

BEAUFORTIA

INSTITUTE OF TAXONOMIC ZOOLOGY (ZOOLOGICAL MUSEUM)
UNIVERSITY OF AMSTERDAM

Vol. 33, no. 8

December 30, 1983

A REVISION OF THE CRANE FLY GENUS *NEPHROTOMA* MEIGEN, 1803, IN NORTH AMERICA (DIPTERA, TIPULIDAE). PART I: THE *DORSALIS* SPECIES-GROUP

IDA R. M. TANGELDER

Institute of Taxonomic Zoology (Zoologisch Museum), University of Amsterdam, P.O. Box 20125, 1000 HC Amsterdam, the Netherlands

ABSTRACT

In this study a taxonomic revision of the 20 nearctic species of the *dorsalis*-group is given. For each taxon the following data are presented: references, type material, material examined, diagnostic features, description, detailed drawings of male and female copulatory organs, biology and distribution with distribution maps. A separate key for males and females is presented. One new species is described (*oosterbroeki*), one is given new status (*gnata*) and one species is new for the Nearctic region (*ramulifera*). For the 20 taxa discussed, 37 names are known in literature; four of them are new synonymies, five other synonymies (proposed by Byers, in literis) are published for the first time. The taxonomic information is summarized in a checklist.

CONTENTS

Introduction	111
Material	112
Terminology and drawings	114
Maps and diagrams	114
Abbreviations	114
The genus <i>Nephrotoma</i>	114
Introduction	114
Diagnosis-Description	116
The <i>dorsalis</i> -group	117
Checklist of the species, Table 1	118
Key to the males	119
Key to the females	121
Section 1: <i>breviorcornis</i> , <i>occipitalis</i> , <i>vittula</i> , <i>excelsior</i> , <i>oosterbroeki</i>	123
Section 2: <i>eucera</i> , <i>eucerooides</i> , <i>polymera</i>	142
Section 3: <i>cornifera</i> , <i>okefenoke</i> , <i>urocera</i>	154
Section 4: <i>macrocera</i> , <i>gnata</i>	165
Section 5: <i>cingulata</i> , <i>rogersi</i> , <i>sodalis</i>	172
Section 6: <i>gracilicornis</i> , <i>tenuis</i> , <i>penumbra</i> , <i>ramulifera</i>	185
Acknowledgements	201
References	202

INTRODUCTION

The first paper in which a nearctic species of crane-fly (Tipulidae) of the genus *Nephrotoma* is described is that of Fabricius, 1805 (*ferruginea*). Since then a large series of publications concerning nearctic *Nephrotoma* has appeared. The majority deal with restricted areas and provide isolated descriptions, locality-data or biological notes; the most comprehensive papers are by Dietz (1918), Alexander (1919b) and Alexander (1942).

The main reason for undertaking this revision of the nearctic *Nephrotoma* species is the intended analysis of the faunal exchange between the Nearctic and Palaearctic regions, especially by way of Beringia. The genus *Nephrotoma* is particularly suitable for such a study because of the number of species-groups with a holarctic distribution and because Tipulidae in general

are well suited for phylogenetic (cladistic) analysis. In order to make this study possible, a revision of the nearctic species became necessary, providing the opportunity to describe some newly recognized species, to supplement the inadequate descriptions of most species, to indicate and confirm the many synonymies, to provide distinct drawings of all the species and an effective key and to summarize the current information about the biology and distribution of the species. Part 1 of the paper deals with the *dorsalis* species-group (sensu Oosterbroek, 1979b, 1980), distributed on both sides of Beringia and including more than half of all the *Nephrotoma* species in the Nearctic region (20 out of 37), the other species-groups will be discussed in part 2 by Oosterbroek (in prep.). Both papers have a revisionary scope and will be followed by a survey of the eastern palaeartic species (Tangelder, Oosterbroek, in preparation). Together with the revision of the western palaeartic species (Oosterbroek, 1978-1980), all the assembled information will be used for a phylogenetic and historic-biogeographic analysis of the holarctic *Nephrotoma* fauna. The delimitation of species within the genus is based on morphological characters and much attention is paid to the male hypopygial and the hitherto practically neglected female ovipository organs. On the basis of these genital structures the different species can be separated from and related to each other.

As already indicated this study is limited to the species of *Nephrotoma* that occur in the Nearctic region north of Mexico. Only three species have a holarctic distribution: *lundbecki*, *occipitalis* and *ramulifera*; all others are confined to the North American continent. At present, more than 60 species and subspecies are described in the literature. In this revision 37 valid species of nearctic *Nephrotoma* are recognized, four of which are new species.

MATERIAL

In anticipation of this revision, the following institutions were visited in 1982 to study material:

The University of Kansas, Lawrence, which has a large collection with many specimens from hitherto uncollected or poorly collected regions and which has on loan much material from particularly the Rogers-collection (UMMZ) and the Dietz-collection (ANSP).

The Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts, where the important collections of Loew and Osten Sacken are preserved.

The Academy of Natural Sciences of Philadelphia, which includes the Dietz-collection.

The United States National Museum, Washington D.C., which offered the opportunity to study the C. P. Alexander-collection, slides as well as pinned material, although the collection was still packed and unordered at that time. This collection contained in addition large quantities of unpinned material, from which particularly specimens from Alaska and Canada were selected, brought to Amsterdam and prepared and studied there.

Other material examined originated from the California Academy of Sciences, San Francisco, from the British Museum (Natural History), London, from the Rijksmuseum van Natuurlijke Historie, Leiden, and from the Instituut voor Taxonomische Zoölogie (Zoölogisch Museum), Amsterdam.

The type-material of most of the nearctic *Nephrotoma* species was examined during this study; of some other species the type(s) are only known from detailed notes and drawings, of a few species the type-material is presumably lost. The exact data on the labels of the type-specimens are provided with the descriptions of the species, however without use of diagonals to separate lines. Prof. George W. Byers, University of Kansas, Lawrence, made a detailed study of most of the nearctic *Nephrotoma* types in 1961/1962. He has contributed greatly to this study by kindly placing his notes and drawings at our disposal (the work of G. W. Byers on nearctic *Nephrotoma* is currently supported by grant DEB 8200862 from the National Science Foundation, USA).

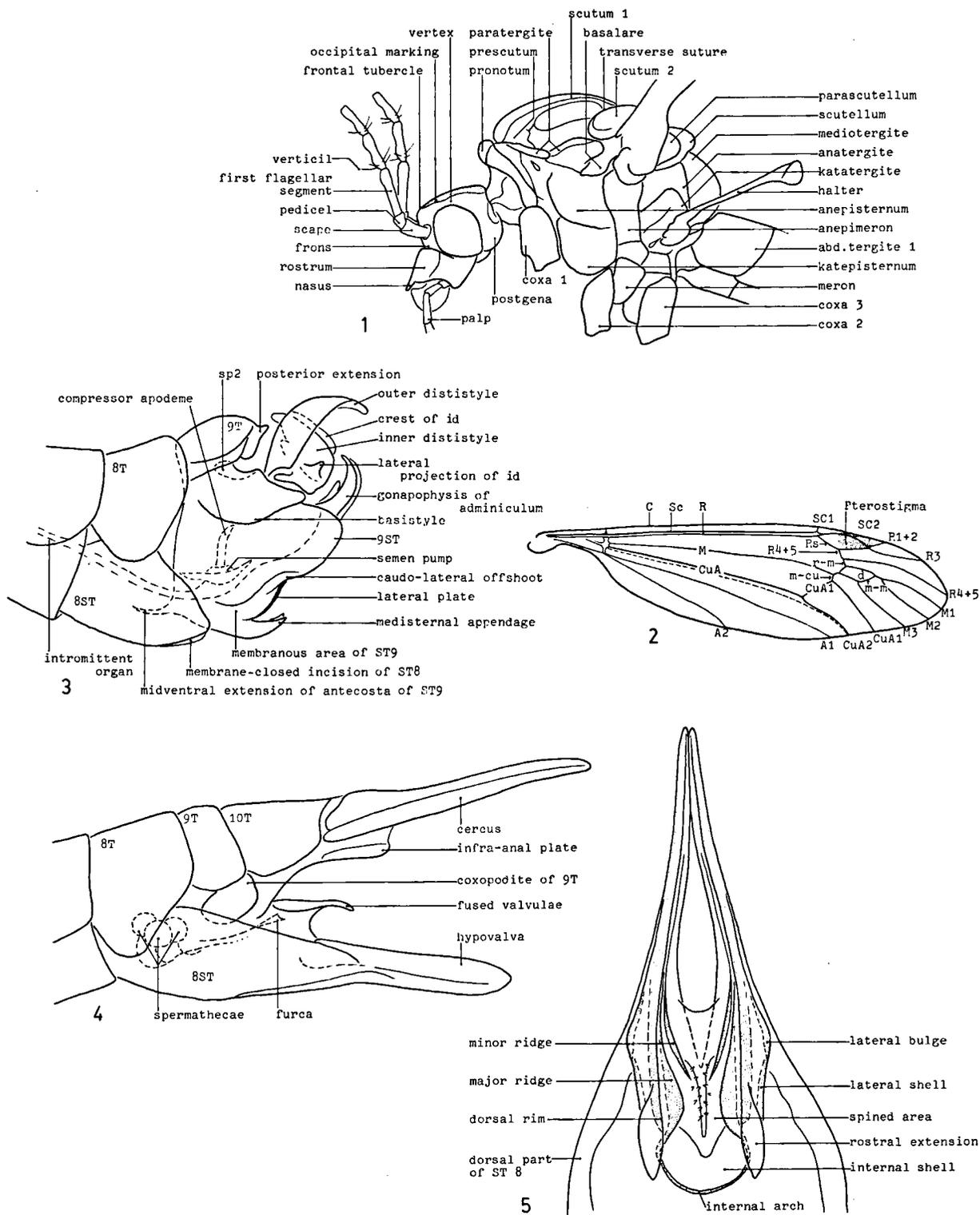


Fig. 1. Generalized drawing of head and thorax, lateral view. Fig. 2. Wing of *N. eucera*; A, anal vein; C, costa; Cu, cubitus; d, discal cell; M, medius; R, radius; Sc, subcosta. Fig. 3. Generalized drawing of the hypopygium, lateral view. Fig. 4. Generalized drawing of the ovipositor, lateral view. Fig. 5. Generalized drawing of the hypovalvae, dorsal view.

TERMINOLOGY AND DRAWINGS

The terminology applied to the different structures mentioned in the keys and descriptions is explained in figures 1 (head and thorax), 2 (wing-venation), 3, 4 and 5 (male and female copulatory organs). The terms are mainly derived from McAlpine (1981), Rees & Ferris (1939), Neumann (1958) and Frommer (1963); some terms are introduced for the first time, especially pertaining to the internal structures of the female genitalia.

All drawings are original, made with the aid of a drawing-tube on a stereoscopic microscope. Genital structures are all drawn and examined on the basis of macerated material (heated for about five minutes in 10% potassium hydroxide). The magnification of the drawings is always the same for the same elements.

MAPS AND DIAGRAMS

The distribution maps and flight-period diagrams are completely based on the data of the specimens examined; the maps are frequently supplemented with reliable data from the literature. The flight-period diagrams are based on number of data (collections, not specimens) per ten-day period or per month. For some species the diagrams are subdivided into regions of different latitude and longitude as given in map 1: NE (northeastern region) includes New York, New England and the Canadian provinces east of Saskatchewan; SE (southeastern) includes the area from South Carolina-Florida to Texas-Oklahoma; ME (middle-eastern) includes the states inbetween NE and SE and east of the Rocky Mountains; NW (northwestern) includes Alaska and the Canadian provinces west of Manitoba; SW (southwestern) includes the Rocky Mountain-states and those states west of them.

ABBREVIATIONS

The following abbreviations are used in text and figures:

biol	biology
comp	comparison
co's.	counties
descr	description

distr	distribution
fig(s)	figure(s)
hypop	hypopygium
id	inner dististyle (males)
loc(s)	locality(ies)
morph	morphology
od	outer dististyle (males)
pl.	plate
sh descr	short description
sp2	sclerotized clasp, lateral part of genital bridge (males)
syn	synonymy
ST	Sternite
T	Tergite
ANSP	Academy of Natural Sciences, Philadelphia, USA
BMNH	British Museum (Natural History), London, England
CAS	California Academy of Sciences, San Francisco, USA
CNCO	Canadian National Collection, Ottawa, Canada
MCZ	Museum of Comparative Zoology, Cambridge, Massachusetts, USA
RMNH	Rijksmuseum van Natuurlijke Historie, Leiden, The Netherlands
UKaL	University of Kansas, Lawrence, USA
UKaL(L)	University of Kansas, Lawrence, USA, on loan from other institutions except UMMZ
UMMZ	University of Michigan, Museum of Zoology, Ann Arbor, USA
USNM	United States National Museum, Washington D.C., USA
USNMA	United States National Museum, Washington D.C., USA, Alexander Coll.
ZIL	Zoologiska Institutionen, University of Lund, Sweden
ZMA	Instituut voor Taxonomische Zoölogie (Zoölogisch Museum), Amsterdam, The Netherlands

THE GENUS *NEPHROTOMA* MEIGEN, 1803

- Pales* Meigen, 1800: 14. Type-species: *Tipula dorsalis* Fabricius, 1781, by designation of Hendel, 1908: 46. Suppressed in 1963, ICZN Opinion 678: 339.
- Nephrotoma* Meigen, 1803: 262. Type-species: *Tipula dorsalis* Fabricius, 1781, by monotypy.
- Pachyrhina* Macquart, 1834: 88. Type-species: *Tipula crocata* Linnaeus, 1758, by designation of Westwood, 1840: 128.

INTRODUCTION

The history of the genus, as presented by Oosterbroek (1978), is briefly summarized



Map 1. The division of North America into faunal regions as defined in the text, see 'Maps and diagrams'.

here: The genus *Pales* Meigen, 1800, was based on one species with 19-segmented antennae (*dorsalis*); Meigen replaced this name by *Nephrotoma* in 1803 and he still classified the

other species, nowadays attributed to the genus *Nephrotoma*, with the large genus *Tipula* Linnaeus, 1758, although since 1818 in a separate section based on wing-venation. Macquart

(1834) elevated this section to genus-rank with the name *Pachyrhina*. Loew (1863) and Osten Sacken (1886) adduced arguments to synonymize *Nephrotoma* and *Pachyrhina*, but this synonymy was only generally accepted after the publication of Alexander (1915b: 465), who stated that species (of the genera *Nephrotoma* and *Pachyrhina*) which are so very similar in many details should not be separated because of a different number of antennal segments. The prior name *Pales*, used by several European authors and cause of a longstanding controversy, was finally suppressed by the International Commission on Zoological Nomenclature in 1963 (Bull. zool. Nomencl. 31: 83).

