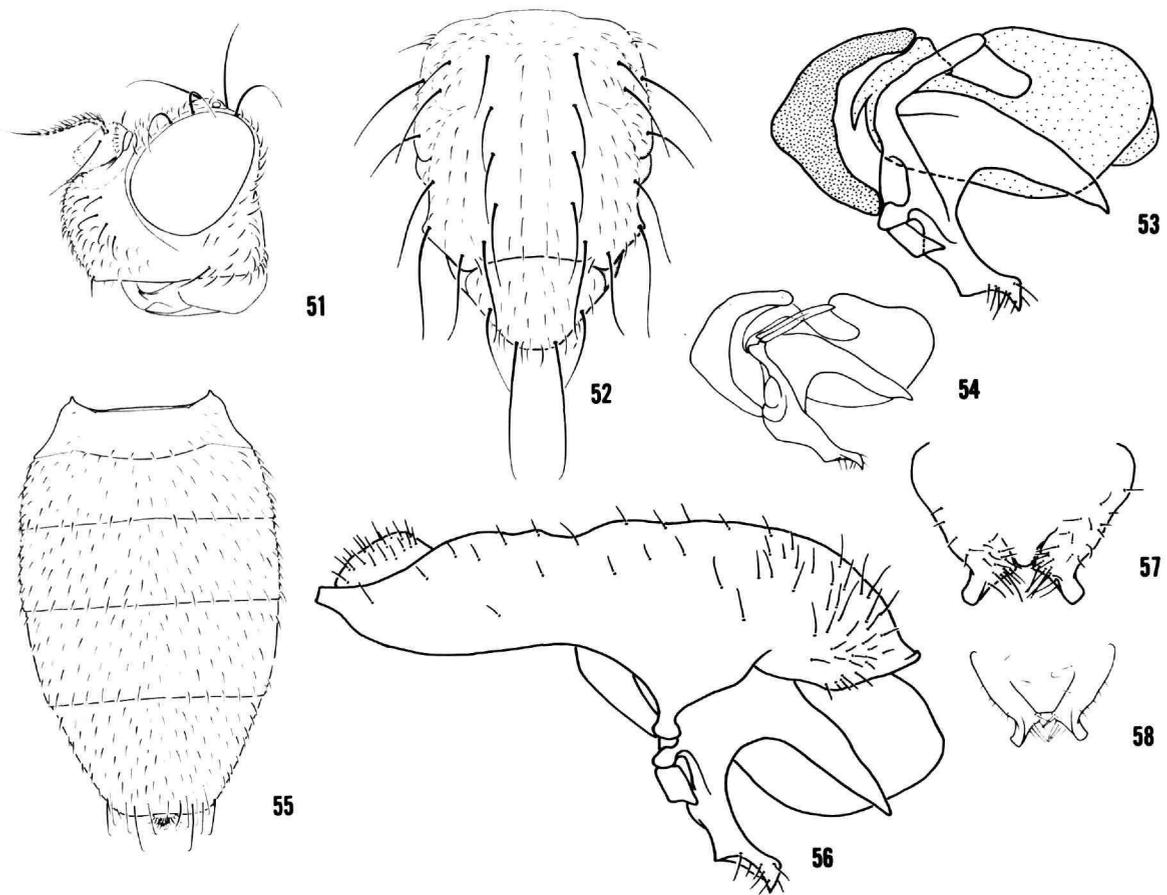
External differences between the species of the *trina* group are slight, and I have relied on features of the male and female terminalia to determine the identity of specimens. Because most species are known only from topotypical specimens, the extent and limits of intraspecific variation are essentially unknown.

7. *Setacera freidbergi*, new species

FIGURES 1, 51–66, 70

DESCRIPTION.—Medium-sized to moderately large shore flies, length 3.37 to 4.31 mm; generally greenish, sometimes faintly greenish brown to gray dorsally, becoming distinctly grayer and duller ventrally.

Head (Figures 51, 59–61): Head width-to-height ratio averaging 1 : 0.68; frons width-to-length ratio averaging 1 : 0.49; metallic luster of mesofrons, fronto-orbits, and dorsum of interfoveal carina bluish to very slightly greenish blue;



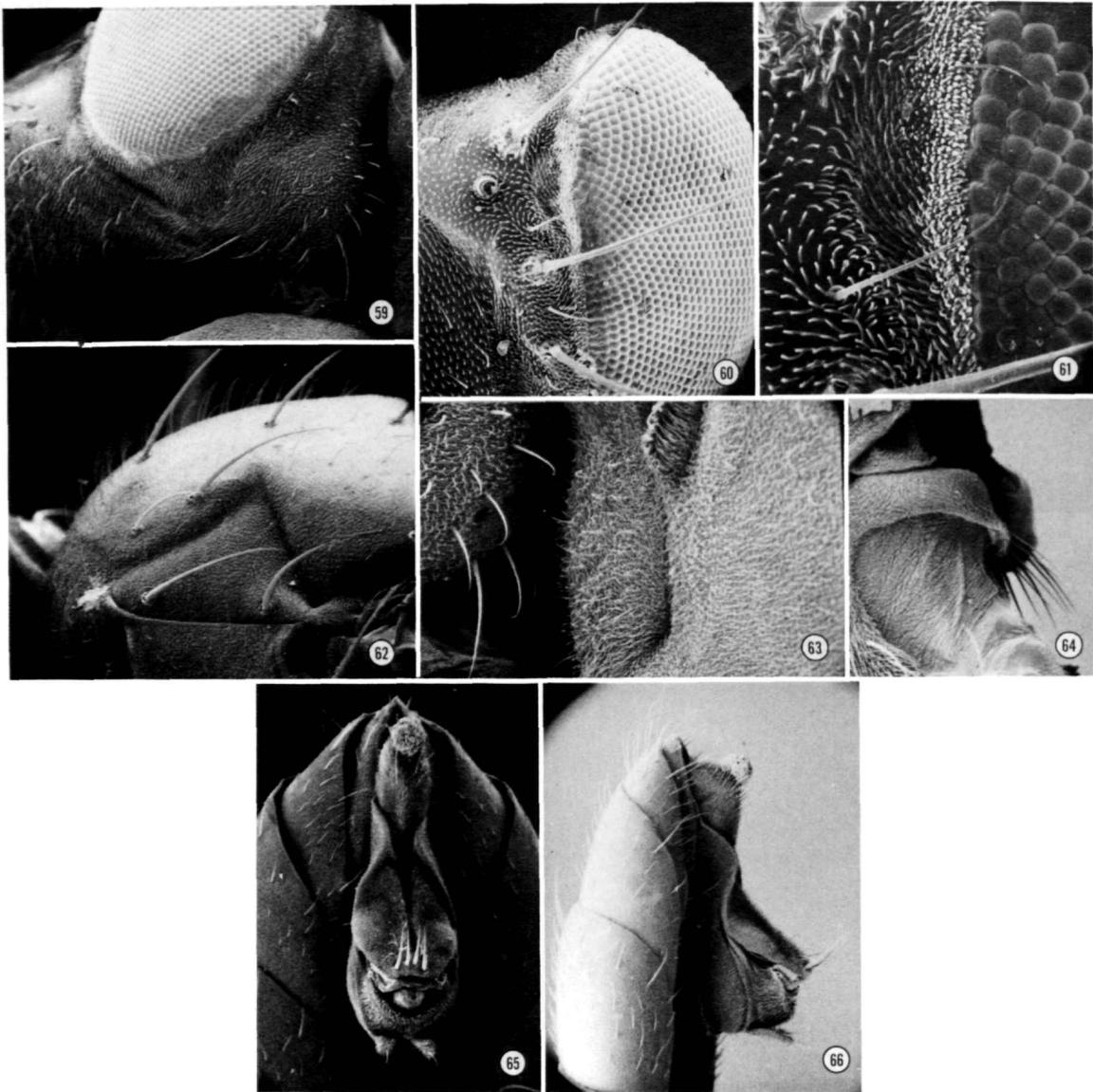
FIGURES 51-58.—*Setacera freidbergi*: 51, head, lateral aspect; 52, thorax, dorsal aspect; 53, internal male genitalia from type-locality; 54, internal male genitalia from Iran; 55, abdomen of male, dorsal aspect; 56, male terminalia, posterior aspect; 57, surstyli from type locality, posterior aspect; 58, surstyli from Iran, posterior aspect.

dorsal surface of face shorter than height of anterior surface; facial angle formed by anterior surface and dorsal surface about 110° ; face with anterior surface yellowish brown, golden, to mostly whitish dorsally, becoming almost entirely whitish ventrally; eye height-to-width ratio averaging 1 : 0.82; eye-to-cheek ratio averaging 1 : 0.44.

Thorax (Figures 52, 62-64): Fore- and midtibiae with basal one-third to two-thirds pale, otherwise grayish blue to faintly grayish green. Costal vein ratio averaging 1 : 0.28; M_{1+2} vein ratio averaging 1 : 0.91.

Abdomen (Figure 55): Male terminalia (Figures 53, 54, 56-58) with apices of recurved surstyli forming distinct angulate point (Figure 56); gonite in lateral view nearly parallel sided over most of length, slender, taper on apical one-fourth more abrupt (Figure 53). Female terminalia as in Figures 65, 66; female ventral receptacle with cervix very gradually widened toward corpus; junction of cervix with corpus gradual; corpus moderately compressed, more so than in *S. trina*.

TYPE MATERIAL.—The male holotype is labeled "ISRAEL: Nahal Tut (5km E. Fureidis) 19



FIGURES 59-66.—*Setacera freidbergi*: 59, ventral portion of head, lateral aspect; 60, left vertex and vertico-orbits of head, dorsal aspect; 61, left vertico-orbit showing velvety tomentosity, dorsal aspect; 62, notopleuron and surrounding area of thorax, lateral aspect; 63, propleuron, lateral aspect; 64, hind coxal strap bearing setae, lateral aspect; 65, female terminalia, ventral aspect; 66, same, lateral aspect.

May 1980 Mathis and Freidberg collectors." Allotype female and 34 paratypes (15♂, 19♀) are labeled with the same locality data as the holotype. The holotype is double mounted (minute nadel in plastic elastomer base) and is in excellent condition. The holotype, allotype, and most paratypes are in the National Museum of Natural History, Smithsonian Institution, USNM 76884. Two male and two female paratypes are in the insect collection of Tel Aviv University.

OTHER SPECIMENS EXAMINED.—IRAN. *Kermanshah Province*: Bisotun Camp 26, 24–26 Jun 1964, John Neal (6♂, 8♀; USNM).

DISTRIBUTION (Figure 70).—Near East of the Old World between 35° and 48° east latitude and between 32° and 35° north longitude.

NATURAL HISTORY.—Dr. Amnon Freidberg and I collected the topotypical series from a small algae-covered pond that was fed mostly from runoff irrigation water. As with most *Setacera* species, specimens were nearly impossible to collect by normal sweeping, and our series was collected by lowering a net over the top of a few flies as they rested on the water's surface. The specimens were abundant on the pond's surface and were not prone to fly far when disturbed.

ETYMOLOGY.—This species is named to honor Dr. Amnon Freidberg, who helped collect the type series, and who has promoted the study of Diptera from the Near East.

REMARKS.—The specimens from Iran are very similar to those from the type-locality, although the shape of the gonite consistently differs slightly. I am of the opinion that the two populations are conspecific and that the differences represent intraspecific variation of allopatric populations. A subspecific name could be applied, but no advantage is gained by so doing.

This species is closely related to the other two known species of the *trina* group, and I can distinguish them only after examination of the male terminalia.

8. *Setacera meneghinii* Canzoneri

FIGURES 67–70

Setacera meneghinii Canzoneri, 1978:28.

DESCRIPTION.—Moderately large shore flies,

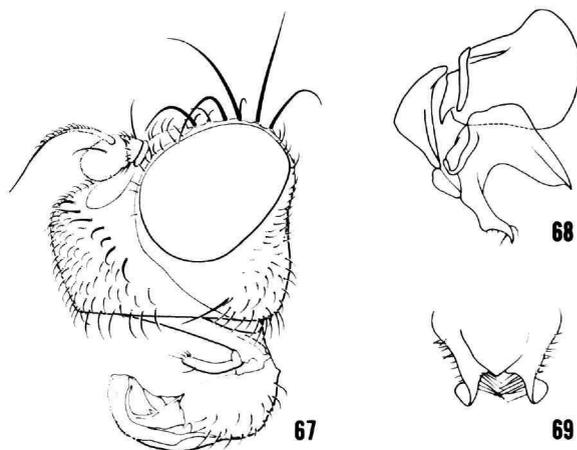
length 4.0 to 4.5 mm; generally olivaceous brown with some bluish to greenish tinges dorsally, becoming grayer and duller ventrally (Canzoneri, 1978; the male paratype I examined was approximately 3.9 mm but lacked the terminal segment of the abdomen).

Head (Figure 67): Head width-to-height ratio 1 : 0.58; frons width-to-length ratio 1 : 0.48; metallic luster of mesofrons and fronto-orbits deeply greenish blue, dorsum of interfoveal carina bronzish green; dorsal surface of face shorter than anterior surface; angle formed by anterior surface and dorsal surface obtuse, about 120°; face brownish gold dorsally, becoming mostly whitish ventrally. Eye width-to-height ratio 1 : 1; eye-to-cheek ratio 1 : 0.44.

Thorax: Fore- and midtibiae with basal one-fourth or less pale. Costal vein ratio 1 : 0.26; M_{1+2} vein ratio 1 : 0.92.

Abdomen: Male terminalia (Figures 68, 69) with apices of recurved surstyli rounded laterally, not pointed (Figure 69) in posterior view; gonite in lateral view moderately wide, tapered gradually toward apex until just before apex, thereafter abruptly tapered to form acutely pointed apex. Females unavailable for study.

TYPE MATERIAL.—The male holotype is la-



FIGURES 67–69.—*Setacera meneghinii*: 67, head, lateral aspect; 68, internal male genitalia, lateral aspect; 69, surstyli, posterior aspect.

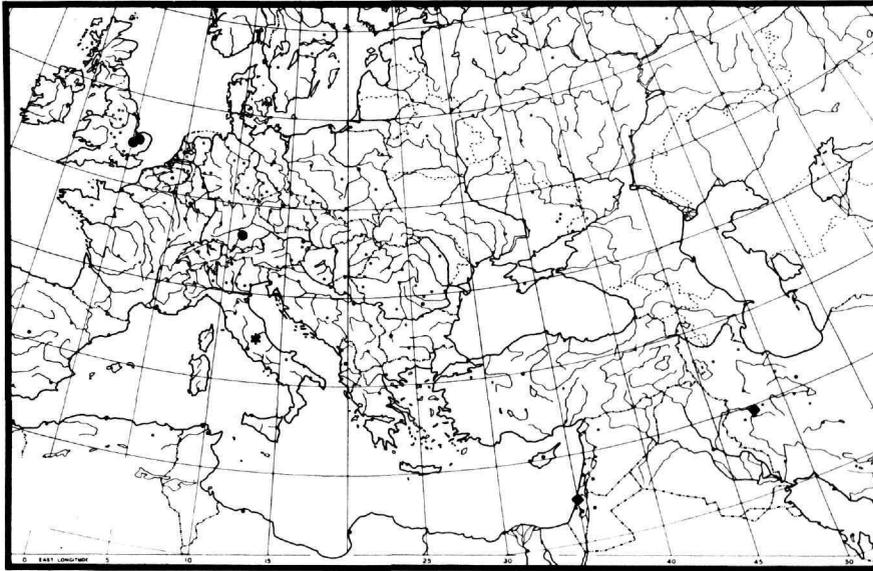


FIGURE 70.—Distribution map of *Setacera trina* (filled circles); *S. meneghini* (star); *S. freidbergi* (diamonds).

beled (based on the label data of a male paratype) “RIETI Sorgenti Solfuree 14–VIII–58 [14 Aug 1958] A. Giordani Soika.” The allotype female and a male paratype are from the same locality and were collected on the same date. The female paratype from Bagni di Tivoli (27 Oct 1974, W. Rossi) was misidentified and is a female of *S. breviventris*. The type series is in the Museo Civico di Storia Naturale de Venezia, Italy.

DISTRIBUTION (Figure 70).—Presently known only from the type locality. **ITALY.** *Rieti Province:* Rieti.

REMARKS.—My treatment of this species is based on minimal data. Aside from the original description, I have examined one male paratype.

This species seems to be intermediate between *S. freidbergi* and *S. trina*, as assessed by the shape of the gonite.

9. *Setacera trina* Collin

FIGURES 70–74

Setacera trina Collin, 1963:148.—Karnecká, 1980:421 [list, Czechoslovakia].

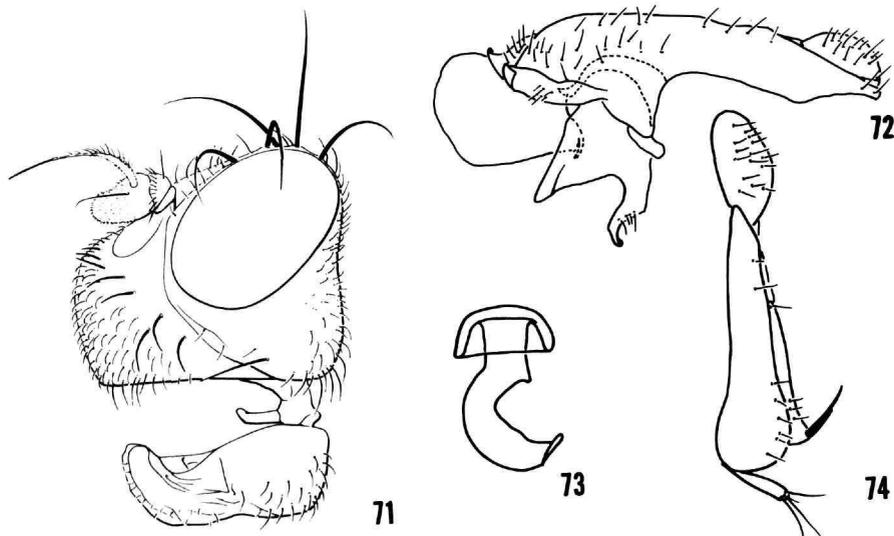
Ephydra trina.—Nartschuk, 1970:387 [key].

DESCRIPTION.—Moderately large shore flies, length 4.21 mm (1 female); generally olivaceous brown with some greenish coloration dorsally, becoming grayer and duller ventrally.

Head (Figure 71): Head width-to-height ratio averaging 1 : 62; frons width-to-length ratio averaging 1 : 0.47; metallic luster of mesofrons and fronto-orbits greenish blue to mostly bluish, dorsum of interfoveal carina lighter colored, subshiny, mostly bronzy green; dorsal surface of face shorter than height of anterior surface; facial angle formed by anterior surface and dorsal surface about 110°; face silvery white to light brownish white, slightly darker dorsally; eye height-to-width ratio averaging 1 : 1; eye-to-cheek ratio averaging 1 : 0.43.

Thorax: Tibiae mostly dark colored, only femoral-tibial articulation pale. Costal vein ratio averaging 1 : 0.29; M_{1+2} vein ratio averaging 1 : 1.

Abdomen: Male terminalia (Figure 72) with gonite in lateral view with posterior projection broadly triangular, apical angle about 45°. Fe-



FIGURES 71-74.—*Setacera trina*: 71, head, lateral aspect; 72, male terminalia of holotype, lateral aspect; 73, female ventral receptacle, lateral aspect; 74, female terminalia, lateral aspect.

male terminalia as in Figure 74; female ventral receptacle (Figure 73) with cervix parallel sided, C-shaped corpus moderately compressed, curvature at junction with cervix abrupt.

TYPE MATERIAL.—The male lectotype, herein designated, is labeled with a round disk, on the underside of which is written "Snailwell [Cambridge] 4.7.11 [4 Jul 1911]/*Setacera trina* ♂ TYPE [handwritten]/LECTOTYPE *Setacera trina* Collin ♂ by W. N. Mathis [handwritten, red]." The lectotype is in the University Museum, Oxford University, Oxford, England. The specimen is double mounted (minute nadel in foam block) and is in good condition, although some of the tarsomeres of the left legs are missing. The abdomen has been removed and dissected; the male terminalia are mounted in balsam on a celluloid rectangle that is pinned separately from the rest of the body.

OTHER SPECIMENS EXAMINED.—GREAT BRITAIN. *Norfolk*: Roudham Heath, 28 Sep 1947 (1♀; UMO). GERMANY. *Bayern*: Dachau (1♂; USNM).

DISTRIBUTION (Figure 70).—In addition to the localities listed for the specimens I examined,

Collin (1963) recorded this species from the following counties in Great Britain: Cambridgeshire, Devonshire, Hampshire, Herefordshire, Hertfordshire, Norfolk, Suffolk, and Surrey. Karnecká (1980) recently recorded this species from Bohemia and Moravia in Czechoslovakia. Although specimens are known only from Great Britain, Czechoslovakia, and Germany, I suspect that the species will be found to occur more widely in northern Europe. This is the northernmost species of the *trina* group.

REMARKS.—In the discussion section of the original description, Collin (1963:148) commented briefly on some, perhaps all, of the specimens of the type series. His discussion included one sentence that probably referred to a type, although it is not clear whether Collin was referring to a type in the nomenclatural sense or to a particular type of male. Collin wrote: "The drawings have been made from the type of male taken at Snailwell (Cambs.) on 4th July, 1911. . . ." I have designated a lectotype for *S. trina* to eliminate any confusion regarding the status of its supposed type.

The width of the male gonite at its base is the largest within the species group and serves to distinguish this species from closely related congeners.

The *aldrichi* Group

SPECIES INCLUDED.—*Setacera aldrichi* Cresson.

DIAGNOSIS.—Specimens of the *aldrichi* group may be distinguished by the following combination of characters: antennal foveae sparsely tomentose, subshiny, concolorous and with same luster as dorsum of interfoveal carina; arista with longest branching dorsal rays about twice arisal width at base; vertico-orbits with velvety tomentose band narrow but conspicuous, with subanterior enlargement; posthumeral bristle well developed, subequal to posterior notopleural bristle, distance between it and presutural bristle about equal to that between notopleural bristles; supraspiracular convexity evenly convex; fore- and midtibiae dark, concolorous with femora, at most with immediate tibial-femoral articulation pale; 5th tergum of male broadly truncate to slightly emarginate, length greater than either 3rd or 4th terga, apical width greater than or equal to length, anteroventral corner with narrow, long, process, curved posteriorly, truncate apically; 3rd and 4th sterna of male lacking dense patch of stout setae toward posterior margin.

Male Terminalia: Epandrium with median sulcus from cercal cavity to base of surstyli, subrectangular, dorsum subtruncate, lateral margins nearly parallel sided, slightly wider dorsally in posterior view; surstyli not fused basomedially, separation nearly equal to width of 1 surstylus at base, basal two-thirds flared laterally subapically, acutely pointed; gonite lacking pronglike processes, broadly protruding posteriorly, posterior margin irregularly sinuate, with anteroventromedial truncate projection bearing short, rounded, lateral process; aedeagus broad basally, acutely pointed posteroapically; hypandrium with 2 anterior prongs, lateral prong over twice length of median one, median prong short, both

acutely pointed, median area of hypandrium with sclerotization less well developed.

Female Terminalia: 7th tergum incomplete, with 2 lateral tergites; 8th tergites about 3 times higher than wide in lateral view, swollen and widest at midheight, dorsum and venter narrowly rounded; 8th sternites short, at most 3 times longer than wide; 9th sternites vertically oriented with 1 ventral projection horizontal, bearing larger bristles; 9th sternal bristles approximate, irregularly aligned horizontally several smaller setae dorsad of larger bristles; cercus higher than wide, with anterodorsal projection, posterior margin subtruncate to broadly rounded; female ventral receptacle with operculum wider than high, broadly rounded dorsally, extending process with cervix about as long as corpus, lateral margin sinuate, corpus curvature compressed.

DISTRIBUTION.—See species treatment, page 36.

NATURAL HISTORY.—See species treatment, page 36.

DISCUSSION.—This species group is the sister lineage of the *pacifica* species group. This relationship and the monophyly of the species group are shown in Figure 2, with accompanying character evidence.

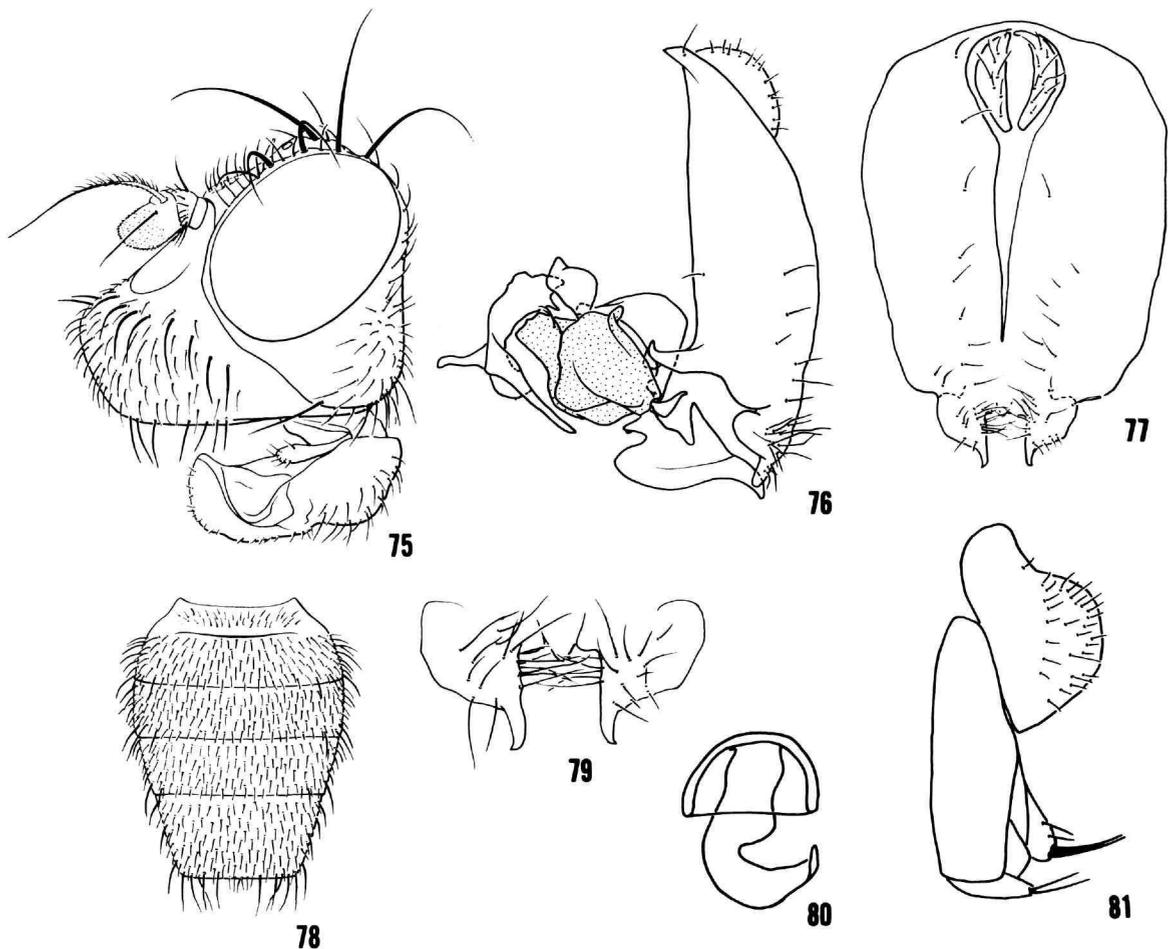
10. *Setacera aldrichi* Cresson

FIGURES 75-82

Setacera aldrichi Cresson, 1935:348.—Sturtevant and Wheeler, 1954:202, 203 [key and locality data].—Wirth and Stone, 1956:472 [key].—Wirth, 1965:754 [nearctic catalog].—Cole, 1969:402 [locality data].

DESCRIPTION.—Medium-sized to moderately large shore flies, length 3.84 to 4.92 mm; dorsum darkly olivaceous brown to mostly greenish, becoming grayer, duller ventrally.

Head (Figure 75): Head width-to-height ratio averaging 1 : 0.64; frons width-to-length ratio averaging 1 : 0.48; mesofrons and fronto-orbits deeply blue to greenish blue, dorsum of interfoveal carina more greenish blue, slightly lighter than mesofrons; shape of face sexually dimorphic,



FIGURES 75-81.—*Setacera aldrichi*: 75, head, lateral aspect; 76, male terminalia, lateral aspect; 77, same, posterior aspect; 78, abdomen, dorsal aspect; 79, surstyli, posterior aspect; 80, female ventral receptacle, lateral aspect; 81, female terminalia, lateral aspect.

dorsal surface of male longer than height of anterior surface, subexplanate, anterior facial ridge broadly rounded, antennal foveae only slightly lower than dorsum, female with dorsal surface about equal to anterior surface, not subexplanate, antennal foveae inclinate; facial angle about 110° ; anterior surface of face golden brown dorsally, becoming silvery white ventrally. Eye height-to-width ratio averaging $1 : 0.98$; eye-to-cheek ratio averaging $1 : 0.43$.

Thorax: Midtibia of male with dense patch of

short setae ventroapically; costal vein ratio averaging $1 : 0.28$; M_{1+2} vein ratio averaging $1 : 0.83$.

Abdomen (Figure 78): Male terminalia (Figures 76, 77, 79) as in species group description. Female terminalia (Figures 80, 81) as in species group description.

TYPE MATERIAL.—The male holotype is labeled "Potlatch Ida[ho] VI. 20. 07. [20 Jun 1907; J. M. Aldrich collector]/♂ TYPE No. 6515 *Setacera ALDRICHI* ♂ E. T. Creson, Jr, [red]." The holotype is in the Academy of Natural Sciences

of Philadelphia, ANSP 6515. Cresson's original description lists a female paratopotype that is also in the Academy's collection. The holotype specimen is directly pinned and is in good condition.