Nephrotoma is a large and worldwide genus, not divided into subgenera, with at present over 400 species and subspecies. Large numbers of species are found in the Palearctic (124), Oriental (114) and Ethiopian (94) regions, fewer in the other regions (Nearctic 37, Neotropical 22, Australian 26, Madagascar 21). The overlap between the zoogeographical regions is very small (Oosterbroek e.a., 1976).

The relationship of the genus *Nephrotoma* to other taxa is not clarified yet. The following cluster, based on similarity, was recognized by Oosterbroek (1980): *Nephrotoma*, *Dolichozepe* (*Dolichozepe*), *Dolichozepe* (*Orozepe*), *Dolichozepe* (*Nesopeze*), *Tipula* (*Trichotipula*), *Scamboneura* and *Prionocera*; further on he stated: "*Trichotipula* and *Scamboneura* apparently are the closest allies of *Nephrotoma*. *Scamboneura* is very probably the sistergroup of *Nephrotoma*, based on synapomorphies of the inner dististyles."

The species of *Nephrotoma* can be found in many different landscapes of the world (pine-, deciduous-, mixed-, rain- and monsoon-forests, meadows, steppes, savannas and even tundras), but in general they prefer the temperate climates which allow the development of deciduous forests and where edges of woods, meadows and banks of streams form the most favourable habitats. The larvae are usually found in humus-rich soil, and in some species they gnaw at roots of plants (Oosterbroek e.a., 1976).

DIAGNOSIS AND DESCRIPTION

The species of *Nephrotoma* are characterized by wing-venation (Oosterbroek, 1978; Alexander & Byers, 1981) (fig. 2): the radial sector (Rs) is very short and oblique; the vein CuAl, or if present cross-vein m-cu, meets vein M before or at the anterior corner of the discal cell, the veins of the discal cell are never (partly) fused with m-cu or CuAl; cell m1 is sessile to distinctly petiolate.

The nearctic species of *Nephrotoma* share the following characteristics: The body length is in males 8-18 mm, in females 10-23 mm. The body colour ranges from nearly completely yellowish to largely black, but is usually yellow with red-yellow, brown or black markings. Rostrum short, about half the length of head. The antennae are usually 13-segmented, ranging up to 18-20 segments in the males of *eucera*; antennal length variable, in males ranging from twice as long as head to more than half the body length, in females about twice as long as head or slightly longer. Flagellar segments subcylindrical to reniform in males and (sub)cylindrical in females, pubescent and with a long verticil at base. The palps have flagelliform terminal segments which are longer than the four preceding ones together. Frons with a gibbous tubercle. Thorax usually highly polished, frequently with limited opaque areas, rarely with an opaque scutal surface. Legs long and slender. The wings lanceolate, never mottled; colour of pterostigma ranging from hardly perceptible to black. The abdomen is long and slender, in males somewhat shorter than the wings, in females as long as or slightly longer than the wings. In males the ninth tergite is never completely fused with the ninth sternite; the differentiated posterior extension of the ninth tergite bears small black spines; the outer dististyle is usually fleshy, flattened and more or less acuminate; the inner dististyle and the adminiculum differ according to species. The females have the hypovalvae shorter than the cerci; the cerci are apically blunt, the hypovalvae are tapering or parallel-sided.

THE *DORSALIS*-GROUP

The name *dorsalis*-group appeared for the first time in Mannheims & Pechlaner (1963), was used there for six European species of *Nephrotoma* (*dorsalis*, *lunulicornis*, *quadristriata*, *scurra*, *austriaca* and *helvetica*) and was defined by the following characters: straight lateral stripes on scutum 1, strongly incised antennal flagellar segments and an angular or round-shaped median incision on hind margin of sternite 8 in males. Savchenko (1973) incorporated these species in his more comprehensive *scurra*-group, characterized by colouration (yellow body colour and straight lateral stripes on scutum 1) and hypopygial features (absence of lateral horns on the posterior extension of tergite 9, presence of a medisternal appendage on posterior surface of sternite 9, presence of a membranous crest on the id and a medially incised hind margin of sternite 8). Finally, on the basis of mainly genital characters Oosterbroek (1979b) reinstated the name *dorsalis*-group for the six above-mentioned western palaeartic species, defined it and established (in Oosterbroek, 1980) the monophyletic origin of the group, including *ramulifera*, by means of nine synapomorphies. The nearctic species which belong to this monophyletic *dorsalis*-group possess the following characteristics:

- a. Body colour light- to dark- or orange-yellow with markings ranging from red-yellow to black.
- b. Number of antennal segments ranging from 13 to 20 in males, from 13 to 16 in females. Flagellar segments more or less cylindrical in females, and ranging from cylindrical to strongly reniform in males. Colouration of the antennae variable.
- c. Lateral stripes on scutum 1 straight; in two species (*excelsior*, *ramulifera*) sometimes with slightly infuscated and downcurved anterior ends.
- d. Surface of prescutum and scutum 1 uniformly polished or (in *macrocera* and *gnata*) uniformly opaque. Except the median part of the pronotum, the remainder of the thorax shining, inclusive the katatergite.

- e. Abdomen midventrally marked with dark spots or stripes, sometimes vague and only visible on a few sternites.
- f. The inner dististyle in males with a slightly to distinctly extended crest along dorsal margin.
- g. Both the od and the id possess a narrow prolongation at their base, inserted inside the sclerotized ring of the basistyle.
- h. The sp2 is large, rounded and folded, with variable transparent extensions along base.
- i. The hind margin of sternite 8 in males with a median incision, ranging from weakly to deeply incised and partly to largely closed by a membrane.
- j. The broad membranous area on caudoventral surface of sternite 9 in males has slight to distinct lateral offshoots at caudal end, while presence and shape of sclerotized lateral plates and a medisternal appendage are variable.
- k. The gonapophyses of the adminiculum are confluent with sternite 9 at their lower posterior corners and are basally broad with dorsally upcurved tips (further modified in *cingulata*).
 - l. No adminicular rods present.
- m. The semen pump has a bifid compressor apodeme, slightly to distinctly extended lateral appendages and more or less converging posterior appendages.
- n. The intromittent organ is completely tubular, thin and variable in length.
- o. The connection of the fused valvulae with the coxopodite of tergite 9 in females is membranous except for one species (*sodalis*).
- p. The hypovalvae are broad and blunt; with two ridges on the inner surface of each, well developed dorsal rims sometimes with rostral modifications and with a basal spined area and a variably developed internal shell.

The *dorsalis*-group consists of about fifty species. The distribution of the group is holarctic, 20 species occur in the Nearctic region, about 30 species in the Palaeartic region, while the overlap between those regions is limited to only

Table 1: Checklist of the nearctic species of the *Nephrotoma dorsalis*-group. Ht = Holotype, Pt = Paratype(s), Lt = Lectotype, Plt = Paralectotype(s), T = Type(s), E = Examined by the author. Remaining abbreviation see p. 114. Type-material between brackets could not be found in the institutions concerned. New synonymies and synonymies proposed by Byers (1961, in literis) are indicated.

Name of species and synonym(s)	Type-material	Institute	E	Distribution (see map 1)
<i>breviorcornis</i> (Doane, 1908)	Ht♂	CAS	—	NE, ME, SW
= <i>approximata</i> (Dietz, 1918)	Ht♂, (Pt5♀)	ANSP	+	-----
= <i>stigmatica</i> (Dietz, 1918)	Ht♂, (Pt1♂)	ANSP	+	-----
<i>cingulata</i> (Dietz, 1918)	Ht♂, Pt8♂ (2♀)	ANSP	+	NE, ME, SE
<i>cornifera</i> (Dietz, 1918)	Ht♂, Pt1♂ (2♂)	ANSP/USNM	+	ME, SE
<i>eucera</i> (Loew, 1863)	Lt♂, Plt2♀	MCZ	+	(NE), ME, SE
<i>euceroides</i> Alexander, 1919	Ht♂, Pt1♂	USNM	+	NE, ME
= <i>clandestina</i> (Dietz, 1921) new syn.	Ht♀	ANSP	+	-----
<i>excelsior</i> (Bergroth, 1888)	T1♂, 1♀	?	—	NW, SW
<i>gnata</i> (Dietz, 1918)	Ht♂	ANSP	+	(NE), ME, SE
= <i>hirsutula</i> (Dietz, 1918) new syn.	Ht♂, Pt1♂	ANSP	+	-----
<i>gracilicornis</i> (Loew, 1864)	Lt♂, Plt1♀	MCZ	+	NE, ME
= <i>festina</i> (Dietz, 1918)	Ht♂, Pt3♂	ANSP	+	-----
= <i>temeraria</i> (Dietz, 1918) syn. Byers	Ht♀	ANSP	+	-----
= <i>tenuis fuscostigmata</i> Alex., 1940 new syn.	Ht♂	USNM	+	-----
<i>macrocera</i> (Say, 1823)	T♂?	?	—	NE, ME, SE
= <i>macrocera atrocera</i> (Dietz, 1918)	Ht♂	ANSP	+	-----
= <i>macrocera virgata</i> (Dietz, 1921) new syn.	Ht♀, Pt5♀ (1♀)	ANSP	+	-----
<i>occipitalis</i> (Loew, 1864)	Ht♀	MCZ	+	NE, (ME), NW, SW
= <i>snowii alternata</i> (Dietz, 1918) syn. Byers	Ht♂, Pt1♂	ANSP	+	-----
<i>okefenoke</i> (Alexander, 1915)	(Ht♂), Pt5♂, 2♀ (4?)	USNM/ANSP	+	(ME), SE
<i>oosterbroeki</i> nov. spec.	Ht♂	USNM	+	SW
<i>penumbra</i> (Alexander, 1915)	Ht♂, Pt2♂ (3♂)	USNM/MCZ?	+	NE, NW
<i>polymera</i> (Loew, 1863)	Lt♂, (Plt1♀)	MCZ	+	NE, ME
<i>ramulifera</i> Tjeder, 1955	Ht♂, Pt1♀	ZIL	—	NW
<i>rogersi</i> Byers, 1968	Ht♂, Pt12♂, 8♀ (3♂)	UMMZ/USNM	+	SE
<i>sodalis</i> (Loew, 1864)	Ht♀	MCZ	+	NE, ME, (SE), NW, SW
= <i>xanthostigma</i> (Loew, 1864) syn. Byers	Lt♂, Plt1♀	MCZ	+	-----
= <i>sodalis nictans</i> (Dietz, 1918) syn. Byers	Ht♂	ANSP	+	-----
= <i>obliterata</i> (Dietz, 1918)	Ht♂, Pt1♂, 2♀ (2♂)	ANSP	+	-----
= <i>wyalusingensis</i> (Dietz, 1918) syn. Byers	(Ht♂, Pt1♀)	ANSP	—	-----
<i>tenuis</i> (Loew, 1863)	Lt♂, Plt1♀	MCZ	+	NE, ME, SE
= <i>tenuis hamata</i> (Dietz, 1918)	Ht♂	ANSP	+	-----
= <i>tenuis nigroantennata</i> (Dietz, 1921)	Ht♂	ANSP	+	-----
<i>urocera</i> (Dietz, 1918)	Ht♂, Pt1♂	ANSP	+	(ME), SE
<i>vittula</i> (Loew, 1864)	Ht♂	MCZ	+	NW, SW
= <i>snowii</i> (Doane, 1908)	Lt♂, (Plt1♂)	CAS	—	-----

two species (*occipitalis* and *ramulifera*). A checklist of species with their synonyms is given in Table 1. The distribution of the 20 nearctic species dealt with in this study is as follows:

Thirteen species occur only in the eastern part of the North American continent; four of them are largely confined to the SE part (*cornifera*, *okefenoke*, *urocera*, *rogersi*); the others (*cingulata*, *eucera*, *euceroides*, *gracilicornis*, *gnata*, *macrocera*, *polymera*, *tenuis*) have their ranges be-

tween Newfoundland, northern Florida and the Great Plains, except for one species (*breviorcornis*) which occurs westward to Colorado.

N. occipitalis and *penumbra* both occur in the NE and W parts of the Nearctic region, *occipitalis* ranges throughout the North, whereas *penumbra* has a disjunct distribution.

Three species (*excelsior*, *oosterbroeki*, *vittula*) are confined to the western part of North America.

One species (*sodalis*) has localities throughout

nearly the whole North American continent, but is most frequently found in the eastern part.

The holarctic species *ramulifera* is so far only known from Alaska.

Although the phylogenetic relationships are not under discussion here, the clustering of the species studied in this paper is not completely arbitrary. The species are divided into sections and treated in the following sequence:

Section 1: The five species *breviorcornis*, *occipitalis*, *vittula*, *excelsior* and *oosterbroeki*, closely related to each other although variable in colour and distinguished by the similarity of many hypopygial and ovipository structures.

Section 2: The species *eucera*, *euceroides* and *polymera*, recognized by the polymerous antennae in both sexes.

Section 3: The three closely related species *cornifera*, *okefenoke* and *urocera*, characterized by the strongly extended and peculiarly formed posterior appendage of the inner dististyle in males and the modified fused valvulae and furca and the presence of two large, sclerotized blade-like sheets at the base of the hypovalvae in females.

Section 4: The two closely related species *macrocera* and *gnata*, characterized by the hairy lobes in the middle of the hind margin of sternite 8 in males.

Section 5: The three species *cingulata*, *rogersi* and *sodalis*, which have more or less darkened bases of the antennal flagellar segments in common but are rather different in genital structures.

Section 6: A final group of miscellaneous species *gracilicornis*, *tenuis*, *penumbra* and *ramulifera*, without the characteristics mentioned in sections 1-5 above.