OTHER SPECIMENS EXAMINED.—CANADA. *British Columbia*: Clayton, 9 Aug 1917, A. L. Melander (2♂; USNM). **UNITED STATES.** *California*: Mono Co., Mammoth Lakes, 29 Jul 1940, L. C. Kuitert (1♀; SU). *Idaho*: Latah Co., Moscow, J. M. Aldrich (1♂; USNM); Moscow, Lake Merton, 2 Mar 1911, J. M. Aldrich (1♀; USNM); Potlach, 20 Jun 1907, J. M. Aldrich (1♂, 1♀; ANSP, USNM). Nez Perce Co., Lewiston, 22 Jun 1968, R. Sanders (1♂; WSU). *Oregon*: Grant Co., Seneca, 4.8 mi S, 17 Jun 1972, W. N. Mathis (5♂, 5♀; USNM). Union Co., Ladd Canyon, 14 mi S LaGrande, 4250 ft, pond, 30 Jul 1977, R. S. Zack, E. J. Davis (3♂; USNM). *Utah*: Rich Co., Garden City, 9 Aug

1967, G. F. Knowlton (1♂; USNM). *Washington*: Clallam Co., Sequim, 25 Aug 1910 (1♀; ANSP). Grant Co., O'Sullivan Dam, 4–5 Apr 1956, H. G. Davis (1♂; WSU). Whitcam Co., Steptoe Canyon, 10 mi SW Pullman, 19 Feb 1977, W. J. Turner (1♂; USNM). *Wyoming*: Lincoln Co., Kemmerer, 14 Aug 1950, A. H. Sturtevant (1♂, 1♀; USNM). Teton Co., Yellowstone Park Lake, 18 Jul 1923, A. L. Melander (1♂; ANSP).

DISTRIBUTION (Figure 82).—Western North America between 110° and 128° west longitude and 37° and 53° north latitude.

NATURAL HISTORY.—I have collected specimens of *S. aldrichi* by sweeping emergent vegetation near the shore of a small backwater area of a mountain stream. Label data accompanying borrowed specimens that I examined indicate that the species also occurs on or near lakes and ponds.

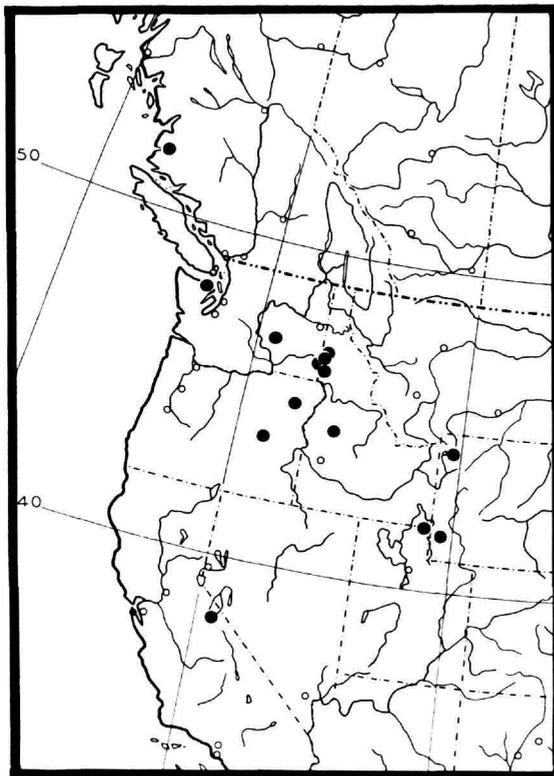


FIGURE 82.—Distribution map of *Setacera aldrichi*.

The pacifica Group

SPECIES INCLUDED.—*Setacera durani* Cresson; *S. jamesi*, new species; *S. needhami* Johannsen; *S. pacifica* (Cresson); *S. pilicornis* (Coquillett); and *S. trichoscelis*, new species.

DIAGNOSIS.—Specimens of the *pacifica* group may be distinguished by the following combination of characters: antennal foveae sparsely tomentose, subshiny, nearly concolorous with dorsum of interfoveal carina and with similar metallic luster; vertico-orbits with velvety tomentose band very narrow, inconspicuous; posthumeral bristle well developed, subequal or slightly weaker than posterior notopleural bristle, distance between it and presutural bristle slightly less than that between notopleural bristles; fore- and mid-tibiae mostly dark and concolorous with femora, at most with tibial-femoral articulation pale; 5th tergum of male longer than either 3rd or 4th, narrowly to bluntly rounded, width at apex much less than length; 3rd and 4th sterna of male usually with dense patch of stout setae toward posterior margin, secondarily reduced in some species (*S. needhami* and *S. trichoscelis*).

Male Terminalia: Epandrium subtriangular in posterior view, much narrower dorsally than ven-

trally, dorsum narrowly rounded, becoming gradually broader, truncate ventrally, lacking median sulcus (*S. pacifica* with superficial indication); cerci almost as wide as high in lateral view, with anteroposterior orientation; surstyli broadly fused basally (best seen in posterior view), usually with lateral and sometimes with median projections (shape diagnostic at species level), apically curved anteriorly in lateral view; gonite with pronglike projections, conformation and arrangement differing with species; aedeagus bluntly rounded apically; hypandrium with 1–2 projections, at least partially and usually mostly well sclerotized.

Female Terminalia: 7th tergum variable; 8th tergite comparatively short, almost as wide as high in some species, shape of dorsum in lateral view varying with species; 8th sternites elongate, 4 or more times longer than wide; 9th sternites vertically oriented, projecting posteriorly, well sclerotized, forming 2 conical projections; 9th sternal bristles borne at apex of 9th sternal projections, 2 large bristles on each, these approximate, often difficult to distinguish; female ventral receptacle with operculum as high as wide, subtrapezoidal to dome-shaped in lateral view, extending process with cervix as long as corpus, more or less parallel sided, juncture of cervix and corpus indicated on inner surface of curvature by small, lateral indentation, forming budlike projection in lateral view, curvature of corpus wide, open.

DISTRIBUTION.—New World. Except for *S. trichoscelis*, this species group is North American, mostly occurring west of the 100° meridian. An obvious exception is *S. pilicornis*, which occurs in southeastern United States and in Mexico.

NATURAL HISTORY.—Adults are generally associated with lentic aquatic systems, usually where algal mats have accumulated on the water's surface. Only the larva and puparium of *S. needhami* have been described (Johannson, 1935).

DISCUSSION.—The characterization of the *pacifica* group and the evidence to establish its monophyly was elaborated earlier (see "Phylogeny," page 6). Herein (Figure 83) I have arranged the species comprising the *pacifica* group into three

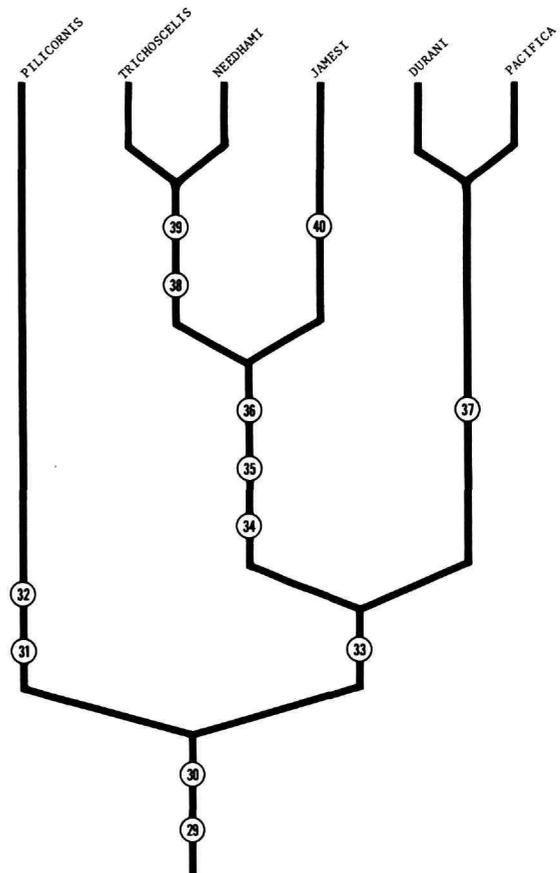


FIGURE 83.—Hypothetical phylogeny of species of the *pacifica* species group.

primary lineages: (1) the stem lineage giving rise to *S. pilicornis*, which is the sister group to the remaining species; (2) the stem sublineage giving rise to *S. trichoscelis*, *S. needhami*, and *S. jamesi*, which comprise the sister group of sublineage number three; and (3) the stem sublineage giving rise to *S. durani* and *S. pacifica*, which comprise the sister group of sublineage number two. Character evidence to establish these lineages is as follows.

Stem lineage number one is characterized, and its monophyly is established, as follows:

31. *Configuration of male terminalia:* the unique shape of the male terminalia of this species is autapotypic.

32. *Configuration of female terminalia:* see discussion of no. 31

(see figures accompanying species treatment).

The stem lineage giving rise to sublineages two and three (see discussion above), the remaining species of the *pacifica* group, is characterized, and its monophyly is established, as follows:

33. *Vestiture of forecoxa of male*: throughout the subfamily, the forecoxae are typically invested with some setulae, especially along the lateral margins. In males of this lineage, however, the setae are longer, appearing like long pile. I interpret this character to be apotypic.

The second sublineage is characterized, and its monophyly is established, as follows:

34. *Epandrium*: a median furrow is the typical and therefore the relatively plesiotypic condition. The lack of such a furrow in males of this group is apotypic.

35. *Configuration of cerci of female*: the female cerci are generally higher than wide, the plesiotypic condition. In females of this sublineage, the cerci are as wide as high, an apotypic character.

36. *Vestiture of gonite of male*: the presence of two long, posterior setae on the gonite is a feature unique to this sublineage. These setae are not present in the other lineages of the genus.

The third sublineage is characterized, and its monophyly is established, as follows:

37. *Configuration of male terminalia*: males of this group have a median projection, apparently a unique, apotypic feature.

The second sublineage is further divided into two groups. The first is characterized, and its monophyly is established, as follows:

38. *Vestiture of mid- and hind tibiae*: typically there are a few setae on the mid- and hind tibiae, but males of this sublineage have apicoventral tufts of long setae, an apotypic character.

39. *Vestiture of midfemur of male*: males of these two species have a short row of distinct setae along the venter of the midfemur. Because this is apparently a unique condition, I interpret it to be apotypic.

The second lineage of the second sublineage is characterized, and its monophyly is established, as follows:

40. *Size*: this is the largest species of the genus, apparently an apotypic character.

11. *Setacera durani* Cresson

FIGURES 84-90

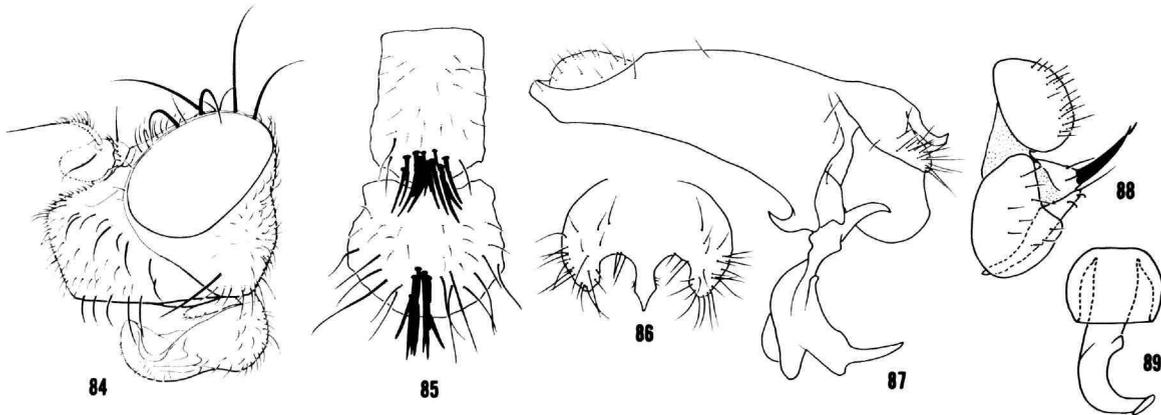
Setacera durani Cresson, 1935:348.—Sturtevant and Wheeler, 1954:202, 203 [key and locality data].—Wirth and Stone, 1956:472 [key].—Wirth, 1965:754 [nearctic catalog].—Cole, 1969:402 [locality data].

DESCRIPTION.—Medium-sized to moderately large shore flies, length 3.45 to 4.95 mm; generally mostly gray to bluish green, dark, becoming grayer and duller ventrally.

Head (Figure 84): Head width-to-height ratio averaging 1 : 0.61; frons width-to-length ratio averaging 1 : 0.48; mesofrons, fronto-orbits, and dorsum of interfoveal carina deeply greenish blue; arista with longest dorsally branching rays about twice greatest arisal width at base; dorsal surface of face explanate laterally (best seen from dorsal view), antennal fovea only slightly lower than dorsum of interfoveal carina; facial angle approximately 90°; angle formed by anterior surface and oral margin obtuse; anterior surface of face mostly silvery white, facial angle brownish to olivaceous. Eye height-to-width ratio averaging 1 : 1.1; eye-to-cheek ratio averaging 1 : 0.52.

Thorax: Supraspiracular convexity evenly convex; forecoxa of male with dense patch of long, slender setae, especially posteroventrally; midtibia of male with dense patch of short setae apicoventrally. Costal vein ratio averaging 1 : 0.27; M_{1+2} vein ratio averaging 1 : 0.79.

Abdomen: Male 5th tergal ratio averaging 1 : 0.66, anteroventral angle lacking process. Male terminalia (Figures 85-87): surstyli in posterior view with lateral margins broadly rounded, lateral projections blunted pointed, 2 U-shaped emarginations ventrally, separated by median process that is parallel sided basally, tapering apically to acutely pointed apex, this process in lateral view curved posteriorly; gonite lacking pronglike process but with acutely pointed, broadly based posterior process at about mid-height; aedeagus folded back on itself, broadly rounded apically; hypandrium with lateral margins well sclerotized becoming weaker toward median, median formed into pocket, with an



FIGURES 84-89.—*Setacera durani*: 84, head, lateral aspect; 85, 3rd and 4th sterna of male, ventral aspect; 86, surstyli, posterior aspect; 87, male terminalia, lateral aspect; 88, female terminalia, lateral aspect; 89, female ventral receptacle, lateral aspect.

anteromedial and posterolateral prong, posterolateral prong arising from broad base, thereafter slender, tapered to acutely pointed apex, anteromedial prong longer, gradually tapered from base to apex. Female terminalia (Figures 88, 89): 7th tergum complete; 8th tergites with anterior margin rounded, posterior margin shallowly emarginate, ventral margin broadly rounded, posterior portion slightly higher than anterior portion; 8th sternites elongate, 5-6 times longer than greatest width; cercus higher than wide, posterior margin evenly rounded; female ventral receptacle (Figure 89) with operculum subtrapezoidal but with rounded lateral margins, otherwise as in species group description.

TYPE MATERIAL.—The male holotype is labeled: "Los Angeles R[iver]. [Los Angeles Co.] Cal[ifornia]. Aug. 15, 1916 V. Duran, Coll/♂/TYPE No. 6516 *Setacera DURANI* E T Cresson, Jr. [name handwritten, red]." The holotype specimen is double mounted (minute nadel in cardboard base), is in excellent condition, and is in the Academy of Natural Sciences in Philadelphia, ANSP 6516. Cresson's original description listed a female paratopotype; this specimen is also in the ANSP.

OTHER SPECIMENS EXAMINED.—MEXICO. *Baja California Norte*: San Vicente, 20 Sep 1941, Ross,

Bohart (1♂; CAS); Santo Domingo, 5.7 mi E Hamilton Ranch, 22 Apr 1963, H. B. Leech, P. H. Arnaud, Jr. (4♂, 1♀; CAS, USNM); Tijuana, 60 km S, 26 Jun 1950, A. L. Melander (1♂; USNM). UNITED STATES. *Arizona*: Cochise Co., Portal, Southwestern Research Station, 5-9 Jun 1972, W. W. Wirth (1♂; USNM). Yuma Co., Alamo Canyon, 7 May 1960, C. E. Benson (1♂; KSU). *California*: Alameda Co., Oakland, 26 May 1915, M. C. Van Duzee (1♀; CAS). Contra Costa Co., Danville, 12 Jul 1951, F. X. Williams (1♂; CAS). Imperial Co., Calexico, 15 mi E, 5-6 Jun 1961, H. F. Howden (3♀; CNC). Inyo Co., Mojave Desert, Lovejoy Spring, 10 May 1944, A. L. Melander (2♂; USNM). Kern Co., Red Rock Canyon, 30 Apr 1950 (1♂, 1♀; USNM). Los Angeles Co., Los Angeles, 15 Aug 1915 (1♀; ANSP); Tulumunga Canyon, 3 May 1950, A. Wheeler (1♀; USNM). Napa Co., Moskowite Corner, 5.5 km NW Capeel Creek, P. H. Arnaud, Jr. (1♀; CAS). Riverside Co., Cathedral Canyon, 3 Apr 1945, A. L. Melander (1♀; USNM); Palm Springs, Palm Canyon, 26 Nov 1944, A. L. Melander (1♂; USNM). San Bernardino Co., Big Bear Lake, 26 Jul-14 Sep, 1932-1934, A. J. Basinger, J. D. Beamer (1♂, 1♀; CAS, USNM); Helendale, 18 May 1955, W. R. Richards (11♂, 15♀; CNC); Victorville, 20 May 1955, W. R. Richards (1♂;

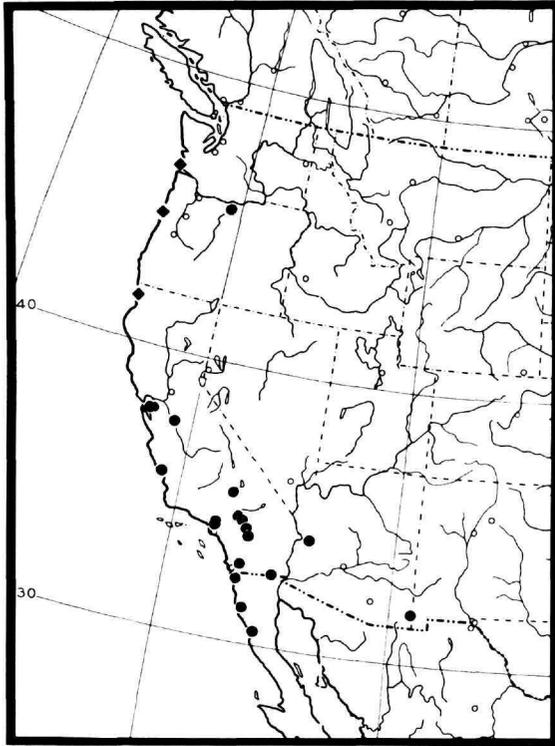


FIGURE 90.—Distribution map of *Setacera durani* (filled circles) and *S. jamesi* (diamonds).

CNC); Wrightwood, SW Victorville, 30 Apr 1950, A. H. Sturtevant (6♂; USNM). San Diego Co., Apr 1915, M. C. VanDuzee (1♀; CAS); Julian, 5 Mar 1945, A. L. Melander (1♂; USNM); San Luis Rey Campground, 28 Jun 1968, P. H. Arnaud, Jr. (1♂; CAS). San Luis Obispo Co., Harmony, 25 Sep 1938, M. Cazier (1♂, 1♀; AMNH). Stanislaus Co., Del Puerto Road, Frank Raines Park, 1 Nov 1969, T. W. Davis (7♂, 27♀; CAS). *Oregon*: Sherman Co., Moro, 10 Aug 1950, O. Sutton (1♀; USNM).

DISTRIBUTION (Figure 90).—Western North America between 108° and 122° west longitude and 30° and 46° north latitude. The known distribution of the species forms a backwards J, beginning in north central Oregon, extending southward through California and eastward across southern Arizona.

NATURAL HISTORY.—Practically nothing is known about the ecology or immatures of this species. Foote (1982) collected adults from an algal mat that had formed in a small sewage-polluted stream near Patagonia, Arizona.

REMARKS.—This species and *S. pacifica* are sister species, as evidenced by the joint possession of a median, triangular projection between the surstyli. Specimens of *S. durani* are separable externally from those of *S. pacifica* by the evenly rounded supraspiracular convexity and by the distinct tuft of setae at the apex of the midtibia.

12. *Setacera jamesi*, new species

FIGURES 90-98

DESCRIPTION.—Large shore flies, length 5.06 to 5.67 mm; generally brown to olivaceous brown or gray, becoming grayer and duller ventrally.

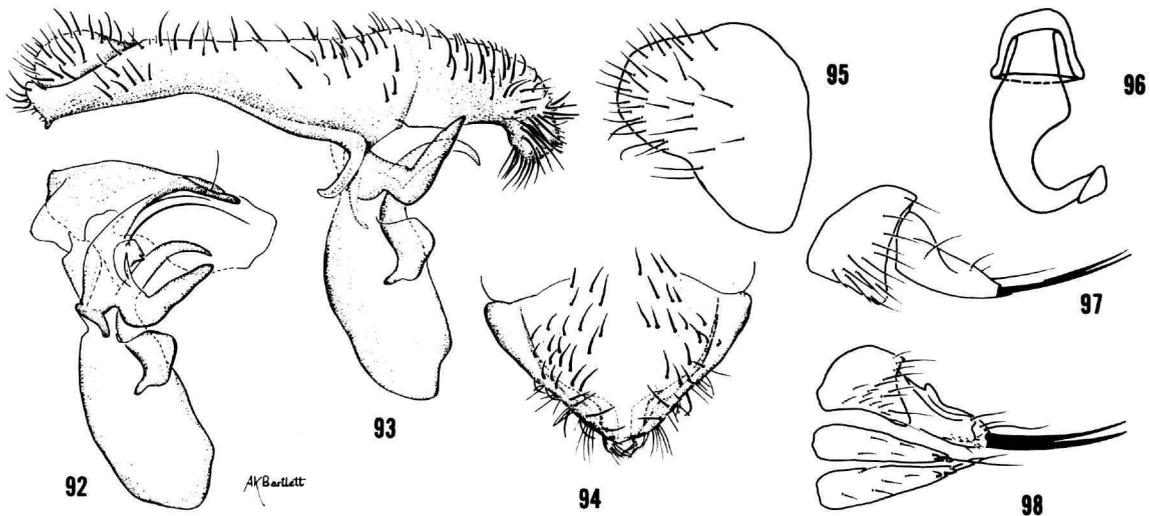


FIGURE 91.—*Setacera jamesi*, head, lateral aspect.

Head (Figure 91): Head width-to-height ratio averaging 1 : 0.67; frons width-to-length ratio averaging 1 : 0.47; mesofrons and fronto-orbits deeply blue to slightly greenish blue; dorsum of interfoveal carina mostly greenish to slightly bluish green; arista with longest dorsally branching rays short, at most slightly longer than aristal width at base; dorsal surface of face broadly explanate (best seen in dorsal view), dorsum of interfoveal carina and antennal foveae almost on same horizontal plane; dorsal surface of face shorter than anterior surface; facial angle at about 90°; angle formed by anterior surface and oral margin obtuse in lateral view, anterior surface receding to oral margin; eye height-to-width ratio averaging 1 : 1.14; eye-to-cheek ratio averaging 1 : 0.57.

Thorax: Supraspiracular convexity evenly convex; forecoxa of male with longer, more numerous setae anteromedially and posteriorly, to a lesser extent on midcoxa; midtibia of male with dense patch of slightly longer setae posteroapically; costal vein ratio averaging 1 : 0.26; M_{1+2} vein ratio averaging 1 : 0.88.

Abdomen: Male 5th tergal ratio averaging 1 : 0.89; 5th tergum of male lacking anteroventral projection. Male terminalia (Figures 92–94): surstyli in posterior view (Figure 94) subtriangular, broadly fused basally lateral margins narrowing to ventral apex at right angles to each other, lacking distinct lateral projections, bluntly rounded and curved anteriorly in lateral view; gonite with ventrolateral prong, curved medially, acutely pointed, 2 long, posterior setae (longer than gonal prong), broadly attached to aedeagus dorsally; aedeagus folded back on itself, broadly rounded apically; hypandrium pocket shaped, lateral margin overlaid, with 2 medial, cruciate, well sclerotized prongs. Female terminalia (Figures 95–98): 7th tergum complete; 8th sternite subtriangular, anterior margin rounded, posterior margin shallowly concave, posteroventral corner slightly projecting; only slightly higher than wide; 8th sternites about 4 times longer than wide; 9th sternites almost twice as long as high; cercus higher than long, with subquadrate posterodorsal projection; female ventral receptacle (Figure 96)



FIGURES 92–98.—*Setacera jamesi*: 92, internal male genitalia, lateral aspect; 93, male terminalia, lateral aspect; 94, surstyli, posterior aspect; 95, cerci of female terminalia, lateral aspect; 96, female ventral receptacle, lateral aspect; 97, female 8th tergite and 9th sternite, lateral aspect; 98, female 8th tergite, sternites, and 9th sternite, ventral aspect.

with lateral margin of operculum slightly flared ventrally, cervix comparatively shorter than other species, lacking distinct indentation at juncture of cervix with corpus.

TYPE MATERIAL.—The male holotype is labeled: "Orick [Humboldt Co.] CAL[ifornia] 18 Sep. [19]34 ALMelander/HOLOTYPE *Setacera jamesi* Mathis [handwritten, red]." Allotype female and one male paratype are labeled with the same label data as the holotype. Other paratypes are as follows. *Oregon*: Lincoln Co., Boiler Bay, 9 Mar 1930, J. Wilcox (1♀; USNM). *Washington*: Pacific Co., Ocean Park, 18 Aug 1950, M. T. James (3♂, 2♀; USNM, WSU). The holotype specimen is in excellent condition (directly pinned) and is in the National Museum of Natural History, Smithsonian Institution, USNM 76885.

DISTRIBUTION (Figure 90).—Coast of western North America between 41° and 48° north latitude.

NATURAL HISTORY.—The immatures and ecology of the species are presently unknown. The apparent association of this species with coastal aquatic systems may indicate a tolerance toward salty environs and, perhaps, a preference for it.

ETYMOLOGY.—The specific epithet *jamesi* hon-

ors Dr. M. T. James, Washington State University, for his continuing contribution to dipterology.

REMARKS.—The sister group of *S. jamesi* comprises *S. needhami* and *S. trichoscelis*, as indicated earlier (see "Discussion," page 37). Externally, specimens of *S. jamesi* are separable from either of its closely related congeners by its larger size, shorter arisal rays, and more normally shaped female cerci. The male terminalia are also distinctive.

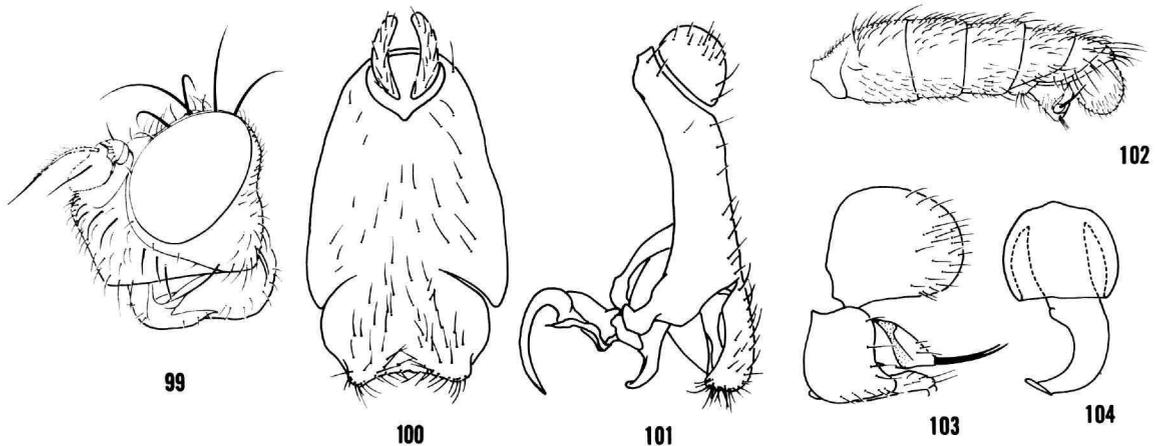
13. *Setacera needhami* Johannsen

FIGURES 99–108

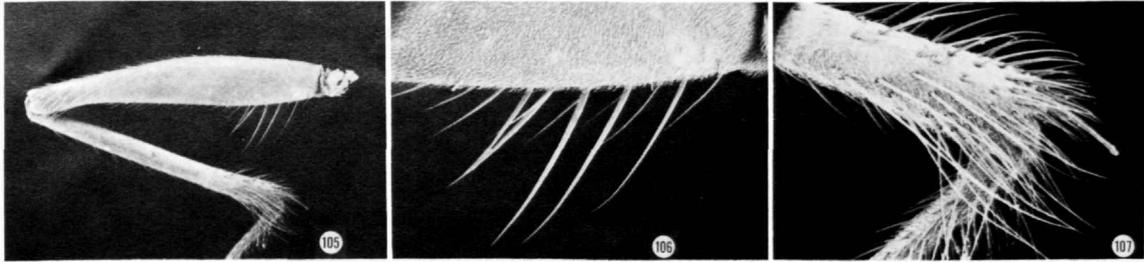
Setacera needhami Johannsen, 1935:53.—Cresson, 1935:347 [description of adult].—Sturtevant and Wheeler, 1954:202, 203 [key and locality data].—Wirth and Stone, 1956:472 [key].—Wirth, 1965:755 [nearctic catalog].—Cole, 1969:402 [locality data].

DESCRIPTION.—Moderately small to moderately large shore flies, length 2.98 to 4.54 mm; dorsum generally dark, brown, olivaceous green to grayish green, becoming more subdued, lighter, grayer ventrally.

Head (Figure 99): Head width-to-height ratio



FIGURES 99–104.—*Setacera needhami*: 99, head, lateral aspect; 100, male terminalia, posterior aspect; 101, same, lateral aspect; 102, abdomen of female, lateral aspect; 103, female terminalia, lateral aspect; 104, female ventral receptacle, lateral aspect.



FIGURES 105–107.—*Setacera needhami*: 105, left midfemur and midtibia, posterior aspect; 106, left midfemur, posterior aspect; 107, apex of left midtibia, posterior aspect.

averaging 1 : 0.69; mesofrons and fronto-orbits deeply dark blue to greenish blue, dorsum of interfoveal carina mostly greenish; frons width-to-length ratio averaging 1 : 0.59; arista with longest branching rays nearly twice greatest arista width; dorsal surface of face with antennal fovea inclined at distinctly lower level than dorsum of interfoveal carina; dorsal surface of face shorter than anterior surface in profile; facial angle moderately angulate, about 110°; angle formed by anterior surface and oral margin obtuse, anterior surface receding. Eye height-to-width ratio averaging 1 : 1.02; eye-to-cheek ratio averaging 1 : 0.37.

Thorax: Supraspiracular convexity evenly convex; fore- and midcoxae of male normal; midfemur of male (Figures 105, 106) with 4–5 long, well-developed setae ventrally toward base; midtibia of male (Figures 105, 107) with large, dense patch of long setae anteroventrally to ventrally; hind tibia of male with small patch of long setae anteroventrally; costal vein ratio averaging 1 : 0.28; M_{1+2} vein ratio averaging 1 : 0.84.