KEY TO MALES OF THE NEARCTIC SPECIES OF THE *NEPHROTOMA DORSALIS*-GROUP:

0. Abdominal sternites midventrally marked with brown to black spots or stripes, sometimes vague. Dorsal thorax yellow with yellowish to dark brown or black

- stripes. Surface of prescutum and scutum 1 uniformly polished or uniformly opaque. Katatergite shining (Part I: *dorsalis* species-group) . 1
- Abdominal sternites without midventral markings. Dorsal thorax entirely darkened or yellow with yellowish to dark brown or black stripes. In the latter case surface of prescutum and scutum 1 dull inbetween shining stripes and/or katatergite dull (Part II: non-*dorsalis* species-groups)
1. Tarsal claws toothed 2
- Tarsal claws untoothed (if claws lacking, continue with 3)..... 3
2. Antennal flagellar segments uniformly black-brown. Occipital marking large and black-brown. Thoracic stripes black. Sternite 9 with a large bifid medisternal appendage (figs. 246, 247) also keyed out in couplet 6 ... *ramulifera*
- Antennal flagellar segments yellowish to dark brown with usually darker basal nodes. No dark occipital marking. Thoracic stripes reddish-brown. Sternite 9 without medisternal appendage (figs. 195, 196) .. also keyed out in couplet 17 .. *sodalis*
3. Antennal flagellar segments uniformly dark to black-brown, inclusive the first segment. Occipital marking dark coloured 4
- Antennal flagellar segments not uniformly dark to black-brown. Occipital marking absent or light brown and small..... 9
4. Antennae 14- to 15-segmented. Pterostigma brown-yellow 5
- Antennae 13-segmented. Pterostigma dark brown to grey-brown..... 6
5. Base of occipital marking not narrowed. Sternite 8 shallowly incised and lined with hairs; medisternal appendage of sternite 9 bifid (figs. 234, 235)..... *penumbra*
- Occipital marking with a narrowed base. Sternite 8 deeply incised, closing membrane set with hairs; medisternal appendage of sternite 9 finger-like (figs. 21, 22) also keyed out in couplet 16 ... *occipitalis*
6. Rostrum with yellow sides. Largest anterior part of vertex opaque. Medisternal appendage of sternite 9 broad, bifid and

- sclerotized (figs. 246, 247)
 also keyed out in couplet 2 *ramulifera*
- Sides of rostrum with (dark)brown spots. Vertex largely shining. Medisternal appendage of sternite 9 absent or slender and hardly sclerotized 7
 - 7. Sternite 9 without an extended medisternal appendage (fig. 32). Posterior extension of tergite 9 without protruding caudo-lateral corners (fig. 40) *vittula*
 - Sternite 9 with a distinctly extended medisternal appendage. Posterior extension of tergite 9 with protruding caudo-lateral corners (figs. 51, 64)..... 8
 - 8. Thoracic stripes caudally fading; posterior part of katatergite not blackened. Medisternal appendage of sternite 9 slightly bifid, lateral plates very small (figs. 61, 62)
 *oosterbroeki*
 - Thoracic stripes not fading caudally; posterior part of katatergite usually blackened, sometimes more pale. Medisternal appendage of sternite 9 finger-like, lateral plates distinct (figs. 48, 49) .. *excelsior*
 - 9. Vertex, prescutum and scutum 1 opaque to subopaque. Hind margin of sternite 8 medially with two extended hairy lobes . 10
 - Vertex and dorsal surface of thorax more or less shining. Hind margin of sternite 8 without hairy lobes in the middle 11
 - 10. Hairy lobes on hind margin of sternite 8 shortly finger-like (fig. 146). First flagellar segment as long as second plus half of third segment (fig. 158) *macrocera*
 - Hairy lobes of sternite 8 large and cone-like (fig. 160). First flagellar segment as long as second plus one third of third segment (fig. 159)..... *gnata*
 - 11. Inner dististyle with a strongly extended and peculiarly formed posterior appendage (figs. 116, 130, 145) 12
 - Inner dististyle without such a posterior appendage 14
 - 12. Posterior appendage of inner dististyle slender and serpentine (fig. 116). Antennal verticillar hairs up to twice as long as segments *cornifera*
 - Posterior appendage of inner dististyle not serpentine but straight or slightly upcurved. Antennal verticillar hairs up to 1.5 times length of segments 13
 - 13. Posterior appendage of inner dististyle slender and straight (fig. 130). Pterostigma yellow-brown to brown *okefenoke*
 - Posterior appendage of inner dististyle large, stout and somewhat upcurved (fig. 145). Pterostigma (dark)brown, usually with a darkened seam along costal margin .
 *urocera*
 - 14. Antennal flagella yellow to brownish, segments without or with slightly to distinctly infuscated basal nodes 15
 - Antennal flagella bicoloured, segments brownish with yellow basal parts 18
 - 15. Costal region of wing conspicuously shaded dark brown. Antennal flagellar segments hardly incised and somewhat elongated. Sternite 8 with a black-brown midventral stripe (fig. 184) *rogersi*
 - Costal region of wing (dark) yellowish. Antennal flagellar segments slightly to distinctly incised. Sternite 8 without a black-brown stripe 16
 - 16. Antennae 14- or 15-segmented, flagellar segments more or less uniformly brownish. Occipital marking (dark)brown. Incision of hind margin of sternite 8 deep, reaching beyond mid-length of sternite. Sternite 9 with a finger-like medisternal appendage (figs. 21, 22) .. also keyed out in couplet 5 ..
 *occipitalis*
 - Antennae 13- or 14-segmented, basal nodes of the flagellar segments infuscated. No dark coloured occipital marking. Hind margin of sternite 8 shallowly incised. Sternite 9 without a medisternal appendage or with a bifid one 17
 - 17. Antero-lateral corners of scutum 2 yellowish. Antennal verticillar hairs not as long as segments. Body colour bright orange-yellow. Medisternal appendage of sternite 9 bifid (figs. 169, 170) *cingulata*
 - Antero-lateral corners of scutum 2 dull grey to black-brown. Longest antennal verticillar hairs longer than segments. Body colour dark to pale yellow. Sternite 9

- without a medisternal appendage (figs. 195, 196) also keyed out in couplet 2 *sodalis*
18. Antennae with 16-20 segments, flagellar segments distinctly reniform; antennae as long as or longer than half body length . 19
- Antennae with 13 segments, flagellar segments not or slightly incised; antennae shorter than half body length 21
19. Antero-lateral corners of scutum 2 velvety black-brown, sometimes more greyish. Pterostigma (dark)brown, usually with many macrotrichia. Posterior extension of tergite 9 with black fuscous, pointed lateral prolongations (fig. 105) *polymera*
- Antero-lateral corners of scutum 2 yellow-brown to dark red-brown. Pterostigma yellow-brown to dark brown, sometimes with a few macrotrichia. Posterior extension of tergite 9 otherwise 20
20. Usually distinct black dashes on anterior part of paratergite and lateral corner of prescutum (fig. 83). Sternite 9 with two sclerotized lateral plates and a bifid medisternal appendage (figs. 84, 85) ... *eucerooides*
- A narrow brownish dash only on anterior part of paratergite. Sternite 9 without sclerotized lateral plates and with a bulbous, medially bifid and laterally winged medisternal appendage (figs. 71, 79) *eucera*
21. Antennae with slightly incised flagellar segments; length of antennae more than one-third of body length. Head with a short triangular, weakly tinted occipital marking. Membranous area of sternite 9 creased, without an extended medisternal appendage (figs. 6, 7) *breviorcornis*
- Antennae with more or less cylindrical flagellar segments; length of antennae about one-fourth of body length. No occipital marking, postgenae with grey-brown spots along eye-margins. Sternite 9 with a bifid medisternal appendage 22
22. Scutal surface of thorax more or less subshining. Antero-lateral corners of scutum 2 yellowish. No significant darkening of (sub)terminal segments. Pterostigma

- brown-yellow *tenuis*
- Entire thorax polished. Antero-lateral corners of scutum 2 red- to dark brown. (Sub)terminal segments (dark)brown. Pterostigma (dark)brown *gracilicornis*

KEY TO FEMALES OF THE NEARCTIC SPECIES OF THE *NEPHROTOMA DORSALIS*-GROUP:

(*N. oosterbroeki*, of which females are unknown, is omitted from this key)

0. Abdominal sternites midventrally marked with brown to black spots or stripes, sometimes vague. Dorsal thorax yellow with yellowish to dark brown or black stripes. Surface of prescutum and scutum 1 uniformly polished or uniformly opaque. Katatergite shining (Part I: *dorsalis* species-group) 1
- Abdominal sternites without midventral markings. Dorsal thorax entirely darkened or yellow with yellowish to dark brown or black stripes. In the latter case surface of prescutum and scutum 1 dull inbetween shining stripes and/or katatergite dull (Part II: non-*dorsalis* species-groups)
1. Antennal flagella more or less uniformly brown to black-brown, including the first flagellar segments. Occipital marking dark coloured and large, reaching to or over frontal tubercle 2
- Antennal flagella not uniformly brown to black-brown. Occipital marking absent or light brown and small 6
2. Antennae 13- to 15-segmented. Pterostigma yellow to brown. Thoracic stripes usually not uniformly coloured, i.e., with blackened areas or caudally fading 3
- Antennae 13-segmented. Pterostigma dark brown. Thoracic stripes practically uniformly dark brown to black coloured . 4
3. Antennae 14 or 15-segmented. Base of occipital marking not narrowed. Median stripe on scutum 1 with a blackened median longitudinal band. Posterior margin of mediotergite dark brown bordered *penumbra*

- Antennae 13-, sometimes 14-segmented. Occipital marking with a narrowed base. Median stripe on scutum 1 usually plain coloured, sometimes with a vaguely blackened longitudinal band. Posterior margin of mediotergite without a dark border also keyed out in couplet 9
..... *occipitalis*
- 4. Rostrum with yellow sides. Most of anterior vertex opaque. Tergite 10 black fuscous *ramulifera*
- Sides of rostrum with (dark)brown spots. Vertex largely shining. Tergite 10 not black fuscous 5
- 5. Nasus yellow. Antero-lateral corners of scutum 2 yellow. Pleura with light to dark brown markings, posterior part of katatergite not black (fig. 45) *vittula*
- Nasus usually brown. Antero-lateral corners of scutum 2 pale to distinct brownish. Pleura with abundant black-brown markings, posterior part of katatergite usually blackened, sometimes more pale (fig. 46) ..
..... *excelsior*
- 6. Vertex, prescutum and scutum 1 opaque to subopaque. Antennal flagellar segments yellow-brown to dark brown with darker basal nodes or parts 7
- Vertex and dorsal surface of thorax more or less shining. Colouration of antennal flagella variable; if scutal surface of thorax is subshining flagellar segments with lighter basal nodes 8
- 7. Wing length exceeding the abdomen by at most 1 mm. Eighth abdominal segment with weak to dark brown darkening
..... *macrocera*
- Wing length usually exceeding the abdomen by 1.5 mm or more. No (sub)terminal darkening *gnata*
- 8. Costal region of wing conspicuously shaded dark brown. Sides of mediotergite more brownish tinted than antero-central part ...
..... *rogersi*
- Costal region of wing yellow to (light)brown shaded. Mediotergite with yellow sides 9
- 9. Head with a (dark)brown occipital marking, narrowed at base and reaching over half length of vertex. Antennal flagella more or less uniformly light to dark brown, inclusive the first flagellar segments
..... also keyed out at nr. 3 *occipitalis*
- Occipital marking on head short triangular and (light)brown tinted or absent. Antennal flagella variable, first flagellar segments usually yellow, sometimes partly brownish tinted 10
- 10. Antennae with 14 to 16 segments; flagellar segments (dark)brown with yellow bases; longest verticillar hairs distinctly exceeding length of segments. Postgenae uniformly yellowish 11
- Antennae 13-segmented; other characters not as above 13
- 11. Antero-lateral corners of scutum 2 velvety black-brown, sometimes more greyish. Transverse suture broadly (light)brownish-tinted in the middle. Pterostigma (dark)brown, usually with many macrotrichia. Dorsal spots on abdomen more or less bottle-shaped and frequently merging with transverse band along hind margins of tergites *polymera*
- Antero-lateral corners of scutum 2 yellow-brown to dark red-brown. Transverse suture not or weakly brown-tinted in the middle. Pterostigma yellow-brown to dark brown with sometimes a few macrotrichia. Dorsal spots on abdomen otherwise 12
- 12. Usually distinct black dashes on anterior part of paratergite and on lateral corner of prescutum (fig. 83). Pterostigma brownish-yellow. Dorsal stripe on abdomen broader than lateral scutal stripes *eucerooides*
- A narrow brown dash only on anterior part of paratergite. Pterostigma light to dark brown with usually a darker tinted part in cell sc2. Dorsal stripe on first few abdominal segments narrower than lateral scutal stripes *eucera*
- 13. Postgenae without dark shading; no brown, triangular occipital marking. Antero-lateral corners of scutum 2 velvety black to dark brown, sometimes more greyish. Anterior part of abdominal tergite 2 with a usually

- distinct transverse brown band *sodalis*
- Postgenae with light to dark brown shading; if not, then a small, (light) brownish triangular occipital marking present. Antero-lateral corners of scutum 2 weakly to darkly tinted with red-brown. Abdominal tergite 2 without a transverse brown band 14
 - 14. Antennal flagellar segments yellowish with distinctly infuscated basal nodes. Body colour bright orange-yellow *cingulata*
 - Antennal flagellar segments more or less uniformly brownish, or brownish with yellow basal parts. Body colour from dark to pale yellow 15
 - 15. Longest verticillar hairs of antennal flagella 1.5 to 2.0 times as long as corresponding segments. Cerci hardly or gradually narrowing towards apex 16
 - Longest verticillar hairs of antennal flagella at most slightly longer than corresponding segments. Cerci with a (slight) sudden narrowing in the apical part (figs. 16, 220) . 19
 - 16. Abdominal dorsal stripe usually broad, (dark) brown and continuous; (sub)terminal segments brown to dark brown. Costal region of wing light yellowish. Base of hypovalvae without blade-like sheets *gracilicornis*
 - Abdominal dorsal markings dark brown to faint, stripe discontinuous; (sub)terminal darkening absent or very weak. Costal region of wing shaded with (light) brown. Base of hypovalvae with a blade-like sheet at each side of fused valvulae (figs. 118, 131, 136) 17
 - 17. Sternite 8 very broad, caudal margin strongly curved towards hypovalvae (fig. 120). Cerci rather broad and short, length about 1.5 times length of extended parts of hypovalvae (fig. 118) *cornifera*
 - Caudal margin of sternite 8 gradually curved towards hypovalvae. Cerci long and slender, nearly twice as long as extended parts of hypovalvae 18
 - 18. Antennal flagella weakly bicoloured, segments brownish with narrow yellowish basal nodes, sometimes vague. Median

- stripe on scutum 1 anteriorly twice as broad as posteriorly. Pterostigma yellow-brown to brown *okefenoke*
- Antennal flagella distinctly bicoloured, segments brown with yellowish basal parts. Median stripe on scutum 1 anteriorly 1.5 times as broad as posteriorly. Pterostigma (dark) brown, usually with a darkened seam along costal margin *urocera*
- 19. Head with a short triangular, usually weakly tinted occipital marking. Postgenae yellowish. Entire thorax highly polished *breviicornis*
- Head without occipital marking. Postgenae with grey-brown spots along eye-margin. Scutal surface of thorax more or less subshining *tenuis*

SECTION 1

Nephrotoma breviicornis (Doane, 1908)

Figs. 6-18, diagram 1, map 2

Doane, 1908: 176, key, 178-9, descr (as *Pachyrhina*); Dietz, 1918: 111, key, 119-120, 137, 138, comp (as *Pachyrhina brevicornis*); Rogers, 1918: 3, loc, biol (as *Pachyrhina brevicornis*); Alexander, 1919a: 172, comp; Alexander, 1919b: 817, loc, 936, key, 937, comp; Dietz, 1921: 262, comp (as *Pachyrhina brevicornis*); Alexander, 1925b: 170, loc, 172, biol; Alexander, 1926: 240, locs; Alexander, 1927a: 229, loc, biol; Alexander, 1928: 56, locs; Leonard, 1928: 699, loc; Alexander, 1929c: 297, loc; Alexander, 1931: 138, loc; Winn & Beaulieu, 1932: 8, locs (partim?), all (Alexander, 1925b to Winn & Beaulieu, 1932) as *breviicornis*; Dickinson, 1932: 165-8, locs, 215, key, 219, note, fig wing; Alexander, 1941: 287, note (as *breviicornis*); Procter, 1938: 283, loc; Alexander, 1942: 224, key, 225, comp, sh descr, distr, locs (partim; Connecticut, Union = *N. tenuis*), 226, 233, comp, note; Rogers, 1942: 19, biol, 46, biol, 61, loc, dates, biol; Alexander, 1962: 8, locs; Frommer, 1963: 581, morph; Alexander, 1965: 20, distr; Byers, 1976: 7-8, notes, 37, figs hypop; Byers, 1979: 605, biol, loc, distr, 612, loc.