Abdomen: Male 5th tergal ratio averaging 1 : 0.62; 5th tergum of male lacking anteroventral process. Male terminalia (Figures 100, 101): surstyli broadly based in posterior view, lateral margins rounded to just before apex, thereafter more or less parallel sided, short, apex wide and shallowly emarginate, lateral projections very shallow; gonite with slender dorsal and ventral prongs, both curved medially, with 2 long posteriorly directed setae inserted at about midheight

in lateral view; aedeagus folded back on itself; hypandrium very poorly sclerotized medially, laterally and posteriorly well sclerotized, with 2 long, well-developed anteromedial prongs, tapered to acutely pointed apex. Female terminalia (Figures 102–104): 7th tergum complete; 8th tergites more or less subquadrate in lateral view, dorsum shallowly sinuate, posterior margin concave, posteroventral corner more projected, nearly as high as wide; 8th sternites elongate, 5–6 times longer than width; cercus wider than high in lateral view, posterior margin shallowly rounded; female ventral receptacle (Figure 104) with dorsum of operculum bearing shallow, median bump, lateral margins rounded, otherwise as in species group description.

TYPE MATERIAL.—The male lectotype, herein designated, is labeled: “Laguna Canyon Orange Co. Cal[ifornia]. [handwritten]/Shore of Pond J. G. Needham Sept. 1922 [handwritten]/TYPE No. 6574 *Setacera* NEEDHAMI ♂ E T Cresson, Jr. [red]/LECTOTYPE *Setacera needhami* Johannsen by W. N. Mathis [handwritten, red].” The lectotype is in the Academy of Natural Sciences of Philadelphia, Pennsylvania. The specimen is double mounted (glued to a paper point) and is in good condition, although the right front leg and the apical tarsomeres of the middle left leg are missing.

OTHER SPECIMENS EXAMINED.—UNITED STATES. *Arizona*: Yuma Co., Horsetank, 2 Dec 1962, E. I. Schlinger (1♀; UCR). *California*: Alameda Co., Berkeley, 4 Oct 1947, W. W. Wirth (2♂, 2♀;

USNM); Jewell Lake, 4 Oct 1947, W. W. Wirth (2♂, 5♀; USNM). Colusa Co., Maxwell, 12 Aug 1954, A. A. Grigarick (1♂, 1♀; USNM). Contra Costa Co., Jewell Lake, 4 Oct 1947, W. W. Wirth (3♂, 1♀; USNM). Humboldt Co., Trinidad, 18 Sep 1934, A. L. Melander (1♂; USNM). Inyo Co., Independence, 13 mi NE, 10 Mar 1964, J. D. Birchim (1♂; CAS). Kern Co., Poso Creek, 18 Jun 1947, B. Brookman (1♀; USNM). Riverside Co., Temecula, 25 May 1965, T. W. Fisher (1♀; UCR). Orange Co., Laguna Beach, J. G. Needham (2 larvae, 1 puparium; CU); Laguna Canyon, J. G. Needham (3♀; ANSP). Sacramento Co., Sacramento, 8 Jun–24 Sep, 1920–1933, H. H. Keifer, C. M. Packard (6♂, 9♀; USNM); Citrus Heights, 11–15 Jun 1967, Keuter (2♀; CAS). San Bernardino Co., Wrightwood, 30 Apr 1950 (5♂, 4♀; USNM). San Diego Co., San Diego, 12–13 May 1916, H. G. Dyar (2♂; ANSP, USNM). Shasta Co., Redding, 7 Nov 1970, T. R. Haig (1♀; USNM). Tehama Co., Corning, 1/2 mi S, 23 Sep 1973, W. N. Mathis (1♂, 1♀; USNM). Yolo Co., Davis, 30 Jan–21 Oct, 1932–1966, J. S. Buckett, A. A. Grigarick, M. E. Irwin, W. H. Lange, H. R. Moffitt, E. I. Schlinger (4♂, 7♀; USNM). *Nevada*: Washoe Co., Pyramid Lake, 24 Jun 1927, E. P. Van Duzee (1♂; CAS). *Oregon*: Benton Co., Corvallis, 29 Mar–20 Jun, 1960–1972, J. Capizzi, W. N. Mathis (2♂; USNM); Corvallis, 12 mi S, 12 Sept 1972, W. N. Mathis (1♂, 2♀; USNM); Oak Creek Lab, 9 Sep 1972, W. N. Mathis (1♂; WNM); Willamette River, 12 Oct 1971, W. N. Mathis (2♂, 2♀; USNM). Linn Co., Peoria, 2 mi S, 24 Oct 1971, W. N. Mathis (1♂, 1♀; KSU, USNM). Polk Co., Corvallis, 14 mi N, 24 May 1972, W. N. Mathis (2♀; USNM). Umatilla Co., Cold Springs, 11 Apr 1954, J. J. Davis, M. T. James (1♀; USNM). *Utah*: Davis Co., Farmington, 13 Feb 1934, W. L. Thomas (1♂; ANSP). Weber Co., Hooper, 20 Oct 1933, T. A. Rowe (1♀; ANSP). *Washington*: Franklin Co., Kahlotus Lake, 11 May 1951, J. J. Davis (1♀, 1 puparium; USNM). Grant Co., Soda Lake near O'Sullivan Dam, Columbia Wildlife Refuge, 19 Mar 1977, R. S. Zack (24♂, 11♀; USNM, WSU). Pacific Co., Ocean Park, 18 Aug 1950, M. T. James (1♂;

WSU). Whitman Co., Almota, 23 Mar 1977, R. S. Zack (1♂; USNM).

ZOOGEOGRAPHIC DISTRIBUTION (Figure 108).—Western North America between 111° and 125° west longitude and 32° and 48° north latitude.

NATURAL HISTORY.—I have collected adults of this species at numerous localities in association with lentic aquatic systems. Presumably the immature stages also occur in these habitats.

REMARKS.—The authorship of *S. needhami* is properly credited to O. A. Johannsen (1935) (Cresson, 1935:347; Wirth, 1965:755), who published a brief diagnosis of the larva and puparium of this species. Johannsen's diagnosis, however, was published without the intention of it being a new species description, and Cresson's (1935) belated description of the adult was not published until nine months later. The publication of Johannsen's description of the immature stages before Cresson's treatment of the adult is unfortunate and has resulted in the ambiguous usage of

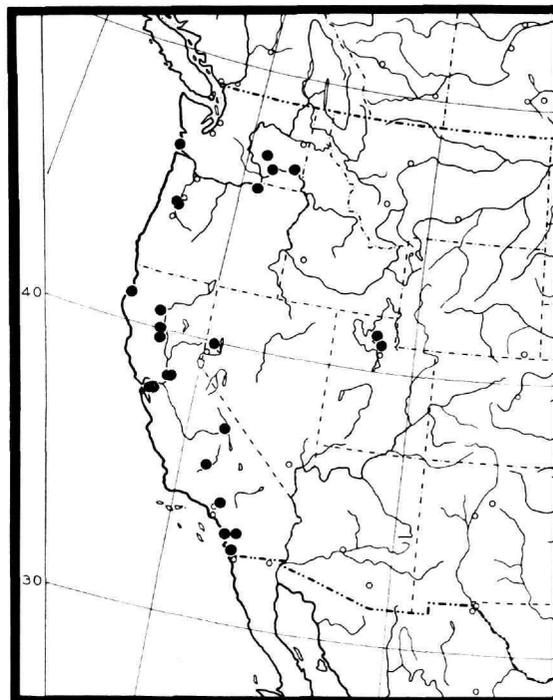


FIGURE 108.—Distribution map of *Setacera needhami*.

this name today. Until now, the status of Johannsen's species was unsatisfactory, being based on the immature stages that are still not recognizable. Indeed, larvae and puparia of *Ephydra* and *Setacera* are still not always separable at the generic level.

If the range of *S. needhami* (based on adults) were isolated, there would be no problem. This, however, is not the case. In southern California, the range of a second species, *S. durani*, is broadly sympatric with that of *S. needhami*, and the possibility exists of finding immatures of both species at the same locality, hence the potential confusion. To promote stability and to avoid the possibility of further confusion, I have herein designated an adult male specimen collected by Needham as the lectotype. The adult male of *S. needhami* is easily recognized, making application of the specific name unambiguous.

According to the current rules of zoological nomenclature (ICZN, 1964), a lectotype is to be designated from one of the syntypes, the latter being defined as "all the specimens of the type-series . . ." when no holotype has been designated (art. 73c, ICZN). The rules also define a "type-series" as "all the specimens on which its author bases the species, except any that he refers to as variants, or doubtfully associates with the nominal species, or expressly excludes from it" (art. 72B, ICZN).

My reasoning for considering adult specimens as part of the type series is as follows. Because Johannsen's diagnosis of *S. needhami* was not intended as a new species description, the content and format of his description were incomplete. Johannsen did not designate a holotype, nor did he clearly state which specimens were included in the type series; however, he specifically stated: "Some specimens of adults, in not very good condition, were determined as *Setacera needhami* by E. T. Cresson (Jr.). They were reared from larvae and puparia collected by Dr. J. G. Needham at Laguna Beach, California [the same larvae and puparia Johannsen then described]." The adult specimens are the imagoes of the same individuals that Johannsen described as larvae and puparia

(Johannsen had the exuviae) and are part of the type series by direct association. In addition, Johannsen made no statement that would exclude the adult specimens; to the contrary, he expressly associated them as "reared from larvae and puparia . . ." Moreover, as stated by Johannsen (cited previously), adult specimens, not the immatures, were sent to Cresson for identification. As the describer, Johannsen clearly based his concept of *S. needhami* on these adults, which by definition became part of the type series from which the lectotype was selected.

This species and *S. trichoscelis* are sister species but are separable by rather subtle characters of the male terminalia and by allopatry. As the characters of the male terminalia are consistent within the sampling I examined, I have recognized the appropriate populations as distinct species. No intermediates are known.

14. *Setacera pacifica* (Cresson)

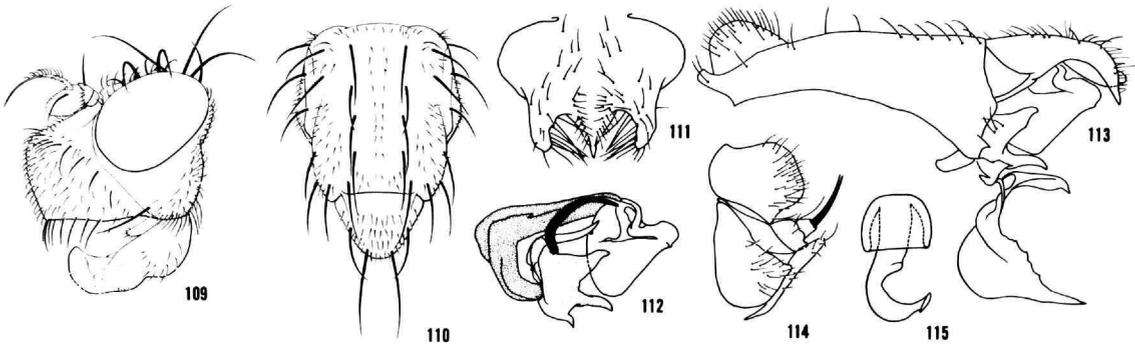
FIGURES 109-125

Ephydra pacifica Cresson, 1925:167.

Setacera pacifica.—Cresson, 1930:116.—Sturtevant and Wheeler, 1954:202, 203 [key and locality data].—Wirth and Stone, 1956:472 [key].—Wirth, 1965:755 [nearctic catalog].—Cole, 1969:402 [locality data].

DESCRIPTION.—Moderately large to large shore flies, length 4.09 to 5.12 mm; dorsum generally green to olivaceous brown, becoming grayish green to green ventrally, duller.

Head (Figures 109, 116-118): Head width-to-height ratio averaging 1 : 0.66; frons width-to-length ratio averaging 1 : 0.49; mesofrons, fronto-orbits, and at least posterior portion of dorsum of interfoveal carina deeply bluish to greenish blue, anterior portion of interfoveal carina sometimes more greenish; arista with longest dorsally branching rays nearly twice arista width at base; dorsal surface of face moderately explanate, antennal foveae only slightly lower and inclined than dorsum of interfoveal carina, nearly horizontal; dorsal surface of face shorter than anterior surface, facial angle about 95°; angle formed by



FIGURES 109-115.—*Setacera pacifica*: 109, head, lateral aspect; 110, thorax, dorsal aspect; 111, surstyli, posterior aspect; 112, internal male genitalia, lateral aspect; 113, male terminalia, lateral aspect; 114, female terminalia, lateral aspect; 115, female ventral receptacle, lateral aspect.

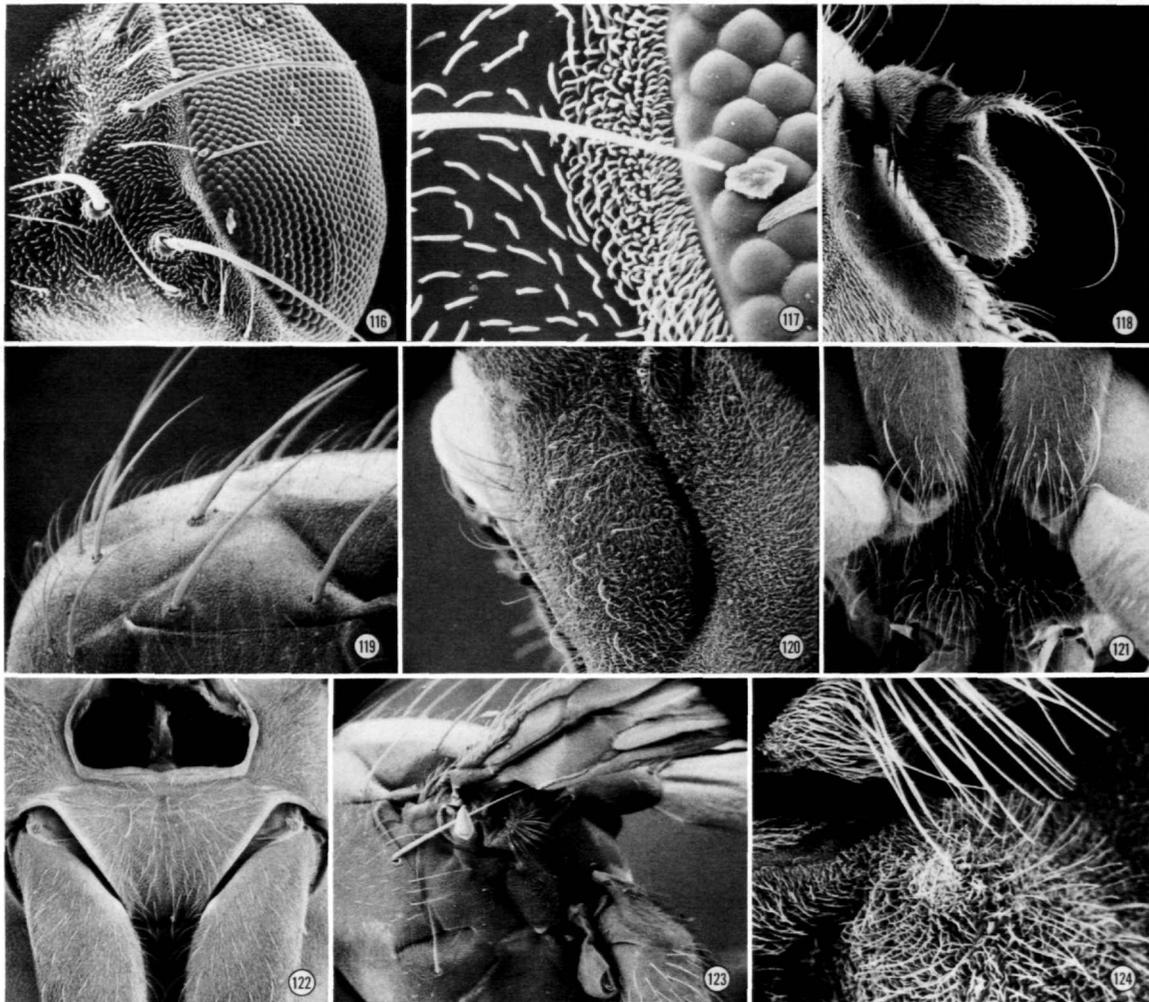
anterior surface and oral margin; eye height-to-width ratio averaging, 1 : 0.98; eye-to-cheek ratio averaging 1 : 0.44.

Thorax (Figures 110, 119-124): Supraspiracular convexity with papilla-like, lateral projection toward anterodorsal portion (Figures 123, 124); fore- and midcoxae of male (Figure 121) with dense patches of long setae, especially ventrally and posteroventrally; front basitarsus of male with long, fine, pale setae ventrally; mid- and hind tibiae of male with slightly more dense patch of setae apicoventrally; costal vein ratio averaging 1 : 0.28; M_{1+2} vein ratio averaging 1 : 0.83.

Abdomen: Male 5th tergal ratio averaging 1 : 0.81; 5th tergum of male lacking an anteroventral projection. Male terminalia (Figures 111-113): epandrium with shallow, median furrow; surstyli, in posterior view, with base rounded laterally, projecting processes narrow, tapered to acutely pointed apices, each process curved anteriorly in lateral view, median projection triangular, wider at base than more lateral processes, median projection, in lateral view, situated anterior of processes and slightly curved posteriorly; gonite with 3 posteriorly projecting prongs, dorsomedial pair more heavily sclerotized, apex slightly curved dorsally, median and ventral pairs along same lateral plane, median prong wider

and shorter, more or less straight, ventral prong narrow and generally curved ventrally; aedeagus folded back on itself, rounded apically; hypandrium more or less evenly sclerotized, prongs and extreme lateral margins more heavily sclerotized, median plate area very shallow, with 2 prongs, posteromedian pair oriented medially, subapically more abruptly tapered, curved, clawlike, anterolateral prong evenly tapered, mostly straight. Female terminalia (Figures 114, 115): 7th tergum incomplete, formed by 2 lateral tergites; 8th tergites higher than wide in lateral view, dorsum pointed, venter rounded, anterior margin more or less straight, posterior margin straight to very shallowly concave; 8th sternites over 6 times longer than wide; cercus as wide or wider than high, roughly subquadrate, posterior margin broadly rounded to subtruncate; female ventral receptacle (Figure 115) with operculum mostly rounded dorsally and laterally, otherwise as in species group description.

TYPE MATERIAL.—The male holotype is labeled: "Vancouver 5 IV[Apr]'[19]02 B[ritish] C[olumbia] R. J. Crew/♂/TYPE No. 6344 Ephydra PACIFICA ♂ E. T. Cresson, Jr. [red]." The holotype is in the Academy of Natural Sciences of Philadelphia, ANSP 6344. The specimen is pinned directly and is in good condition, although



FIGURES 116-124.—*Setacera pacifica*: 116, right vertex and vertico-orbits of head, dorsal aspect; 117, right vertico-orbit showing velvety tomentosity, dorsal aspect; 118, right antenna, lateral aspect; 119, notopleuron and surrounding area of thorax, lateral aspect; 120, propleuron, lateral aspect; 121, fore- and midcoxae, anterior aspect; 122, prosternum anterior aspect; 123, posterior portion of thorax, lateral aspect; 124, supraspiracular convexity with papilla, lateral aspect.

all tarsomeres except for the basitarsus of the right midleg are missing.

OTHER SPECIMENS EXAMINED.—CANADA. *British Columbia*: Oliver, 12 Aug 1953, 1000 ft, D. F. Hardwick (1♂, 1♀; CNC); Oliver, McIntyre Creek, 6 Jun 1959, R. E. Leech (1♂; CNC); Oliver, White Lake, 28 May 1959, L. A. Kelton

(2♂; CNC); Vancouver Island, Cowichan Island, 12 Jul 1924, A. L. Melander (1♂, 1♀; USNM); Vernon, 31 Aug 1937, H. Leech (2♀; CNC). *Manitoba*: Aweme, 4 Oct 1923, N. Criddle (1♀; CNC); Whitewater Lake, 4 mi N Whitewater, 30 Jul 1958, R. L. Hurley (1♂; CNC). UNITED STATES. *California*: Lassen Co., Susanville, 41 mi NW, 17

Jun 1974 (1♀; USNM). San Bernardino Co., Barton Flat, S Fork Camp, 31 Aug–3 Sep 1944, A. L. Melander (2♂, 2♀; USNM), Big Bear Lake, 24 May–26 Jul, 1932–1966, R. H. Beamer, A. L. Melander, R. E. Orth (3♂, 3♀; KU, UCR, USNM), Upper Santa Ana River, 7–11 Oct 1946, J. L. Sperry (4♂, 1♀; USNM). Tehama Co., Battle Creek Campground, S fork, 12 Aug 1977, P. H. Arnaud, Jr. (1♂; CAS). *Colorado*: Jefferson Co., Foxton, 18 Oct 1881 (1♀; ANSP). Larimer Co., Fort Collins, 23 May–21 Aug, 1926–1941, R. H. Beamer, M. T. James (1♂, 1♀; KU, USNM). *Iowa*: Story Co., Ames, Izaak Walton League Lake, 23 Apr 1962, D. L. Deonier (1♂; DLD). *Michigan*: Kalamazoo Co., Gull Lake Biological Station, 22 Jul 1963, R. L. Fischer (1♂; USNM). *Montana*: Lake Co., Ronan, 3 mi S, 30 Jun–17 Aug 1971, B. A. Foote (6♂, 14♀; KSU, USNM), Ronan, 3.2 mi S, 8 Aug 1972, W. N. Mathis (1♂; USNM), Ronan, 5 mi S, 1–20 Jul 1973, B. A. Foote (7♂, 5♀; KSU). Sheridan Co., Medicine Lake, 9 Jun 1969, W. W. Wirth (1♀; USNM). *Nebraska*: Cherry Co., Big Alkali Lake, 2 Jun 1969, W. W. Wirth (2♀; USNM). *New Mexico*: Catron Co., Glenwood, 1 Jun 1972, W. W. Wirth (1♀; USNM). Dona Ana Co., Las Cruces, 14 Jun 1917, J. M. Aldrich (1♂; USNM). Hidalgo Co., Cienega Lake, 15 mi N Rodeo, 30 Jul 1965, H. B. Leech (1♂; USNM). *North Dakota*: Burleigh Co., Long Lake, 4 Jun 1969, W. W. Wirth (1♂; USNM). *Oregon*: Harney Co., Burns, 20 Jul 1962, K. Goeden (2♂, 2♀; USNM), Crane Hot Springs, 8 Mar–24 May 1975, W. N. Mathis (1♂, 1♀; USNM), Harney Lake, south shore, 16 Jun 1972, W. N. Mathis (2♀; USNM). Klamath Co., Klamath Falls, 31 May 1964, J. Schuh (2♂; WSU). Lake Co., Ana Reservoir, 24 Sep 1971, W. N. Mathis (1♂; USNM), Summer Lake, 4.8 mi N, 11 Jul 1974, W. N. Mathis (3♂, 3♀; USNM). *South Dakota*: Mellette Co., Little White River, 4 Jun 1969, W. W. Wirth (1♂; USNM). *Utah*: Piute Co., Kingston, 3 Jul 1938, G. F. Knowlton (1♂, 1♀; ANSP). Utah Co., Goshen Pond, 1 Feb–27 Apr, 1968–1969, W. N. Mathis (17♂, 7♀; USNM). *Washington*: Benton Co., Prosser, Irrigation Experiment Station, 17 Aug 1957, W. Cone (1♀; WSU).

Grant Co., Soda Lake near O'Sullivan Dam, Columbia Wildlife Refuge, 19 Mar 1977, R. Zack (2♂, 2♀; USNM, WSU); O'Sullivan Dam, 4–5 May 1956, H. G. Davis (1♂, 1♀; WSU). San Juan Co., Olga, 26 Jul 1909 (1♀; ANSP). Whitman Co., Almota, 3 Mar 1977, W. J. Turner (1♀; WSU), Pullman, 25 Mar–11 Sep, 1971–1976, W. J. Turner, R. S. Zack (1♂, 1♀; WSU). *Wyoming*: Bighorn Co., Shell Creek, S Shell Canyon, 24 Jun 1964, H. B. Leech (1♀; CAS).

DISTRIBUTION (Figure 125).—North America, primarily in the West, between 85° and 124° west longitude and 31° to 51° north latitude. This species is the most widespread of the *pacifica* group.

NATURAL HISTORY.—Like most species of this species group, specimens of *S. pacifica* occur mostly in association with lentic aquatic systems but with one major difference—there appears to be a preference toward alkaline water (Foote, 1982). I have also collected several adults from algal mats on the surface of the pooled effluent of thermal springs in Oregon (Crane Hot Spring) and Utah (Goshen Ponds).

Foote's (1982) study of *S. atrovirens* has extensive notes on *S. pacifica*. Like the former species, a generation can be completed in 25 to 30 days during the warm season, with divisions among stadia as follows:

Egg incubation	2.3 days
Larval period (3 instars)	10 days
Pupal period	7 days
Adult preoviposition period	6–9 days

Foote studied this species at highly alkaline ponds near Ninepipes Wildlife Refuge, south of Ronan, Montana. The ponds had large quantities of carbonate and bicarbonate ions, and the pH averaged above nine.

Both eggs and larvae were abundant in floating algal mats comprised mostly of *Anabaena* and *Oscillatoria*. Larvae were also found in a mat of primarily *Rhizoclonium*, a filamentous green alga, the diatom genera *Navicula* and *Synedra*, and the desmid genera *Closterium*, *Cosmarium*, and *Staurastrum*. Cells of *Cosmarium*, among others, were found in the gut of 2nd- and 3rd-instar larvae.

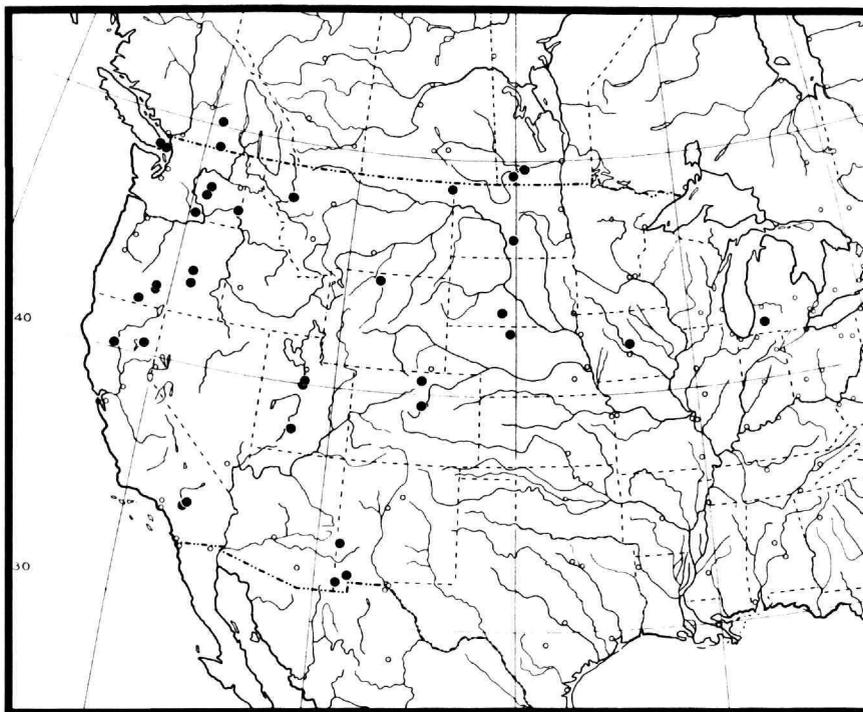


FIGURE 125.—Distribution map of *Setacera pacifica*.

As in *S. atrovirens*, the puparia of *S. pacifica* are attached by their hindmost prolegs to pieces of aquatic macrophytes and occasionally to filaments of algae. Also like *S. atrovirens*, the puparial attachment was frequently below the water's surface, as much as 10 cm.

REMARKS.—Together with *S. durani*, this species is the sister lineage of the group comprising *S. jamesi*, *S. needhami*, and *S. trichoscelis*. Specimens of *S. pacifica* are separable from those of closely related congeners by the papilla-like projection of the supraspiracular convexity, the setation of the arista and legs, and by the conformation and position of the male terminalia.

15. *Setacera pilicornis* (Coquillett)

FIGURES 126–133

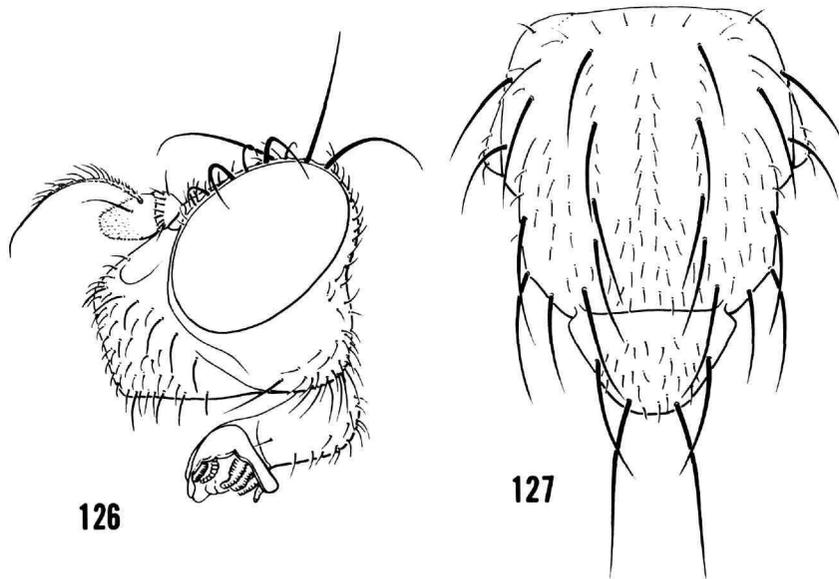
Ephydra pilicornis Coquillett, 1902:184.

Setacera pilicornis.—Sturtevant and Wheeler, 1954:202, 204

[key, locality data, and discussion of synonymy].—Wirth, 1965:755 [nearctic catalog]; 1968:24 [neotropical catalog]. *Setacera knabi* Cresson, 1935:346 [synonymy by Sturtevant and Wheeler, 1954:204].

DESCRIPTION.—Medium-sized to moderately large shore flies, length 3.34 to 4.05 mm; dorsum mostly grayish green to blue with some brownish coloration, becoming more subdued, grayer ventrally.