Nephrotoma approximata (Dietz, 1918).

Dietz, 1918: 112, key, 136-7, descr, comp, pl. V, fig wing, pl. VII, fig hypop (as *Pachyrhina*); Alexander, 1919b: 826, distr, 937, comp, sh descr, distr; Alexander, 1942: 224, key, 225, comp, sh descr, distr, note syn; Alexander, 1965: 20, syn.

Nephrotoma stigmatica (Dietz, 1918).

Dietz, 1918: 112, key, 137-8, descr, 138, comp, pl. V, fig wing, pl. VII, fig hypop (as *Pachyrhina*); Alexander, 1919b:

826, distr, 937, comp, sh descr, distr; Dietz, 1921: 261, loc (as *Pachyrhina*); Brimley, 1938: 319, loc (= *breviorcornis*?); Alexander, 1941: 284, loc (see Brimley, 1938), 287, comp; Alexander, 1942: 224, key, 233, comp, sh descr, distr, note syn; Alexander, 1965: 21, syn.

Material examined

Type material: *Pachyrhina breviornis* was described by Doane (1908) from one male, CAS, labelled: "Battle Creek Mich." "type" "*Pachyrhina breviornis* Doane." The specimen was not examined by me, but is known from detailed notes and figures supplied by Byers, who saw the type in 1962.

Pachyrhina approximata was described by Dietz (1918) from one male (holotype) and five topotypic females. The holotype, condition fair, ANSP, type no. 6449, is labelled: "Wyalusing, Bradford Co. Pa. VIII.2 '16" "HOLOTYPE" "HOLOTYPE *Pachyrhina approximata* W. G. Dietz 6449". The paratypes were not found in the ANSP-collection.

Pachyrhina stigmatica was described by Dietz (1918) from two males. The holotype, condition poor, ANSP, type no. 6462, is labelled: "Wyalusing, Bradford Co., Pa. VIII.2 '16" "HOLOTYPE" "HOLOTYPE *Pachyrhina stigmatica* W. G. Dietz 6462". The topotypic paratype was not found there. The synonymy of both *approximata* and *stigmatica* with *breviorcornis* was proposed by Rogers (in Alexander, 1942) and confirmed by Alexander (1965) and Byers (1961, in literis).

Other material: 117 ♂, 64 ♀, from the following states and provinces: Colorado (2♂, 4♀), Connecticut (1♀), Maine (1♂), Maryland (1♀), Michigan (88♂, 36♀), Minnesota (7♂, 5♀), Nebraska (1♂, 1♀), New Hampshire (4♂, 1♀), New Mexico (1♂), New York (4♂, 2♀), North Dakota (1♂, 1♀), Nova Scotia (1♀), Ohio (1♀), Ontario (3♂, 1♀), Pennsylvania (1♂, 6♀), Quebec (1♂), South Dakota (1♂, 2♀), Wisconsin (2♂), Wyoming (1♀).

Diagnostic features

N. breviornis is most similar to lightly coloured forms of *occipitalis*, from which it differs in the

yellow-based flagellar segments of the antennae. Confusion, especially of females, also appears to have occurred with *eucera*, *eucerooides*, *gracilicornis* and *tenuis*, all species with bicoloured, yellow-based antennal flagellar segments. *N. breviornis* can be distinguished from these species by the following combination of characters: the vague to clearly indicated (pale) brown occipital marking, the yellow palps and the (dark) brown lateral parts of the rostrum, the hardly or weakly darkened anterolateral corners of scutum 2, the yellow pterostigma, the nearly continuous and anteriorly somewhat more accentuated spots on abdominal tergites and the usually distinct brown (sub)terminal darkening. In hypopygial characters *breviorcornis* strongly resembles *occipitalis*, *excelsior*, *oosterbroeki* and *vittula*.

Description

Body length: ♂ 11-15 mm, ♀ 15-20.5 mm.

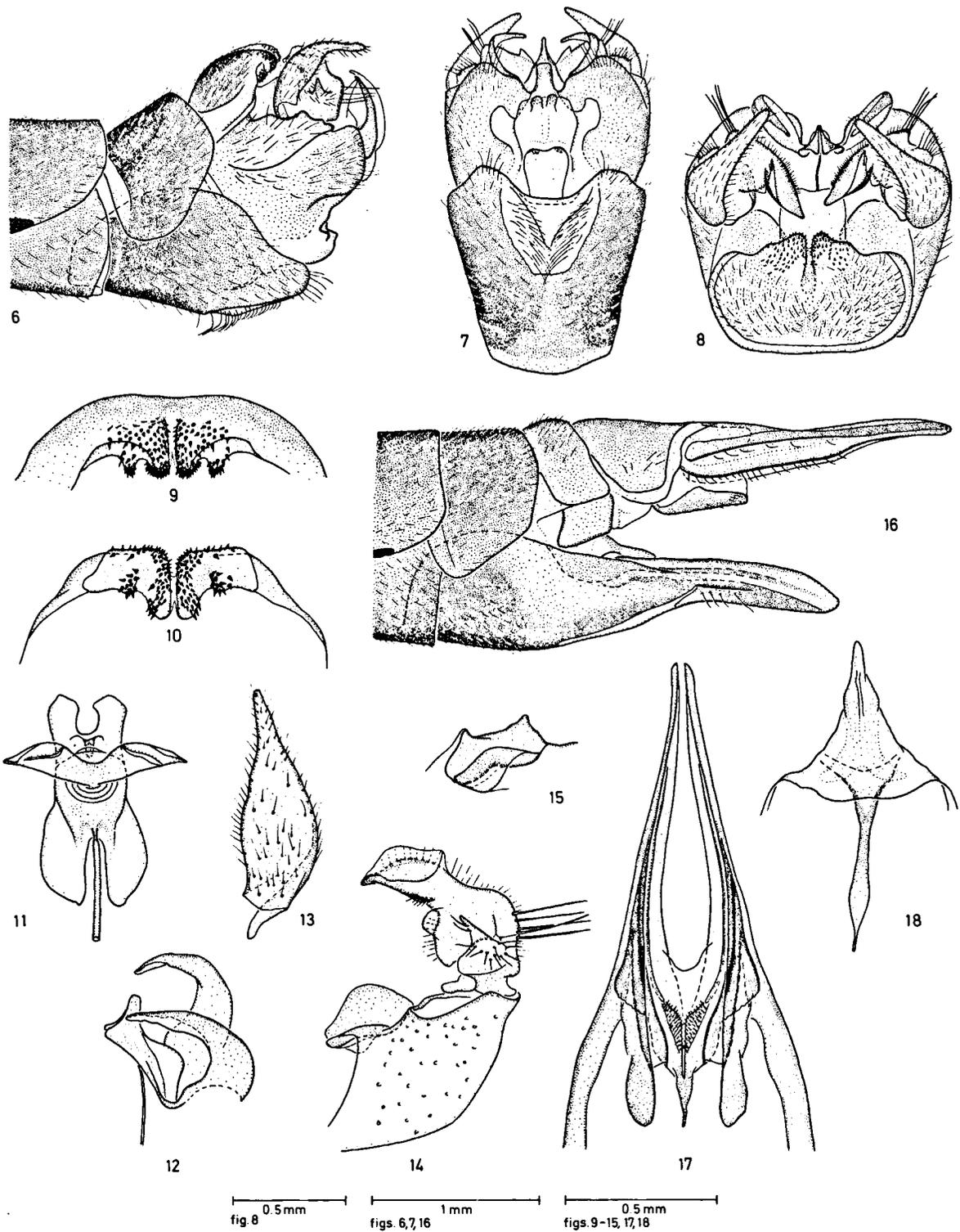
Wing length: ♂ 10-14.5 mm, ♀ 12-15 mm.

Antennal length: ♂ 4.3-5.3 mm, ♀ 2.7-3.4 mm.

Body colour pale to dark yellow.

Head: Antennae 13-segmented; scape yellow, pedicel sordid yellow, first flagellar segment yellowish and apically darkened, following flagellar segments distinctly bicoloured with yellow to yellow-brown basal nodes and dark brown distal parts; second and following flagellar segments in ♂ slightly incised beneath, in ♀ cylindrical; verticillar hairs reaching up to nearly length of segments, in ♀ up to as long as segments. Rostrum yellow with a usually light, sometimes dark brown spot on each side. Palps yellowish. Frons, tubercle and anterior part of vertex opaque, remainder of head shining yellow to sordid yellow; transition of opaque to shining on vertex sometimes marked with brown spots. Occipital marking short triangular, usually only anterior part of it tinted brown to light brown.

Thorax: Pronotum yellowish; median part sordid to light brown-yellow. Rest of thorax highly polished. Stripes ranging from light brown to dark red-brown, usually somewhat



Figs. 6-18. *N. breviorcornis*; 6-15, ♂; 16-18, ♀. 6. hypopygium, lateral view; 7. hypopygium, caudo-ventral view; 8. hypopygium, dorsal view; 9. tergite nine, caudal view; 10. tergite nine, ventral view; 11. semen pump, dorsal view; 12. adminiculum, lateral view; 13. od, outside; 14. id, inside; 15. sp2, from inside; 16. ovipositor, lateral view; 17. hypovalvae, dorsal view; 18. fused valvulae and furca, dorsal view.

fading caudally. Median stripe sometimes vaguely divided by a yellow longitudinal line; lateral stripes on scutum 1 straight. Prescutum usually with a pale brownish tinge laterally. Transverse suture uncoloured, sometimes brown-tinted medially; antero-lateral corners of scutum 2 not tinted or pale brown. Scutellum and narrow anterior stripe and caudal part of mediotergite transparently dark to brown-yellow. Pleura largely bright yellow to whitish yellow with a few light red-yellow markings. Legs yellowish, slightly or distinctly darkened apically and at tips of separate segments. Tibiae of middle and hind legs distinctly shorter than metatarsi. Tarsal claws untoothed. Wings hyaline, costal region light yellow; pterostigma yellowish, sometimes with a few macrotrichia; cell m1 varying from sessile to long-petiolate.

Abdomen: Dorsal stripe on tergites 1-7 light brown to brown, not broader than scutellum, sometimes ill-defined, usually with darker spot on anterior part of tergite and slightly interrupted near posterior margin; in ♀ usually more distinct and continuous. Lateral stripe consisting of two elongate brown spots on each side of segment, anterior one in ♂ usually small and pale, in ♀ more distinct. Sternites anteriorly distinctly marked with dark brown oblong spots, in ♀ more elongate. Tergites 8 and 9 and basal part of sternite 8 varying from strongly to faintly fuscous.

Hypopygium: Posterior margin of tergite 9 narrowly incised medially, posterior extension on dorsal side sparsely set with black spines; ventral surface (fig. 10) abundantly set with black spines, with small lateral protrusions. Details of inner and outer dististyles figs. 13, 14; crest of id broad, lateral projection set with black hairs and ending spine-like; posterior margin bulging, with some long and thick black setae. Sp2 with basally a small external and a broad internal transparent rim (fig. 15). Median incision of hind margin of sternite 8 widely U-shaped (fig. 7), reaching to nearly half of sternal length, largely closed by a thick membrane which is rather abundantly set with medially directed white-yellow hairs. Ventro-caudal surface of sternite 9 with a somewhat

bulbous and folded membranous area with a curved offshoot at each side (fig. 7). Adminiculum with slender, pointed and dorsally curved gonapophyses; median part cone-like with a slight bulge anteriorly (fig. 12). Semen pump fig. 11. Intromittent organ reaching into fourth segment, in length varying from 11 to 20 mm. Breadth of hypopygium less than breadth of scutum 1.

Ovipositor: Cerci with a sudden narrowing in apical half (fig. 16); hypovalvae ending in a somewhat downcurved blunt point. Dorsal view of hypovalvae, furca and fused valvulae see figs. 17, 18; rostral extensions well developed, no sclerotized internal arch and a very narrow, rostrally prolonged internal shell (as in *occipitalis*, *excelsior* and *vittula*).