Head (Figure 126): Head width-to-height ratio averaging 1 : 0.57; frons width-to-length ratio averaging 1 : 0.54; mesofrons and fronto-orbits deeply greenish blue to mostly green, dorsum of interfoveal carina usually more lightly colored, mostly greenish; arista with longest dorsally branching rays nearly twice aristal width at base; dorsal surface of face with antennal foveae distinctly inclined from dorsum of interfoveal carina, not subexplanate; dorsal surface in profile shorter than anterior surface; facial angle about 115°;



FIGURES 126, 127.—*Setacera pilicornis*: 126, head, lateral aspect; 127, thorax, dorsal aspect.

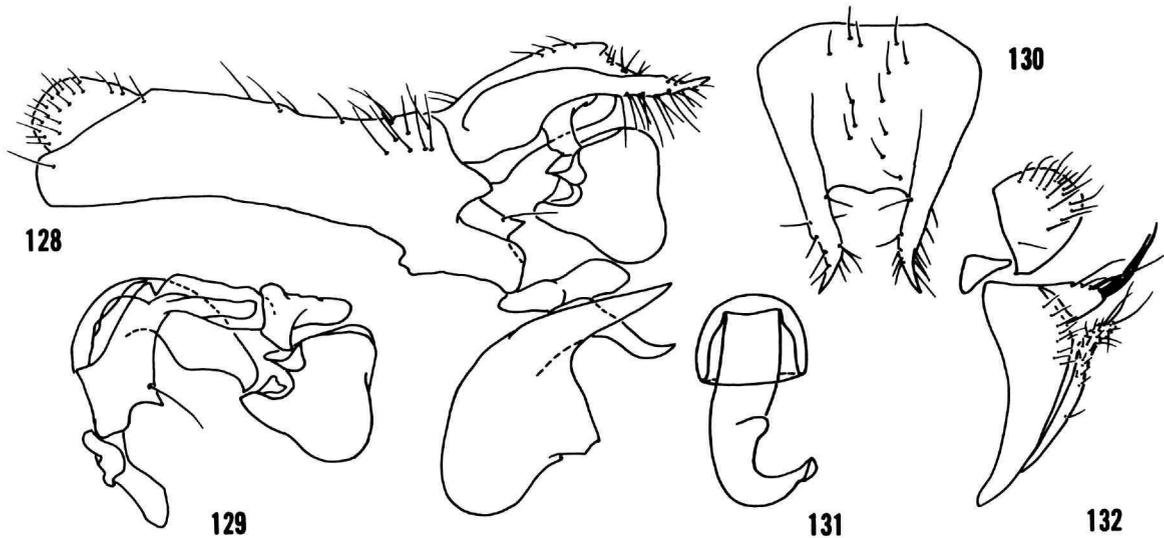
angle formed by anterior surface of face and oral margin obtuse; anterior surface of face with dorsal ridge usually golden brown, thereafter becoming silvery white ventrally. Eye height-to-width ratio averaging 1 : 1.1; eye-to-cheek ratio averaging 1 : 0.34.

Thorax (Figure 127): Posthumeral bristle weak, at most slightly stronger than largest humeral bristle; supraspiracular convexity evenly convex; coxae and legs of male lacking conspicuous tufts or dense patches of longer setae; costal vein ratio averaging 1 : 0.23; M_{1+2} vein ratio averaging 1 : 0.81.

Abdomen: Male 5th tergal ratio averaging 1 : 0.69; 5th tergum of male lacking anteroventral projection. Male terminalia (Figures 128–130): epandrium broadly rounded dorsally; surstyli in posterior view with lateral margin tapering gradually, straight, to apex of projecting arms, each arm curved laterally apically, no median process toward venter, with 1 long posterior seta; aedeagus usually folded back on itself, rounded apically; hypandrium well sclerotized laterally, weak medially, with 2 posterior prongs, lateral pair

acutely pointed, wider at base, tapered more steeply, median prong more slender, curved posteriorly, more parallel sided. Female terminalia (Figures 131, 132): 7th tergum complete; 8th narrow, tapered ventrally, widest subdorsally, anterior margin shallowly concave, posterior margin rounded; 8th sternites elongate, over 6 times longer than wide; cercus in lateral view wider than high, posterior margin broadly rounded, with distinct, separate sclerite between cercus and 8th tergite; female ventral receptacle (Figure 131) with operculum rounded dorsally and laterally, otherwise as in species group description.

TYPE MATERIAL.—The male holotype of senior synonym is labeled: “BISC [anye]. BAY, FL[orida]A.[Mrs. Annie T.] Slosson Collector/Type No 6645 U.S.N.M. [red].” The specimen is double mounted (glued to a paper point) and is in good condition. The male holotype of the junior synonym is labeled: “Miami, 23. II. 12 [23 Feb 1912] FL[orida]a/Fredk Knab Collector/ δ /TYPE No. *Setacera* KNAB δ E. T. Cresson, Jr, [pink]/Type No 51098 USNM [red].” This specimen is double mounted (glued to a paper point)



FIGURES 128–132.—*Setacera pilicornis*: 128, male terminalia, lateral aspect; 129, internal male genitalia, lateral aspect; 130, surstyli, posterior aspect; 131, female ventral receptacle, lateral aspect; 132, female terminalia, lateral aspect.

and is in good condition. Both holotypes are in the National Museum of Natural History, Smithsonian Institution.

OTHER SPECIMENS EXAMINED.—MEXICO. *Tabasco*: Villahermosa, 6 Aug 1964, P. J. Spangler (3♂, 5♀; USNM). UNITED STATES. *Florida*: Alachua Co., Austin Lary Forest, 5 Jul 1969, L. A. Hetrach (1♂; USNM); Gainesville, 29 Apr–11 Dec, 1958–1972, H. R. Dodge, R. P. Esser, F. W. Mead, J. W. Perry (7♂, 10♀; USNM). Broward Co., Fort Lauderdale, 19 Dec 1960, G. F. Spencer (7♂, 4♀; USNM). Charlotte Co., Punta Gorda, 12 Apr 1952, J. R. Vockeroth (1♀; CNC). Dade Co., Homestead, Subtropical Experimental Station, 2 May 1967, B. V. Peterson (1♀; CNC); Miami, 23 Feb 1912, F. Knab (3♀; ANSP). Highland Co., Archbold Biological Station, 14 Apr–1 Jun, 1960–1967, B. V. Peterson, S. W. Frost, J. G. and B. L. Rosen (5♂, 4♀; AMNH, CNC, USNM). Hillsborough Co., Plant City, 15 Aug 1930, J. O. Nottingham (2♂, 3♀; KU, USNM); Tampa, 21 Apr 1961, L. A. Kelton (1♂; CNC). Lee Co., Fort Myers, 26 Dec 1953, B. H. Judd (1♀; USNM). Polk Co., Fort Meade, 13 Aug 1930, P. W. Oman

(1♂, 1♀; KU, USNM). Taylor Co., Williams Landing, 21–30 Jun 1967, R. Smith (1♀; USNM). *Georgia*: Liberty Co., St. Catherines Island, 21–23 Apr 1978, R. W. Matthews (35♂, 67♀; USNM). *Louisiana*: Lafourche Parish, Cut Off, 9–11 Jul 1975, V. A. Brou (1♂, 2♀; USNM). Iberville Parish, Sunshine, 8–15 Aug 1972, V. A. Brou (1♂, 5♀; USNM). Orleans Parish, New Orleans, 28 Jan–28 Nov, 1942–1974, V. A. Brou, D. G. Denning, E. H. Metzler (3♂, 8♀; DLD, USNM). St. Charles Parish, Norco, Bonnet Carre Spillway, 20 Feb 1972, E. H. Metzler (3♂; DLD). St. Helena Parish, Fluker, 10 mi SW, 13 Apr 1972, E. H. Metzler (2♂, 3♀; DLD). St. John the Baptist Parish, Edgard, 2 Mar–24 Jun 1972, V. A. Brou (2♂, 1♀; USNM). *Mississippi*: Jackson Co., Vancleave Road, 15 Jun 1962, D. L. Deonier (1♂; DLD). *South Carolina*: Beaufort Co., Hilton Head Island, 12 Jul 1965, H. F. Howden (1♀; CNC).

DISTRIBUTION (Figure 133).—Southeastern North America, especially the Gulf Coast states (South Carolina to Louisiana), and southcentral and Gulf coastal Mexico between 80° and 100° west longitude and 18° and 33° north latitude.

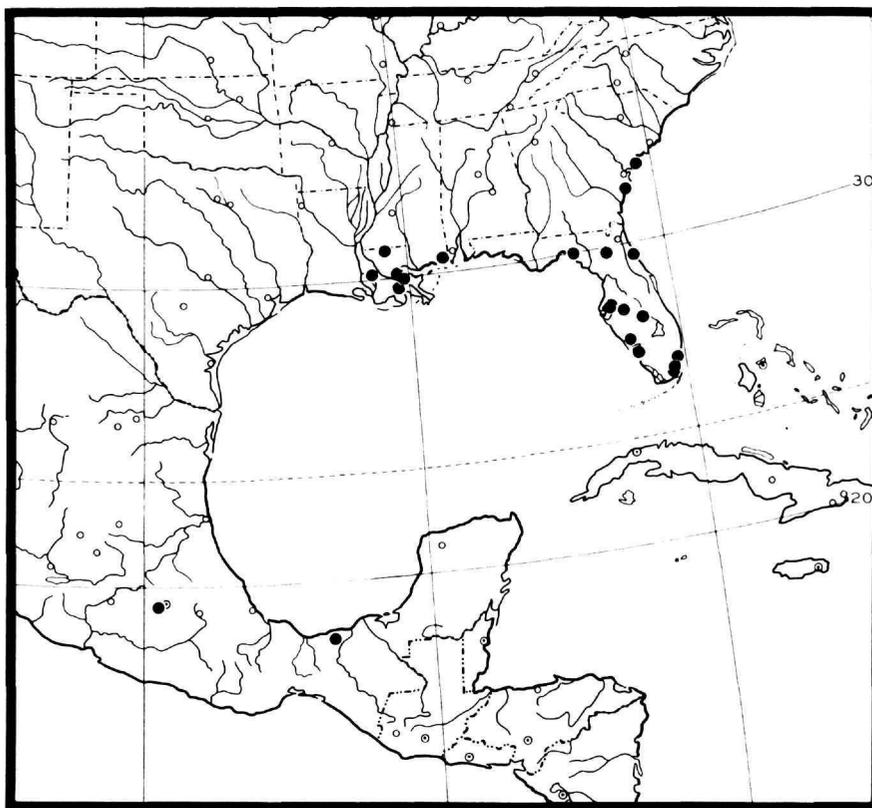


FIGURE 133.—Distribution map of *Setacera pilicornis*.

NATURAL HISTORY.—Numerous specimens of this species were collected as prey of sphecid wasps on St. Catherines Island, Georgia. The wasps were being studied behaviorally and ecologically by Dr. R. W. Matthews and students (University of Georgia). Both sexes were selected as prey and in about equal numbers.

REMARKS.—When Sturtevant and Wheeler (1954) reviewed the nearctic species of *Setacera*, they tentatively listed *S. knabi* Cresson as a junior synonym of *S. pilicornis*. Their uncertainty was due to the fact that the type specimen of *S. knabi*, stated to be in the USNM, could not be located for comparison. The type was subsequently located by Drs. Selwyn S. Roback and Willis W. Wirth among specimens at the Academy of Natural Sciences of Philadelphia that

were not returned to the lending institution following the untimely death of E. T. Cresson, Jr. I have examined the types of both species and can confirm their conspecificity and consequently the status of *S. knabi* as a junior synonym. Only one species of *Setacera* is known to occur in Florida.

Although Coquillett's original description of this species indicated only a single male specimen, which automatically becomes the holotype, the collection at the Academy of Natural Sciences of Philadelphia contains four additional specimens labeled as paratypes with Cresson's characteristic blue labels. These specimens cannot be paratypes, however, as Coquillett's description specifically listed only one male specimen.

In the phylogenetic scheme of this species group, *S. pilicornis* is the sister species of the re-

maining species in the group, being separable from them by the lack of shaggy-appearing setae on the forecoxae of males and by the unique characters of the male and female terminalia.

16. *Setacera trichoscelis*, new species

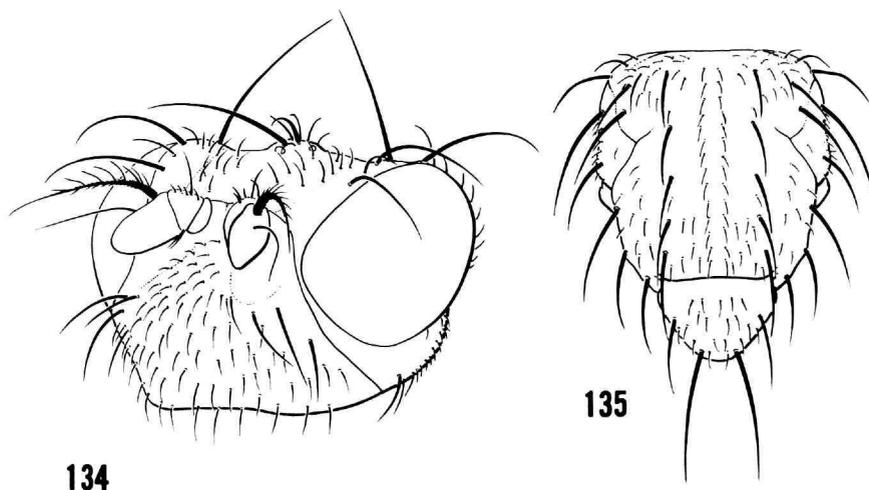
FIGURES 134–138

DESCRIPTION.—Medium-sized to moderately large shore flies, length 3.24 to 4.21 mm; mostly subdued, pollinose, light brown to grayish green except for dorsum which is subshiny to shiny.

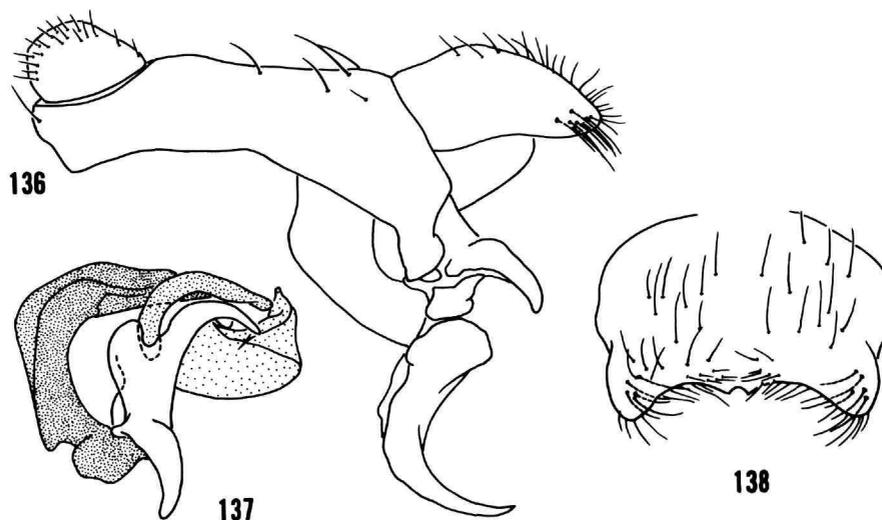
Head (Figure 134): Head width-to-height ratio averaging 1 : 0.70; frons width-to-length ratio averaging 1 : 0.49; frons and fronto-orbital plate distinctly shiny with metallic blue to greenish blue reflections; frons with sparsely scattered, pilose hairs; ocelli arranged in isosceles triangle, distance between posterior pair shorter than between median ocellus and either posterior ocellus. Antenna unicolorous, blackish brown, dull, tomentose with grayish vestiture; 3rd segment slightly longer than combined length of 1st and 2nd; 2nd segment with some greenish color ventrally. Face mostly silvery white except dorsal shelf; antennal fovea and interfoveal space with metallic reflections similar in color to mesofrons;

area immediately surrounding base of antenna with golden brown tomentosity; lower portion of face receding; facial angle approximately 90° from profile view; length of lower portion longer than distance between base of antenna to facial angle. Eye width-to-height ratio averaging 1 : 0.92, oval, oriented at oblique angle to plane of epistoma. Gena wide, eye-to-cheek ratio averaging 1 : 0.43; concolorous with face, becoming duller posteriorly and with some grayish green to olivaceous coloration.

Thorax (Figure 135): Mesonotum mostly brown to greenish brown; anterior portion more subdued, pollinose, grayish brown, becoming darker and with more shiny, metallic green, posteriorly; scutellum with mostly greenish to bronzy blue metallic luster shining through darker-brown vestiture. Mesopleuron, pteropleuron, and sternopleuron mostly concolorous, grayish golden brown to olivaceous; forecoxa shiny gray; hypopleuron mostly gray to lightly olivaceous in color. Femora mostly gray but with some bluish or light brown coloration, becoming darker apically; tibiae mostly concolorous with femora but with less grayish coloration; tarsi yellowish orange but with some blackish coloration; legs of males with tufts of long hairs near apices of mid- and hind tibiae; posteroventral surface of mid femur with



FIGURES 134, 135.—*Setacera trichoscelis*: 134, head, lateroblique aspect; 135, thorax, dorsal aspect.



FIGURES 136–138.—*Setacera trichoscelis*: 136, male terminalia, lateral aspect; 137, internal male genitalia, lateral aspect; 138, surstyli, posterior aspect.

distinct row of bristles, which become larger toward base. Costal vein index averaging 1 : 0.30; M_{1+2} vein index averaging 1 : 0.83.

Abdomen: Dorsum mostly unicolorous, brown with metallic bluish green to green luster; tergum of 1st segment more pollinose, grayish, other terga becoming darker and more shinier posteriorly but not as dark as dorsum of scutellum. 5th tergum of male longer than wide, nearly as long as combined length of 3rd and 4th segments; lateral margins tapering gradually to subtruncate apex. Epandrium of male terminalia triangular, becoming wider toward venter; surstyli attached to ventral margin of epandrium, broadly fused to form subrectangular plate with ventrolateral, rounded processes; 5th sternum loosely attached to posteroventral corners of epandrium, anterior ends produced into gently curved, well-sclerotized, sickle-like processes; see figures of terminalia (Figures 136–138) for further details.

TYPE MATERIAL.—The male holotype is labeled: “Yaguarcocha, 3 km N. Ibarra, 1950 m, Imbabura, Ecuad[or], 8–9. VI. 65 [8–9 Jun 1965], L. Peña/Holotype *Setacera trichoscelis* Mathis [handwritten; red].” Female allotype and 36 paratypes (10♂, 26♀) are labeled with the same label data as the holotype. The holotype, allotype, and most of the paratypes are in the Canadian National Collection, Ottawa, type 15239. Two pairs of male and female paratypes are in the National Museum of Natural History, Smithsonian Institution.

ETYMOLOGY.—The species epithet *trichoscelis* is of Greek derivation and is a combination of *tricho* and *scelis* (“hair” and “leg” respectively). The name refers to the tufts of long hairs on the mid- and hind legs of males.

DISTRIBUTION.—This species is known only from the type-locality.

Literature Cited

- Aldrich, J. M.
1905. A Catalogue of North American Diptera. *Smithsonian Miscellaneous Collections*, 46:1-680.
- Becker, T.
1896. Dipterologische Studien IV: Ephydridae. *Berliner Entomologische Zeitschrift*, 41(2):91-276, 4 plates.
1905. Ephydridae. In T. Becker et al., editors, *Katalog der paläarktischen Dipteren*, 4:185-215. Budapest.
1926. Ephydridae und Canaceidae: Families 56a, 56b. In E. Lindner, editor, *Die Fliegen der paläarktischen Region*, 6(1):1-115, figures 66-134. Stuttgart.
- Beyer, A.
1939. Morphologische, ökologische und physiologische Studien an den Larven der Fliegen: *Ephydra riparia* Fallén, *E. micans* Haliday und *Caenia fumosa* Stenhammar. *Kieler Meeresforschungen*, 3:265-320, 40 figures, 2 tables.
- Clausen, P. J.
1973. A Revision of the Nearctic Species of the Genus *Pelina* (Diptera: Ephydridae). *Transactions of the American Entomological Society*, 99:119-156, 75 figures.
1977. A Revision of the Nearctic, Neotropical, and Palearctic Species of the Genus *Ochthera*, Including One Ethiopian Species, and One New Species from India. *Transactions of the American Entomological Society*, 103:451-530, 175 figures.
- Clausen, P. J., and E. F. Cook
1971. A Revision of the Nearctic Species of the Tribe Parydrini (Diptera: Ephydridae). *Memoirs of the American Entomological Society*, 27: 150 pages, 234 figures.
- Canzoneri, S.
1978. Una nuova *Setacera* D'Italia (Diptera, Ephydridae). *Societa Veneziana di Scienze Naturali-Lavori*, 3:28, 29, 1 figure.
- Cogan, B. H.
1980. Family Ephydridae. In R. W. Crosskey, editor, *Catalogue of the Diptera of the Afrotropical Region*, pages 655-669. London: British Museum (Natural History).
1977. Family Ephydridae. In M. D. Delfinado and D. E. Hardy, editors, *A Catalogue of the Diptera of the Oriental Region, Volume III: Suborder Cyclorrhapha (Excluding Division Aschiza)*, pages 321-339. Honolulu: University Press of Hawaii.
- Cole, F. R. [with Evert I. Schlinger]
1969. *The Flies of Western North America*. xi + 693 pages, 360 figures. Berkeley and Los Angeles: University of California Press.
- Collin, J. E.
1963. The British Species of *Ephydra* (Dipt., Ephydridae). *The Entomologist's Monthly Magazine*, 99:147-152, 3 figures.
- Coquillett, D. W.
1902. New Acalyptrate Diptera from North America. *Journal of the New York Entomological Society*, 10(4):177-191.
- Cresson, E. T., Jr.
1925. Descriptions of New Genera and Species of the Dipterous Family Ephydridae, VII. *Entomological News*, 36(6):165-167.
1930. Studies in the Dipterous Family Ephydridae, Paper III. *Transactions of the American Entomological Society*, 56:93-131.
1935. Descriptions of New Genera and Species of the Dipterous Family Ephydridae. *Transactions of the American Entomological Society*, 61:345-372.
- Dahl, R. G.
1959. Studies on Scandinavian Ephydridae (Diptera Brachycera). *Opuscula Entomologica*, supplement, 15: 224 pages, 84 figures.
1974. Notes on Scandinavian Ephydridae (Diptera Brachycera). *Entomologisk Tidskrift*, 95(3-4):186-189, 3 figures.
- Deonier, D. L.
1972. Observations on Mating, Oviposition, and Food Habits of Certain Shore Flies (Diptera: Ephydridae). *The Ohio Journal of Science*, 72(1):22-29, 1 figure, 1 table.
- Foote, B. A.
1979. Utilization of Algae by Larvae of Shore Flies. In D. L. Deonier, editor, *First Symposium on the Systematics and Ecology of Ephydridae (Diptera)*, pages 61-71, 6 tables. Oxford, Ohio: North American Benthological Society.
1982. Biology and Immature Stages of *Setacera atrovirens*, a Grazer of Floating Algal Mats (Diptera: Ephydridae). *Proceedings of the Entomological Society of Washington*, 84(4).
- Frey, R.
1948. Anteckningar om dipterfaunan pa Karlo (Hailu-

- oto) sommaren 1947. *Memoranda Societatis pro Fauna et Flora Fennica*, 24:69-80, 2 figures.
- Haliday, A. H.
1833. Catalogue of Diptera Occurring about Holywood in Downshire. *The Entomological Magazine* (London), 1:147-180.
- Hendel, F.
1913. H. Sauter's Formosa-Ausbeute: Acalyptrate Musciden (Dipt.), II. *Supplementa Entomologica*, 2:77-112, 7 figures.
- ICZN
1964. *International Code of Zoological Nomenclature Adopted by the XV International Congress of Zoology*. 176 pages. London: International Trust for Zoological Nomenclature.
- Johannsen, O. A.
1935. Aquatic Diptera, Part II: Orthorrhapha-Brachycera and Cyclorrhapha. *Cornell University Agricultural Experiment Station Memoir*, 177:1-62, 12 plates.
- Karol, O.
1930. Thalassobionte und thalassophile Diptera Brachycera. In G. Grimpe and E. Wagler, editors, *Die Tierwelt der Nord- und Ostsee*, XI(e):33-84, 93 figures. Leipzig.
- Karnecká, H.
1980. Shore Flies (Diptera, Ephydriidae) New to the Fauna of Czechoslovakia. *Acta Entomologica Bohemoslovaca*, 77(6):419-423.
- Loew, H.
1860. Die Europaischen Ephydrinidae und die bisher in Schlesien beobachteten Arten derselben. In *Neue Beiträge zur Kenntniss der Dipteren. Programm der Königlichen Realschule zu Meseritz*, 7:1-46.
1862. Monographs of the Diptera of North America, Part I. *Smithsonian Miscellaneous Collections*, 6:1-221, 15 figures, 2 plates.
- Mathis, W. N.
1979a. Studies of Notiphilinae (Diptera: Ephydriidae), I: Revision of the Nearctic Species of *Notiphila* Fallén, Excluding the *caudata* Group. *Smithsonian Contributions to Zoology*, 287: iii+111 pages, 210 figures, 1 table.
1979b. Studies of Ephydrinae (Diptera: Ephydriidae), II: Phylogeny, Classification, and Zoogeography of Nearctic *Lamproscatella* Hendel. *Smithsonian Contributions to Zoology*, 295: iii+41 pages, 52 figures.
1979c. Ephydrinae (Diptera: Ephydriidae): A New Perspective. In D. L. Deonier, editor, *First Symposium on the Systematics and Ecology of Ephydriidae (Diptera)*, pages 47-60, 5 figures, 1 table. Oxford, Ohio: North American Benthological Society.
1980. Studies of Ephydrinae (Diptera: Ephydriidae), III: Revision of Some Neotropical Genera and Species. *Smithsonian Contributions to Zoology*, 303: iii+50 pages, 77 figures.
1981. Studies of Ephydrinae (Diptera: Ephydriidae), IV: Revision of the Australian Species of Subgenus *Neoscatella* Malloch. *Smithsonian Contributions to Zoology*, 325: iii+27 pages, 46 figures.
1982. Studies of Ephydrinae (Diptera: Ephydriidae), VI: Review of the Tribe Dagini. *Smithsonian Contributions to Zoology*, 345: iii+30 pages, 89 figures.
- Mathis, W. N., and G. E. Shewell
1978. Studies of Ephydrinae (Diptera: Ephydriidae), I: Revisions of *Parascatella* Cresson and the *tristeta* Group of *Scatella* Robineau-Desvoidy. *Smithsonian Contributions to Zoology*, 285: iii+44 pages, 62 figures, 1 table.
- Mathis, W. N., and K. W. Simpson
1981. Studies of Ephydrinae (Diptera: Ephydriidae), V: The Genera *Cirrula* Cresson and *Dimecoenia* Cresson in North America. *Smithsonian Contributions to Zoology*, 329: iii+51 pages, 119 figures.
- Meijere, J.C.H. de
1916. Studien über sudostasiatische Dipteren ZII: Javanische Dolichopodiden und Ephydriden. *Tijdschrift voor Entomologie*, 59:225-273, 1 plate.
- Miyagi, I.
1966. Descriptions of Three New Species of Ephydriidae, with One Unrecorded Species from Japan (Diptera, Ephydriidae). *Kontyû*, 34(2):136-140, 1 plate.
1977. Ephydriidae (Insecta: Diptera). In *Fauna Japonica*, 113 pages, 49 plates, 500 figures.
- Nartschuk, R. P.
1970. Cem. Ephydriidae-Beregovushki [Fam. Ephydriidae-Shore Flies]. In A. A. Stackelberg and E. P. Nartschuk, editors, [Flies, Fleas]. In G. Ya. Beibienko, editor, *Opredelitel Nasekimich Europejskoi tsasti SSSR* [Keys to the Insects of the European USSR], 5(2):363-388. Leningrad. [In Russian.]
- Osten Sacken, C. R.
1878. Catalogue of the Described Diptera of North America. *Smithsonian Miscellaneous Collections*, 16:1-276.
- Papp, L.
1975. Család: Ephydriidae-vízilegyek [Family Ephydriidae-Water Flies]. In *Fauna Hungariae*, 15(Diptera II)(6):1-128, 75 figures. Budapest. [In Hungarian.]
- Schiner, I. R.
1863[1864]. Die Fliegen (Diptera). In *Fauna Austriaca*, 2(9-10):81-288. Vienna.
- Séguy, E.
1934. Diptères (Brachycères). In *Faune de France*, 28: 832 pages, 27 plates.
- Soika, A. G.
1956. Diagnosi preliminari do nouvi Ephydriidae e Can-

- accidae della Regione etiopica e del Madagascar (Diptera). *Bollettino del Museo Civico di Storia Naturale di Venezia*, 9:123-130, 2 figures.
- Stenhammar, C.
1844. Försök till gruppering och revision af de svenska Ephydrinae. *Kongliga Vetenskaps-Academiens Handlinger*, series 3, 1843:75-272, 1 plate.
- Sturtevant, A. H., and M. R. Wheeler
1954. Synopses of Nearctic Ephydriidae (Diptera). *Transactions of the American Entomological Society*, 79:151-257.
- Wirth, W. W.
1965. Family Ephydriidae. In A. Stone et al., editors, A Catalog of the Diptera of America North of Mexico. *U.S. Department of Agriculture, Agriculture Handbook*, 276: iv+1696 pages.
1968. Family Ephydriidae. In N. Papavero, editor, *A Catalogue of the Diptera of the Americas South of the United States*, 77:1-43. São Paulo: Departamento de Zoologia, Secretária da Agricultura.
1971. The Brine Flies of the Genus *Ephydra* in North America (Diptera: Ephydriidae). *Annals of the Entomological Society of America*, 64(2):357-377, 41 figures.
1975. A Revision of the Brine Flies of the Genus *Ephydra* of the Old World (Diptera: Ephydriidae). *Entomologica Scandinavica*, 6(1):11-44, 59 figures.
- Wirth, W. W., and A. Stone
1956. Aquatic Diptera. In R. L. Usinger, editor, *Aquatic Insects of California*, pages 372-482, 64 figures. Berkeley: University of California Press.
- Zetterstedt, J. W.
1837. Conspectus familiarum, generum et specierum dipterorum, in fauna insectorum Lapponica descriptorum. *Isis* (Oken's), 1837:27-67.
1846. *Diptera Scandinaviae: Disposita et descripta*. Volume 5, pages 1739-2162. Lund.

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