Biology (diagram 1)

N. breviorcornis is recorded from "...underbrush along the river" (Rogers, 1918), "woods" and "bog" (Alexander, 1925b, 1927a), flood plain woods and along brooks and creeks, especially

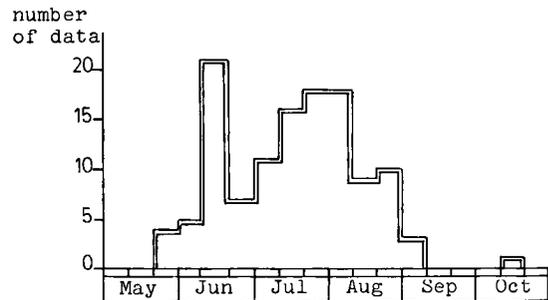
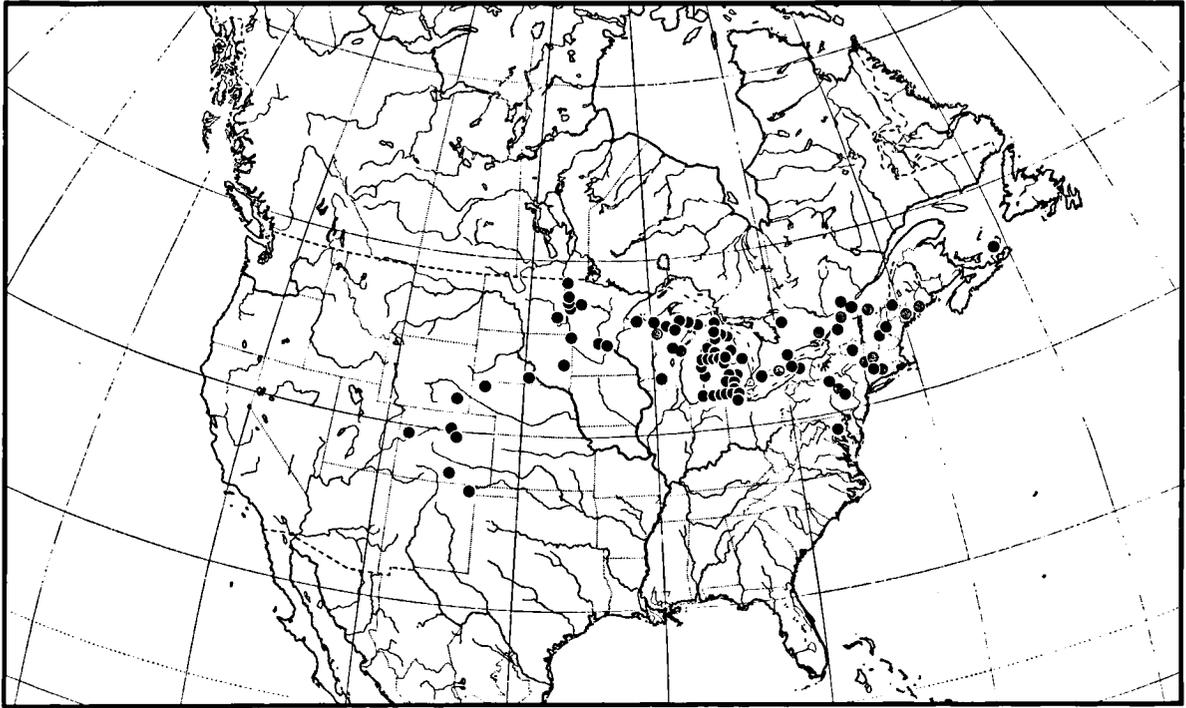


Diagram 1. Period of flight of *N. breviorcornis*.

at the open or partially shaded grassy stream banks (Rogers, 1942) and "low streamside vegetation" (Byers, 1979). The altitude seems not to exceed 1500 feet (450 m). The immature stages are unknown, Rogers (1942) observed a female "ovipositing into wet soil at the edge of a grass clump, some six inches from the margin of a brook. This took place about three hours before sunset in a partially shaded situation". This rather abundant species is on the wing from the end of May to the first decade of days of September (one record of October 20,



Map 2. Distribution of *N. breviorcornis*, based on material examined (black dots) and literature (stippled dots).

Maryland). Rogers (1942) supposed two clear-cut generations a year in Michigan, also slightly indicated by the two-peaked diagram. The sex-ratio of the museum-specimens is remarkable: about twice as many males as females.

Distribution (map 2)

The studied material reveals that *breviorcornis* does not occur as far south as mentioned by Alexander (1942, 1965) and Byers (1979), who suppose South Carolina to be the southern limit. Moreover, the range of *breviorcornis* reaches westward to the Rocky Mountains, where specimens originated from New Mexico: Union County; Colorado: Platte Cañon, Denver, Garfield County, Huerfano County; Wyoming: Platte County. The other specimens originated from the following localities or counties: Connecticut: Litchfield Co.; Maine: Franklin Co.; Maryland: Prince Georges Co.; Michigan: 35 counties; Minnesota: Clearwater, Norman, Traverse, Polk, Hennepin, Kittson

and Wright co's.; New Hampshire: Pinkham Notch, Grafton Co.; Nebraska: Dawes Co.; New York: Erie, St. Lawrence, Fulton co's.; North Dakota: Cass Co.; Nova Scotia: Margaree River on Cape Breton Isl.; Ohio: Lucas Co.; Ontario: Belfountain (Peel Co.), Bothwell, Fort Erie; Pennsylvania: Bradford, Carbon co's.; Quebec: Lachine; South Dakota: Brookings, Tripp co's.; Wisconsin: Oconto Co. The localities "Matapedia, Quebec" (Winn & Beaulieu, 1932: 8) and "Raleigh, North Carolina" (Brimley, 1938: 319) are situated far outside the present-known range and are probably based upon misidentifications. In the literature can be found supplementary localities for Quebec, Ontario, Maine, Massachusetts, Connecticut, New York, Pennsylvania and Wisconsin.

***Nephrotoma occipitalis* (Loew, 1864)**

Figs. 19-31, diagram 2, map 3

Loew, 1864: 65, descr, comp, 66, comp (as *Pachyrrhina*); Osten Sacken, 1878: 40, loc (as *Pachyrrhina*); Loew, 1879:

1, note, 3, key (as *Pachyrrhina*); Aldrich, 1905: 98, loc (as *Pachyrrhina*); Doane, 1908: 174, note, 175, key (as *Pachyrrhina*); Dietz, 1918: 111, key (as *Pachyrrhina*); Alexander, 1919b: 782, 784, 786, 826, locs, 936, key (presumably partim; Washington DC = ? *gracilicornis*); Alexander & McAtee, 1920: 396, key, 397, loc (Plummers Isl. = ? *gracilicornis*); Dietz, 1921: 261, loc (Hazleton, Pennsylvania, VII-11-1913 = *gracilicornis*) (as *Pachyrrhina*); Alexander, 1927b: 216, loc; Alexander, 1928: 57, loc; Alexander, 1929a: 246, loc; Winn & Beaulieu, 1932: 8, loc; Alexander, 1942: 223, key, 230, sh descr, 231, distr; Alexander, 1949a: 266, loc, biol, 277, loc, note; Alexander, 1965: 22, distr; Cole, 1969: 53, distr; Byers, 1979: 605-6, biol, loc, distr.

Nephrotoma snowii alternata (Dietz, 1918).

Dietz, 1918: 109, key, 117, comp, descr (as *Pachyrrhina*); Alexander, 1965: 22, distr; Cole, 1969: 53, distr.

As *N. vittula*: Johnson, 1925: 35, locs (presumably partim); Alexander, 1926: 240, loc; Alexander, 1962: 8, locs.

As *N. snowii*: Alexander, 1948: 17, loc, note.

Material examined

Type material: *Pachyrrhina occipitalis* Loew, 1864 was described from the "♀" only. Preserved in the MCZ is a single type-labelled female of *occipitalis*, considered to be the holotype, type no. 10314, condition rather good, labels as follows: "R.A." with "Kennicott" on the reverse, "occipitalis m." "10314" "Type.". The original description gives as type-locality: "Hudsons Bay Territory; Kennicott", while Osten Sacken (1878) adds to this "Yukon River". In the past century Hudsons Bay Territory referred to all of Canada (Stielers Handatlas, 1872). The type locality of *occipitalis* therefore is most probably in Yukon (Yukon River).

Pachyrrhina snowii alternata Dietz, 1918 was described from two males from Colorado, both preserved in the ANSP, type no. 6440. The holotype, condition fair, is labelled: "N.W. Col 7/20/11" "HoloTYPE" "HOLOTYPE *Pachyrrhina snowii alternata* W. G. Dietz 6440". The paratype is from "8/19/15" "Osler. Platte Cañon Col.". The synonymy of *snowii alternata* with *occipitalis* was already proposed by Byers (1961, in literis).

Other material: 128♂, 90♀, from the following states and provinces: Alaska (49♂, 34♀), Alberta (5♂, 14♀), British Columbia (46♂, 16♀), Colorado (3♂, 2♀), Maine (2♂,

2♀), Manitoba (2♀), Michigan (1♀), Minnesota (4♀), Newfoundland (3♂, 2♀), New Hampshire (1♂), North Dakota (1♀), Northwest Territories (4♂, 2♀), Ontario (2♂, 2♀), Quebec (10♂), Saskatchewan (1♀), South Dakota (1♂, 1♀), Utah (1♀), Washington (1♂, 2♀), Wisconsin (1♀), Wyoming (1♂, 1♀), Yukon (1♀).

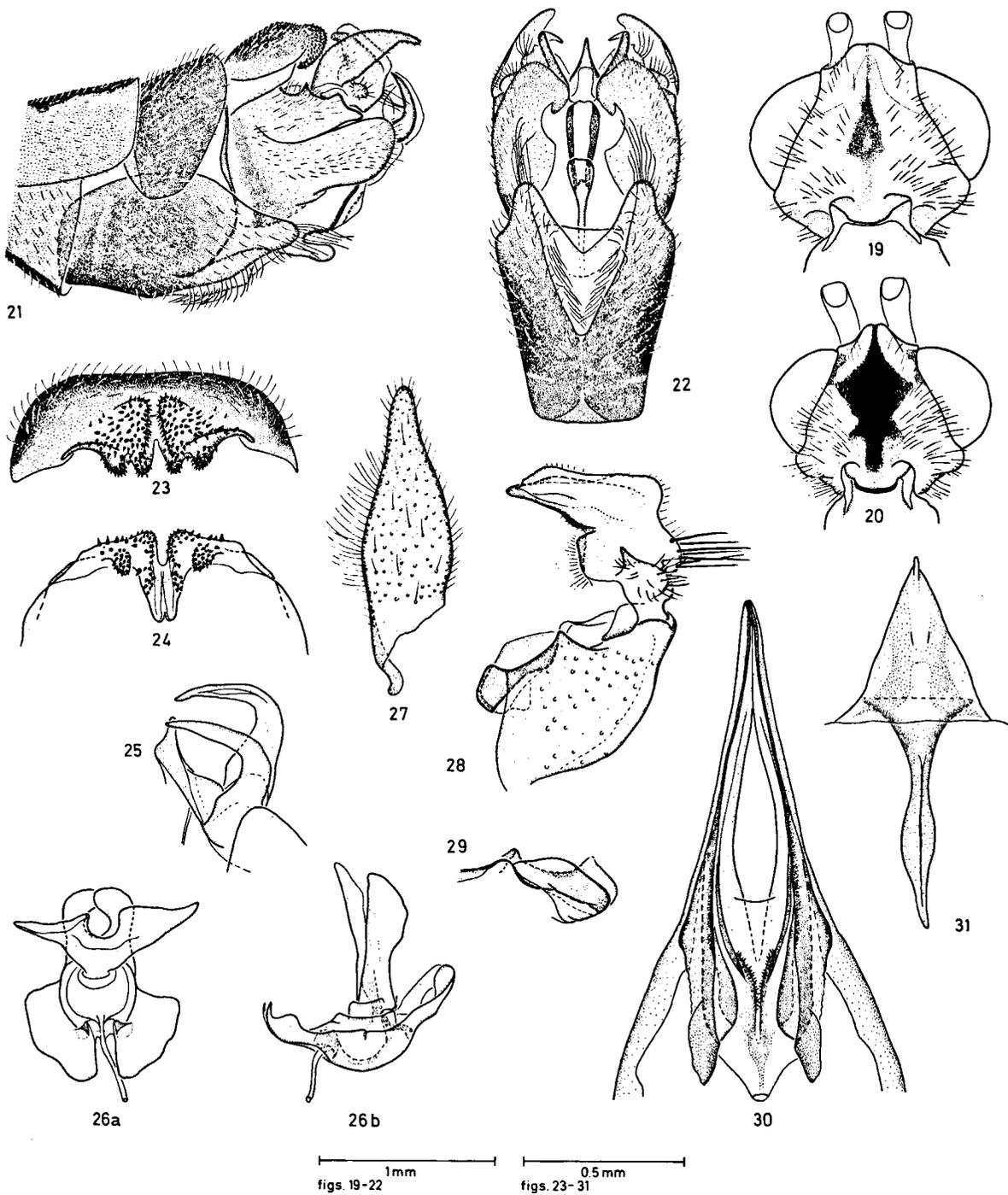
Diagnostic features

N. occipitalis resembles *penumbra* in general appearance (the differences are mentioned under the diagnostic features of *penumbra*) and is a close relative of *breviorcornis*, *excelsior*, *oosterbroeki* and *vittula*. *N. occipitalis* differs from *breviorcornis* in the more or less uniformly brownish antennal flagella (contrasted with yellow-based flagellar segments in *breviorcornis*) and the number of antennal segments (in ♂ 14 or 15, in ♀ 13 or 14, while in *breviorcornis* both sexes have 13-segmented antennae). *N. occipitalis* can be separated from *excelsior*, *oosterbroeki* and *vittula* also by the number of antennal segments, the yellow-brown pterostigma and the caudally fading colouration of the thorax (*excelsior*, *oosterbroeki* and *vittula* have 13-segmented antennae and a (dark)brown pterostigma, while *excelsior* and *vittula* have the thoracic stripes hardly fading or not fading posteriorly).

Description

Body length: ♂ 10-14 mm, ♀ 13.5-18.5 mm.
Wing length: ♂ 10-14 mm, ♀ 12-15.5 mm.
Antennal length: ♂ 3.9-5.6 mm, ♀ 2.4-3.4 mm.

Body colour ranging from light to dark yellow. Head: Antennae of ♂ 14 or 15-segmented, flagellar segments two and following slightly reniform, verticillar hairs at most reaching length of segments; antennae of ♀ 13-, sometimes 14-segmented, segments cylindrical, verticils reaching or slightly exceeding length of segments. Antennae of both sexes with yellow scape, sordid to brown-yellow pedicel and more or less uniformly light to dark brown flagellum. Rostrum yellow, with a (light) brown spot,



Figs. 19-31. *N. occipitalis*; 20-29, ♂; 19, 30-31, ♀. 19. head, dorsal view, ♀ from Alberta; 20. head, dorsal view, ♂ from Alaska; 21. hypopygium, lateral view; 22. hypopygium, caudo-ventral view; 23. tergite nine, caudal view; 24. tergite nine, ventral view; 25. adminiculum, lateral view; 26. semen pump: a, dorsal view, b, lateral view; 27. od, outside; 28. id, outside; 29. sp2, from inside; 30. hypovalvae, dorsal view; 31. fused valvulae and furca, dorsal view.

sometimes vague on each side. Palps yellow to brown. Frons, tubercle and rostro-lateral parts of vertex opaque yellow, remainder of head shining yellow; dark brown occipital marking with the base always narrowed and varying in shape from narrowly triangular or spool-shaped to more star-shaped, expanded, reaching over half length of vertex to or over frontal tubercle; frequently small brown orbital spots between eye and tubercle and sometimes a brown spot between antennal bases.

Thorax: Entire thorax polished except subopaque yellow to brownish median part of pronotum, lateral parts of pronotum yellowish or with distinct brown spots and brown posterior margins. Stripes red-brown to black-brown, colours fading caudally. Transverse suture hardly to distinctly reddish-brown tinted medially; antero-lateral corners of scutum 2 vaguely to distinctly red-brown tinted. Scutellum transparently dark to brown-yellow, occasionally with a narrow brown median line; narrow antero-median stripe and broad caudal part of mediotergite also transparently dark to brown-yellow. Pleura yellow to light yellow with light reddish to (dark)brown markings; dashes on paratergites and lateral parts of prescutum weak to distinct, posterior part of katatergite (light) brown, not blackened. Legs dark to brown-yellow with darkened femoral and tibial tips and tarsi. Metatarsi of middle and hind legs usually longer than corresponding tibiae, sometimes of about equal length. Tarsal claws untoothed. Wings hyaline to yellowish tinted, costal region yellow; pterostigma yellowish, with 0 to 20 macrotrichia; cell m1 ranging from sessile to long-petiolate.

Abdomen: Dorsal stripe on tergites 1-7 usually distinct and well-defined, brown to dark brown, usually about as broad as scutellum or slightly broader and more or less continuous. Lateral stripes on the tergites 2-7 ranging from distinctly dark brown and slightly interrupted to very vague. Sternites marked with narrow longitudinal (dark)brown lines, usually with a more thickened spot anteriorly; ventral stripe ranging from nearly continuous to very vague

and largely obliterated. Tergites 8, 9 and sternite 8 very weak to distinctly dark brown fuscous; remainder of (sub)terminal segments yellowish.

Hypopygium: Hind margin of tergite 9 narrowly incised medially, medio-caudal parts of posterior extension somewhat pronounced, this and protrusions on ventral surface set with black spines (figs. 23, 24). Outer dististyle fig. 27; crest of inner dististyle broad and extended at both ends, posterior margin weakly bulging and set with some thick, long brown hairs, lateral projection with a small point (fig. 28). Sp2 with two transparent extensions at base (fig. 29). Sternite 8 with a deep V-shaped incision, largely covered by a thin membrane rather abundantly set with short, thin yellow hairs (fig. 22). Membranous area on ventro-caudal surface of sternite 9 with a finger-like or clubbed medisternal appendage, two narrow and slightly sclerotized lateral plates and two curved, acutely pointed caudo-lateral offshoots (fig. 22). Adminiculum with dorsally curved and slender gonapophyses; median part slenderly tipped and slightly extended anteriorly (fig. 25). Semen pump fig. 26a, b. Intramittent organ long and winding, reaching into the third abdominal segment, length varying from 19.5 to 24 mm. Hypopygium not as broad as scutum 1.

Ovipositor: Cerci tapering with very slender apical parts and slightly downcurved tips; hypovalvae with obtusely pointed tips. Internal base of hypovalvae with well-developed rostral extensions and a rostrally prolonged internal shell (fig. 30) (as in *breviorcornis*, *excelsior* and *vitula*). Fused valvulae and furca fig. 31.

Variability: The most northern specimens are in general more strongly coloured: occipital marking longer and darker, more blackened thoracic and abdominal stripes and stronger (sub)terminal darkening.

Biology (diagram 2)

N. occipitalis is a widely distributed and locally abundant boreal species, belonging to the Hudsonian, high Canadian Life zone (Alexander,

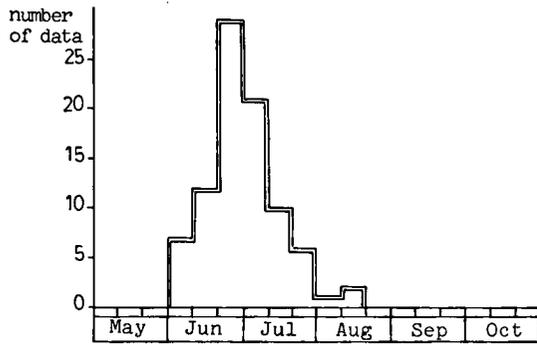


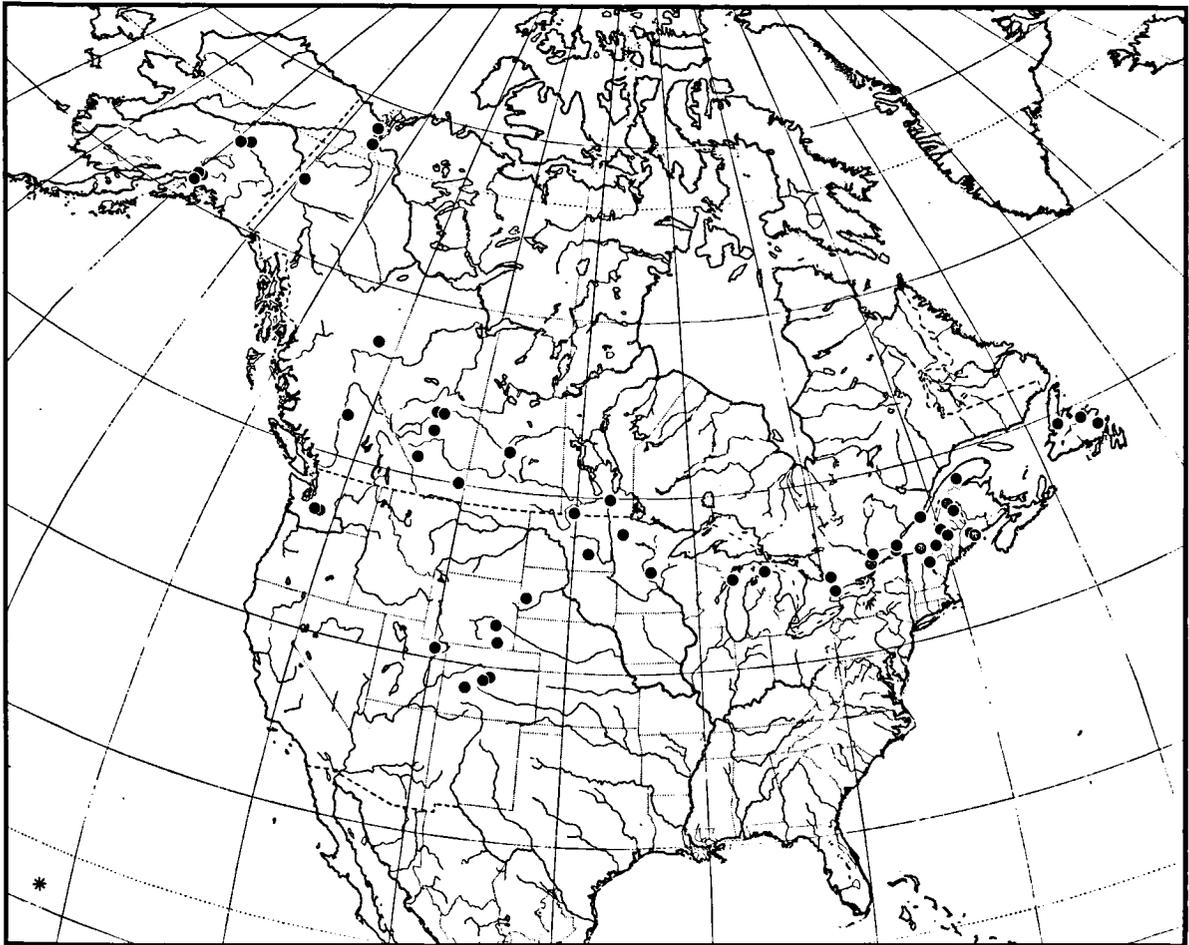
Diagram 2. Period of flight of *N. occipitalis*.

1942); recorded from low to dense vegetation along river banks and swamp margins (Alexander, 1949a; Byers, 1979; labels) and from drier woods of birch and aspen with ground

cover of grasses and broad-leaved herbs (in Minnesota, Byers, 1979). The species can be found at altitudes up to 3770 feet (1150 m), but there is one record of 7500 feet (2285 m) (Colorado). A larva of *occipitalis*, captured in Matanuska Valley, Alaska, on May 23, was reared on lettuce and the adult emerged on June 6 (information on label); there is no further knowledge about the immature stages of *occipitalis*. The flight-period ranges from the beginning of June to the third week of August with a distinct peak in the last half of June and the first half of July.

Distribution (map 3)

Only recently was discovered that *occipitalis* has a holarctic distribution, with a few localities in



Map 3. Distribution of *N. occipitalis* in North America, based on material examined (black dots) and literature (stippled dots). * The species is also known from a few localities in the Eastern Palearctic region.

the Palaearctic region from the Krasnoyarsk region to the Kamchatka peninsula. In the Nearctic region *occipitalis* is more widely distributed than known from the literature. The range stretches from Newfoundland, Maine and New Hampshire in the east to Colorado in the south, Washington in the west and up to Northwest Territories and Alaska in the north. Specimens originated from the following localities and counties: Alaska: Anchorage, Fairbanks, Nenana, Palmer and Matanuska Valley (7 mi SW of Palmer); Alberta: Bilby (30 mi W of Edmonton), Cochrane (20 mi NW of Calgary), Edmonton, Gull Lake and Medicine Hat; British Columbia: Alaska Hwy mileage point 118 (beyond Wonowon) and 150 Mile House (14 mi E of Williams Lake); Colorado: Platte Cañon on border of Douglas and Jefferson co's. (paratype *snowii alternata*), State Creek (Ramp St.) not located, Gunnison in Gunnison Co., South Park in Park Co. and NW Colorado without further specification (holotype *snowii alternata*); Maine: Ashland in Aroostook Co., Capens (on Moosehead Lake) in Somerset Co., Greenville in Piscataquis Co. and Rangeley in Franklin Co.; Manitoba: Turtle Mts. and Winnipeg; Michigan: Cheboygan Co.; Minnesota: Lake Itasca in Clearwater Co. and Vineland in Mille Lacs Co.; Newfoundland: Blue Pond Camp (not located), Deer Lake (3 mi W of Village), Lewisporte and Terra Nova Nat. Park; New Hampshire: Bretton Woods in Coos Co.; North Dakota: Jamestown (City Park) in Stutsman Co.; Northwest Territories: Aklavik, Ft. McPherson; Ontario: Orillia, Ottawa and Toronto; Quebec: Amqui (Gaspé Peninsula), Beaulieu (SW point of Ile d'Orleans), Chateauguay (S of Montreal) and Montreal; Saskatchewan: Saskatoon; South Dakota: Sylvan Lake (Harney Nat. Forest) in Custer Co.; Utah: Leeton in Uintah Co.; Washington: Longmire (Mt. Rainier N.P.) in Pierce Co. and Naches River (outside Mt. Rainier N.P.) in Yakima Co.; Wisconsin: Door Co.; Wyoming: Laramie in Albany Co. and 25 mi S of Douglas in Converse Co.; Yukon: Dawson and Yukon River (holotype). Supplementary localities in literature for Maine, Ontario and Quebec.

Nephrotoma vittula (Loew, 1864)

Figs. 32-44, 45, map 4

Loew, 1864: 63-64, descr (as *Pachyrrhina*); Osten Sacken, 1878: 40, loc (as *Pachyrrhina*); Loew, 1879: 2, key (as *Pachyrrhina*); Aldrich, 1905: 99, locs (partim: White Mts., N.H. = *penumbra*) (as *Pachyrrhina*); Doane, 1908: 174, key, 177, comp (as *Pachyrrhina*); Alexander, 1915b: 466, note, 468, comp; Dietz, 1918: 109, key (as *Pachyrrhina*); Alexander, 1919b (partim): 829, biol, 935, key; Alexander, 1940a: 119, note; Alexander, 1942: 223, key, 234-35, sh descr, distr; Alexander, 1949b: 99, comp; Alexander, 1965: 22, distr; Cole, 1969: 53, distr; Byers, 1976: 9, syn.

Presumably referring to *N. penumbra*: Slosson, 1895: 320, loc (according to Alexander, 1940) (as *Pachyrrhina*); Alexander, 1919b (partim): 782, 785, 826, locs.

Presumably referring to *N. occipitalis*: Johnson, 1925: 35, locs; Alexander, 1926: 240, loc; Alexander, 1962: 8, locs. Referring to *N. occipitalis*: Alexander, 1948: 17, loc, note.

Nephrotoma snowii (Doane, 1908).

Doane, 1908: 174, key, 176-77, descr, comp (as *Pachyrrhina*); Dietz, 1918: 109, key, 117, comp (as *Pachyrrhina*); Alexander, 1949a: 277, comp; Alexander, 1949b: 99, comp; Alexander, 1965: 22, distr (as *N. snowii snowii*); Cole, 1969: 53, distr (as *N. snowii snowii*); Byers, 1976: 9, notes, comp, syn, 37, figs hypop.

Material examined

Type material: Loew (1864) described *Pachyrrhina vittula* on the basis of "♂" only, without mentioning the number of specimens. In the MCZ there are five males pinned beside the *vittula* label, all from Hudsons Bay Territory; only one male bears a red type label, considered the holotype, type no. 10312, condition rather good, labels as follows: "H.B.T." "153" "vittula n.sp." "Loew Coll." "10312" "Type" (the original description gives as type-locality "Hudsons Bay Territory; Kennicott", see for note on Hudsons Bay Territory: type-material of *occipitalis*); the other four males (one of them is *N. occipitalis*), all from the Osten Sacken-collection and labelled "H.B.T. Kennicott", are supposed not to belong to the type-series.

The description of *Pachyrrhina snowii* Doane, 1908 was based on one male and one female from "Wyoming"; only the male is preserved in the CAS-collection and was designated as lectotype by Byers (1976). Its condition is rather good, labels as follows: "Near Lander Wyo.

5000 to 8000 ft. July Roy Moodie” “24” “Pachyrhina snowii Doane” and lectotype-label. The specimen was not examined by me but is known from detailed notes and figures, supplied by Byers, who has seen the type in 1962. The synonymy of *snowii* with *vittula* was already proposed by Byers (1976).

Other material: 20♂, 3♀, from the following states and provinces: Alaska (6♂, 1♀), Alberta (6♂, 1♀), Colorado (4♂, 1♀), Wyoming (1♂), Canada, locality not specified but presumably Yukon (3♂).

Diagnostic features

The three strongly similar species *vittula*, *excelsior* and *oosterbroeki* are closely related to *breviorcornis* and *occipitalis*, from which they differ in the 13-segmented antennae in both sexes, the completely black-brown antennal flagella, the (dark)brown pterostigma, the more or less unicolourous dark to black-brown thoracic stripes (fading caudally in *oosterbroeki*), the large black-brown occipital marking and the strong black (sub)terminal darkening. In general appearance *vittula*, *excelsior* and *oosterbroeki* also resemble *penumbra* (differences mentioned under that species) and *ramulifera*, from which they easily can be separated by the brown spot on each side of the rostrum (absent in *oosterbroeki* and *ramulifera*), the largely shining vertex (rostral half opaque in *ramulifera*) and the un-toothed tarsal claws of the male (toothed in *ramulifera*). There are distinct hypopygial differences between the males of *vittula*, *excelsior* and *oosterbroeki*. Differences between the females however are hard to find. Unlike *vittula* and *excelsior*, *oosterbroeki* has caudally fading thoracic stripes, but as in *vittula* the posterior part of the katatergite is not blackened. Some distinguishing characters of *vittula* and *excelsior* are: the usually brown nasus in *excelsior*, the darker and more abundant markings of the pleura (figs. 45, 46), including the blackened posterior part of the katatergite in *excelsior* (not black in *vittula*), the weakly invaginated anterior margin of the median thoracic stripe in *vittula* (straight in *excelsior*), the completely yellow antero-lateral cor-

ners of scutum 2 in *vittula* and the absence of a medisternal appendage and the short whitish setal bundles on the incision-membrane of sternite 8 in males of *vittula* (contrasted with a distinct medisternal appendage and long whitish setal bundles in males of *excelsior*).

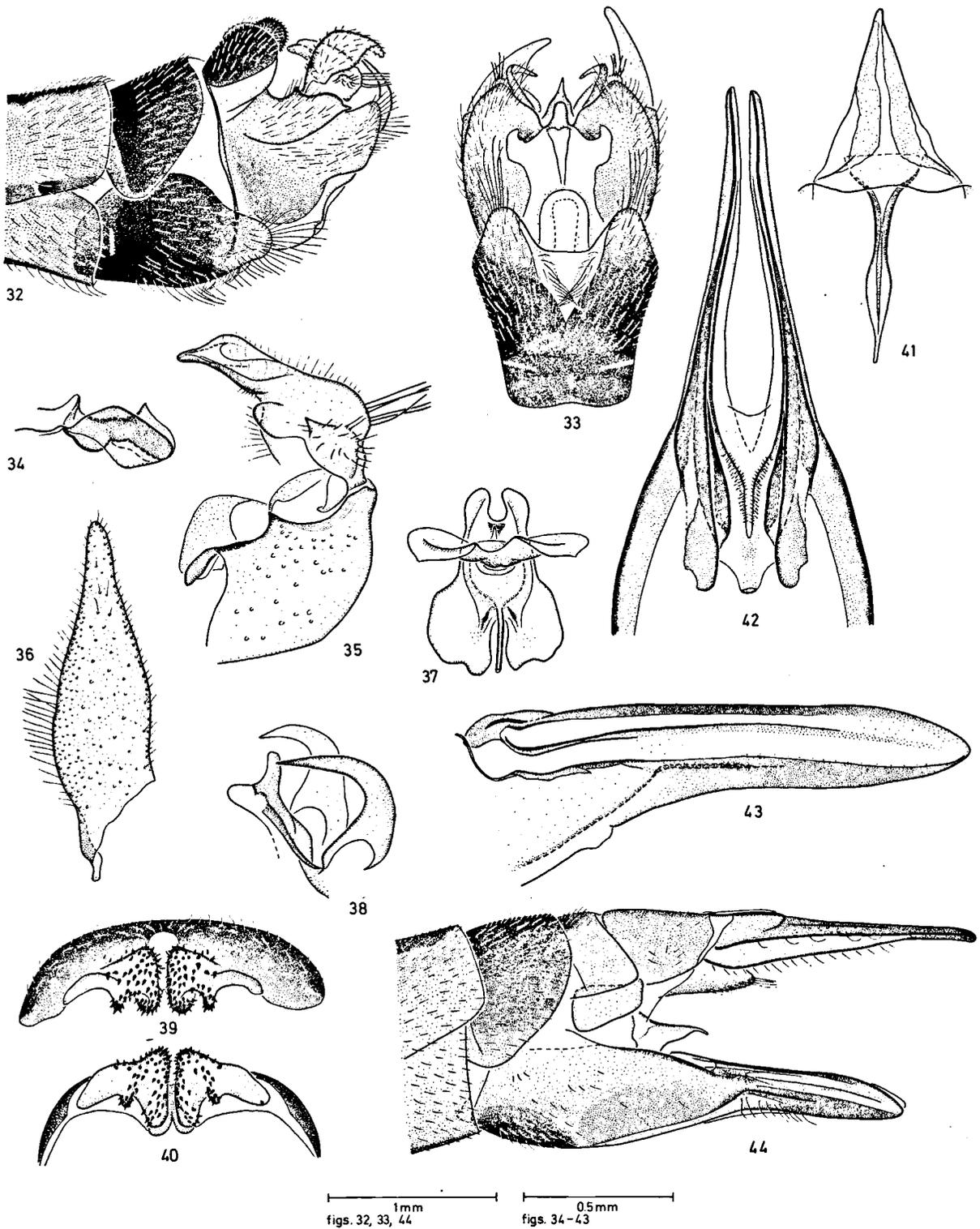
Description

Body length: ♂ 11-13 mm, ♀ 17.5-18.5 mm. Wing length: ♂ 11-13 mm, ♀ 13.5-14.5 mm. Antennal length: ♂ 4.2-4.8 mm, ♀ 3.1-3.3 mm.

Body colour bright yellow.

Head: Antennae of both sexes 13-segmented; in ♂ flagellar segments two and following weakly reniform, longest verticillar hairs reaching to nearly length of segments; in ♀ flagellar segments cylindrical, verticillar hairs reaching or slightly exceeding length of segments. Scape yellow, pedicel yellow to brown, flagellum completely dark brown to black, segments usually more deeply darkened at basal nodes. Shining yellow rostrum with a dark brown spot on each side and two small dark brown stripes on dorsal surface. Palps brown to dark brown, apically paler. Frons, tubercle and narrow rostro-lateral parts of vertex opaque yellow, remainder of head shining (dark)yellow; occipital marking black-brown, band-shaped, broadened near mid-length, sometimes extending to eye-margin, and reaching up to or over tubercle; usually two small orbital spots on level with tubercle and a brown spot on each side of the neck-attachment.

Thorax (fig. 45): Median part of pronotum subopaque, tinted with yellow-brown, lateral parts shining, with a brown dorsal half and black-brown posterior margin. Remainder of thorax shining and bright yellow. Stripes (brown)-black, colours not or hardly fading caudally; anterior margin of median stripe weakly invaginated, lateral stripes occasionally weakly curved down anteriorly. Transverse suture tinted with brown in the middle; antero-lateral corners of scutum 2 yellow. Scutellum transparently brownish, with a narrow brown,



Figs. 32-44. *N. vittula*; 32-40, ♂; 41-44, ♀. 32. hypopygium, lateral view; 33. hypopygium, caudo-ventral view; 34. sp2, from inside; 35. id, outside; 36. od, outside; 37. semen pump, dorsal view; 38. adminiculum, lateral view; 39. tergite nine, caudal view; 40. tergite nine, ventral view; 41. fused valvulae and furca, dorsal view; 42. hypovalvae, dorsal view; 43. right hypovalva, inside; 44. ovipositor, lateral view.

sometimes obliterated, median line. Mediotergite with a transparently light to dark brown, narrow anterior stripe and a broad caudal marking; posterior margin frequently lined with dark brown to black. Pleura with some light to dark brown markings; posterior part of paratergite narrowly tinted with black; posterior part of katatergite transparent to brown-tinted, not blackened. Coxae with (dark) brown spots at bases, femora and tibiae yellow-brown with darkened tips, tarsi brown. Metatarsi of middle and hind legs longer than or as long as corresponding tibiae. Tarsal claws untoothed. Wings hyaline with (dark) brown veins, costal region yellowish, base of cell r3 weakly shaded with brown; pterostigma (dark) brown, sometimes with a few macrotrichia; cell m1 sessile to short-petiolate.

Abdomen: Tergites 1-7 dorsally marked with a dark brown, nearly continuous stripe, as broad as median thoracic stripe or slightly broader; posterior margins of first few tergites sometimes lined with brown. Tergites 2-7 on each side marked with one large black-brown dash and a usually paler and smaller one anteriorly. Spots on sternites 2-7 dark brown, oval- to star-shaped, with usually a narrow caudal tail, markings sometimes obliterated on caudal segments. Tergites 8, 9 and largest part of sternite 8 strongly black-brown fuscous; remainder of (sub)terminal segments yellowish (fig. 32).

Hypopygium: Hind margin of tergite 9 with a narrow U-shaped median incision; posterior extension with black-spined medio-caudal swellings and on ventral surface rather small and black-spined median and lateral protrusions (figs. 39, 40). Details of outer dististyle fig. 36; inner dististyle with a slightly extended, double lobed crest; posterior margin somewhat bulging and set with a few long, dark brown hairs; lateral projection small and pointed (fig. 35). Sp2 with at base two transparent extensions (fig. 34). Hind margin of sternite 8 with a rather deep V-shaped incision, largely covered by a thin membrane set with thin yellow hairs (fig. 33). Membranous area on ventro-caudal surface of sternite 9 slightly bulbous and weakly

extended, with two curved caudo-lateral offshoots (fig. 33). Adminiculum with tapering, dorsally curved gonapophyses; median part with a long slender top and anterior extensions (fig. 38). Semen pump fig. 37. Intromittent organ winding, length varying from 13.4 to 15.5 mm. Hypopygium usually somewhat narrower than scutum 1.

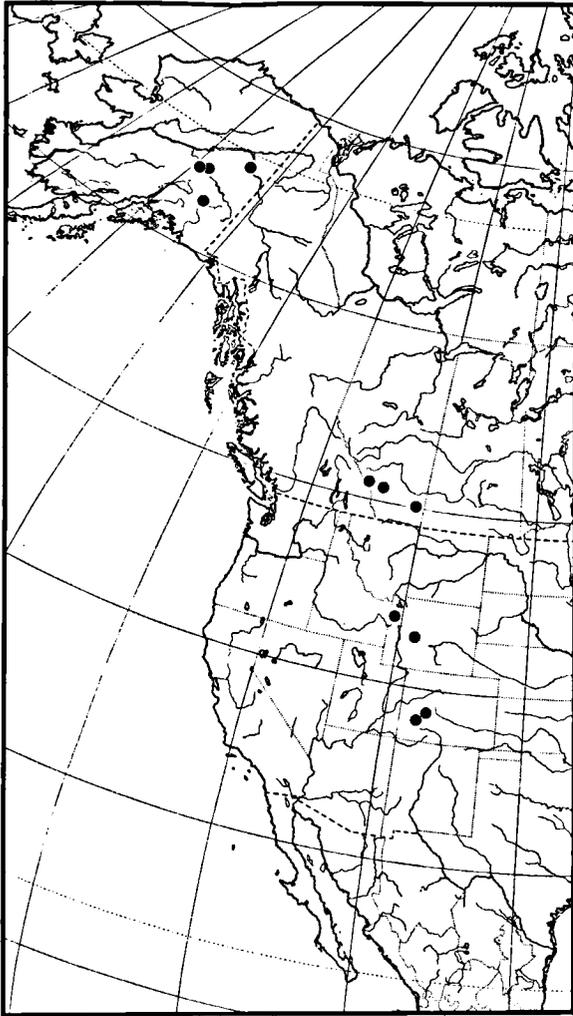
Ovipositor: Cerci tapering, tips very slender; hypovalvae with bluntly pointed tips (fig. 44). Internal base of hypovalvae with well developed rostral extensions and a rostrally prolonged internal shell (as in *breviorcornis*, *occipitalis* and *excelsior*) (figs. 42, 43). Fused valvulae with two slightly sclerotized areas (fig. 41).

Biology

No information about the habitat of *vittula* can be found in the available literature, except that the species belongs to the Hudsonian/high Canadian Life zone (Alexander, 1942). Specimens of *vittula* can be found at altitudes up to 9650 feet (2940 m) (Wyoming). The flight-period ranges from the beginning of June till half August, with a slight peak in July.

Distribution (map 4)

In the past *vittula* has been mixed up in particular with *occipitalis* and *penumbra*, species which occur in the eastern part of the North American continent; as a consequence the distribution-range of *vittula* as mentioned in the literature (Alexander, 1942, 1965; Cole, 1969) is incorrect. The present-known distribution-range of *vittula* covers more or less the Rocky Mountains from Alaska to Colorado. The specimens seen originated from the following localities: Alaska: Circle on the Yukon River, Fairbanks, Nenana and Shaw Creek Rd (Richardson Highway); Alberta: Banff, Calgary (St. George Island) and Medicine Hat; Colorado: Gunnison in Gunnison Co., Ridgway in Ouray Co.; Wyoming: Grand Tetons in Teton Co. and near Lander in Fremont Co. (type-locality of *snowii*, from literature); Hudsons Bay Territory (type-



Map 4. Distribution of *N. vittula*, based on material examined (black dots) and literature (stippled dot = type locality).

locality, probably Yukon River, see under 'material examined').

***Nephrotoma excelsior* (Bergroth, 1888)**

Figs. 46, 47, 48-60, map 5

Bergroth, 1888b: 239-40, descr, 240, comp (as *Pachyrhina*); Aldrich, 1905: 98, loc (as *Pachyrhina*); Doane, 1908: 174, key (as *Pachyrhina*); Dietz, 1918: 109, key, 117, comp (as *Pachyrhina*); Alexander, 1949b: 99, comp; Alexander, 1965: 21, distr; Cole, 1969: 53, distr.

Material examined

Type material: Bergroth (1888b) described *Pachyrhina excelsior* on the bases of one male and

one female from British Columbia (Cascade Ranges). The types of Bergroth were supposed to be preserved in the Zoological Museum of Helsinki, Finland, but they were not found there since long (Lindeberg, i.l. 1981) and no further information about the repository of these types is available. The original description of *excelsior* however is extensive and clear enough to establish a correct diagnosis: because of the four black longitudinal stripes on the abdomen the species belongs to the *dorsalis*-group, and the conspicuous colouration of the thorax separates it from the closely related species *occipitalis*, *oosterbroeki* and *vittula*.

Other material: 30♂, 27♀, from the following states and provinces: Alaska (1♀), Alberta (1♂, 5♀), British Columbia (18♂, 9♀), Colorado (5♂, 6♀), Wyoming (1♂, 1♀), Yukon (5♂, 5♀).

Diagnostic features

See under *vittula*. Some characteristics of *excelsior* are: the 13-segmented antennae with black-brown flagella, the usually brown nasus, the large occipital marking, the darkly spotted pleura, including the blackened posterior parts of the katatergites and the very strong black (sub)terminal darkening.

Description

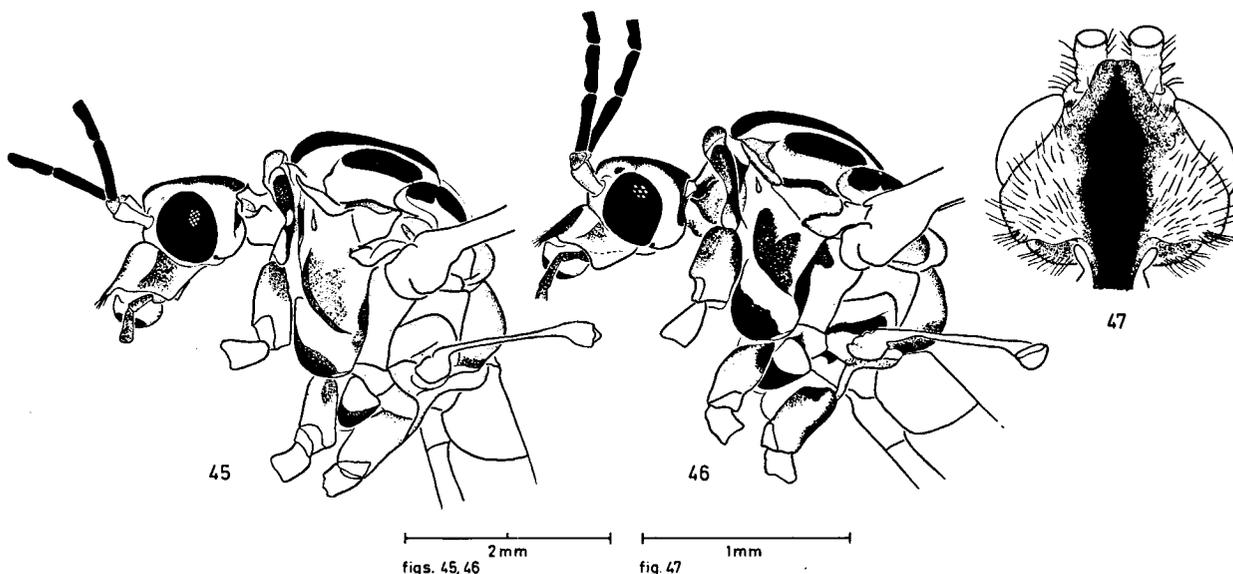
Body length: ♂ 10.5-13.5 mm, ♀ 14-17 mm.

Wing length: ♂ 11.5-13 mm, ♀ 11.5-15 mm.

Antennal length: ♂ 4.3-4.9 mm, ♀ 2.6-3.3 mm.

Body colour bright to dark yellow.

Head: Antennae of both sexes 13-segmented; in ♂ flagellar segments two and following slightly reniform, longest verticillar hairs not exceeding length of segments; in ♀ flagellar segments more or less cylindrical with slightly thickened basal nodes, longest verticillar hairs reaching to 1.5 times length of segments. Scape dark yellow, pedicel dark yellow to brown, flagellum completely dark brown to black, segments usually more deeply darkened at basal



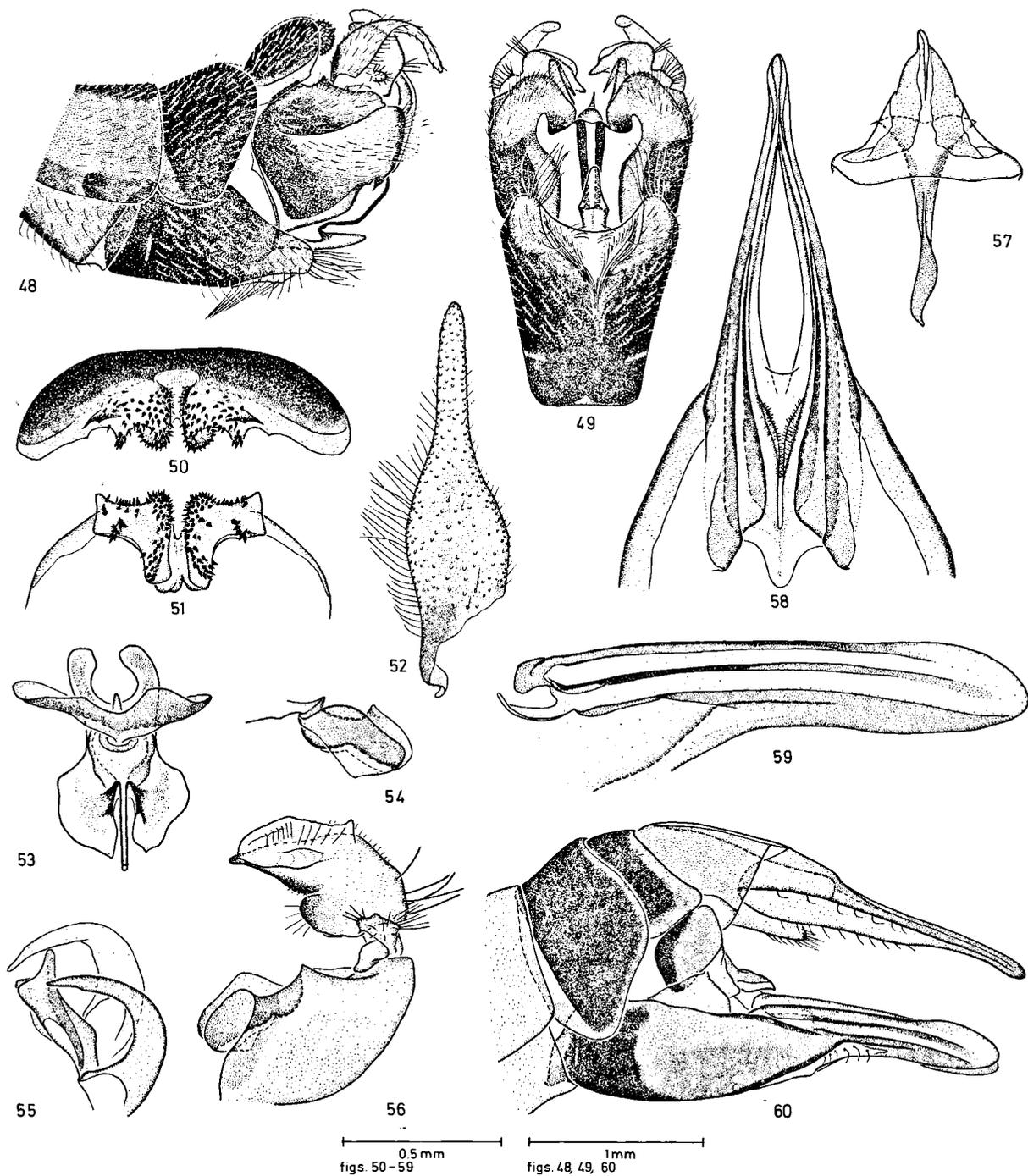
Figs. 45-47. 45. *N. vittula*, head and thorax, lateral view, ♂ from Calgary, Alberta; 46. *N. excelsior*, head and thorax lateral view, ♂ from Muncho Lake, British Columbia; 47. *N. excelsior*, head, dorsal view, ♀ from Lake Louise, Alberta.

nodes. Rostrum shining with a dark brown spot on each side and a light to dark brown area on dorsal surface; nasus usually brownish. Palps dark brown, apically paler. Frons, tubercle and narrow rostro-lateral parts of vertex more or less opaque, remainder of head shining yellow. Vertex with a broad black-brown band, frequently with extensions nearly to eye-margins, reaching over tubercle; usually two distinct orbital spots on level with tubercle and a dark brown spot on each side of neck-attachment (fig. 47).

Thorax (fig. 46): Median part of pronotum subopaque brownish, lateral parts shining dark brown with distinctly blackened posterior margins. Remainder of thorax shining. Stripes (brown)-black, colours not or hardly fading caudally; lateral ones straight, sometimes anteriorly passing into a paler downcurved spot. Transverse suture weakly to distinctly brown tinted in the middle; antero-lateral corners of scutum 2 pale to brownish-tinted. Scutellum transparently (light) brownish, sometimes with a narrow brown line medially; mediotergite with transparent to dark brown narrow anterior stripe and broad caudal marking, posterior margin lined with dark brown to

black. Pleura with dark to black-brown markings, paratergites with a distinct black dash on posterior parts, lateral parts of prescutum usually brownish, posterior parts of katatergites blackened, rarely paler. Coxae with dark brown spots at bases, femora and tibiae yellow-brown with broad dark brown tips, tarsi brown. Metatarsi of middle and hind legs usually slightly longer than corresponding tibiae. Tarsal claws untoothed. Wings hyaline or with a slight brownish tinge, veins (dark) brown, costal region hyaline-yellowish, bases of radial cells weakly shaded; pterostigma (dark) brown, frequently with a few macrotrichia; cell m1 sessile to short-petiolate.

Abdomen: Dorsal stripes on tergites 1-7 dark brown, slightly interrupted or continuous, about as broad as scutellum or broader; posterior margins of tergites 2-7 sometimes lined with brown. Lateral stripes on tergites (1)2-7 black-brown, frequently broad and more or less continuous, sometimes slightly interrupted. Sternites 2-7 marked with dark brown longitudinal and anteriorly widened spots, ventral stripe sometimes continuous. Tergites 8, 9 and sometimes part of tergite 7, largest part of sternite 8 and in ♂ base of sternite 9 strongly



Figs. 48-60. *N. excelsior*; 48-56, ♂; 57-60, ♀. 48. hypopygium, lateral view; 49. hypopygium, caudo-ventral view; 50. tergite nine, caudal view; 51. tergite nine, ventral view; 52. od, outside; 53. semen pump, dorsal view; 54. sp2, from inside; 55. adminiculum, lateral view; 56. id, outside; 57. fused valvulae and furca, dorsal view; 58. hypovalvae, dorsal view; 59. right hypovalva, inside; 60. ovipositor, lateral view.

black fuscous; remainder of (sub)terminal segments yellowish (fig. 48).

Hypopygium: Hind margin of tergite 9 with a shallow U-shaped incision; posterior extension with black-spined median swellings and pointed lateral extensions caudally and on ventral surface with rather narrow median protrusions and small lateral ones (figs. 50, 51). Outer dististyle with a long and slender apex (fig. 52); crest of inner dististyle dorsally extended and bulbously lobed at base, curved posterior margin of id with some long dark brown hairs, lateral projection like a short setose ridge (fig. 56). Sp2 with two transparent extensions at base (fig. 54). The broad V-shaped incision of the hind margin of sternite 8 not reaching over half length of sternite, closed by a thin membrane and abundantly set with long and thin yellowish setae (fig. 49). Membranous area on ventro-caudal surface of sternite 9 with a long finger-like medisternal appendage, two narrowly sclerotized lateral plates and two curved caudolateral offshoots (fig. 49). Adminiculum with slender, tapering, dorsally curved gonapophyses; median part with a long slender top and slight anterior extensions (fig. 55). Semen pump fig. 53. Intromittent organ winding, length varying from 15.4 to 18.2 mm. Hypopygium slightly narrower than scutum 1. Ovipositor: Cerci tapering with slender tips; hypovalvae with rounded to obtuse pointed tips; sternite 8 with large dark brown oval spots on both sides of median incision (fig. 60). Rostral extensions of hypovalvae well-developed, internal shell rostrally prolonged (as in *breviorcornis*, *occipitalis* and *vittula*), base of major ridge longdrawn (figs. 58, 59). Fused valvulae with two slightly sclerotized areas (fig. 57).

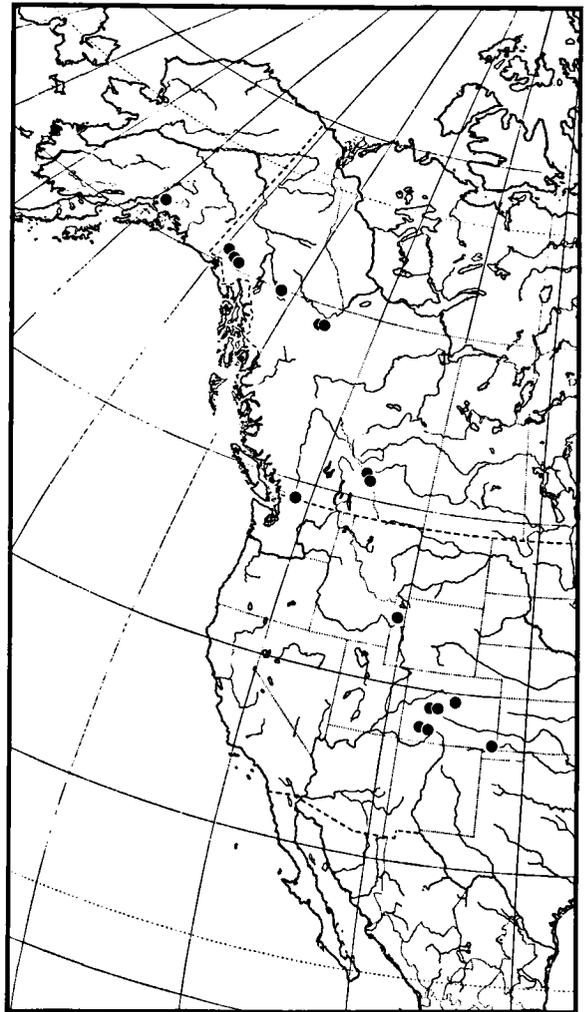
Biology

About the general habitat of *excelsior*, G. W. Byers (in literis) informs: open (unshaded) meadow on gentle slope, grasses and herbaceous plants about 0.5 m deep, near willow bushes beside a small mountain brook. The species can be found at higher altitudes (up to

10,960 feet (3340 m)) especially in the southern part of the range (Colorado and Wyoming). The flight-period ranges from half June till the end of August.

Distribution (map 5)

N. excelsior is hitherto known from several localities which are all situated within the range of the Rocky Mountains, from Alaska to Colorado. The specimens originated from the following localities: Alaska: Matanuska Valley 7 mi SW of Palmer; Alberta: Banff and around Lake Louise, both in Banff Nat. Park; British



Map 5. Distribution of *N. excelsior*, based on material examined (black dots) and literature (stippled dot = type locality).

Columbia: Toad River and Muncho Lake, both on Alaska Hwy, mile 748.5 on Alaska Hwy (east of Teslin Lake), Cascade Ranges (type-locality, from literature); Colorado: Platte Cañon (border of Douglas and Jefferson co's.), Bear Creek in Baca Co., Spring Creek Pass in Hinsdale Co., Malta in Lake Co., Wolf Creek Pass in Mineral Co., Maroon Creek (8 mi SW of Aspen) in Pitkin Co.; Wyoming: Grand Tetons in Teton Co.; Yukon: Alaska Hwy mileage points 1006 (Marshall Creek, near Haines Jct.), 1048 (Christmas Creek, near Kluane), 1143, 1148 and 1152 (all northwest of Burwash Ldg.).

***Nephrotoma oosterbroeki* spec. nov.**

Figs. 61-70

Type material

Holotype ♂, labelled: "Washington/Rainier/Longmire/Springs/2800'/VII-25,'53/Alexander". Preserved in the USNM (Alexander-collection), condition good; the dissected genitalia in a micro-vial on the same pin.

Diagnostic features

N. oosterbroeki is a close relative of *excelsior*, *vittula*, *occipitalis* and *breviorcornis*; some differences have already been mentioned under the diagnostic features of *vittula*. In addition to the hypopygial differences, *oosterbroeki* can be recognized by the following combination of characters: 13-segmented antennae with a unicolourous black-brown flagellum, yellowish sides of the rostrum, a bold spool-shaped occipital marking, black-brown thoracic stripes fading to red-brown on scutum 2, a weakly tinted posterior part of the katatergite and a grey-brown pterostigma with dark brown spot along the Rs.

Description

Body length: ♂ 14 mm.

Wing length: ♂ 13 mm.

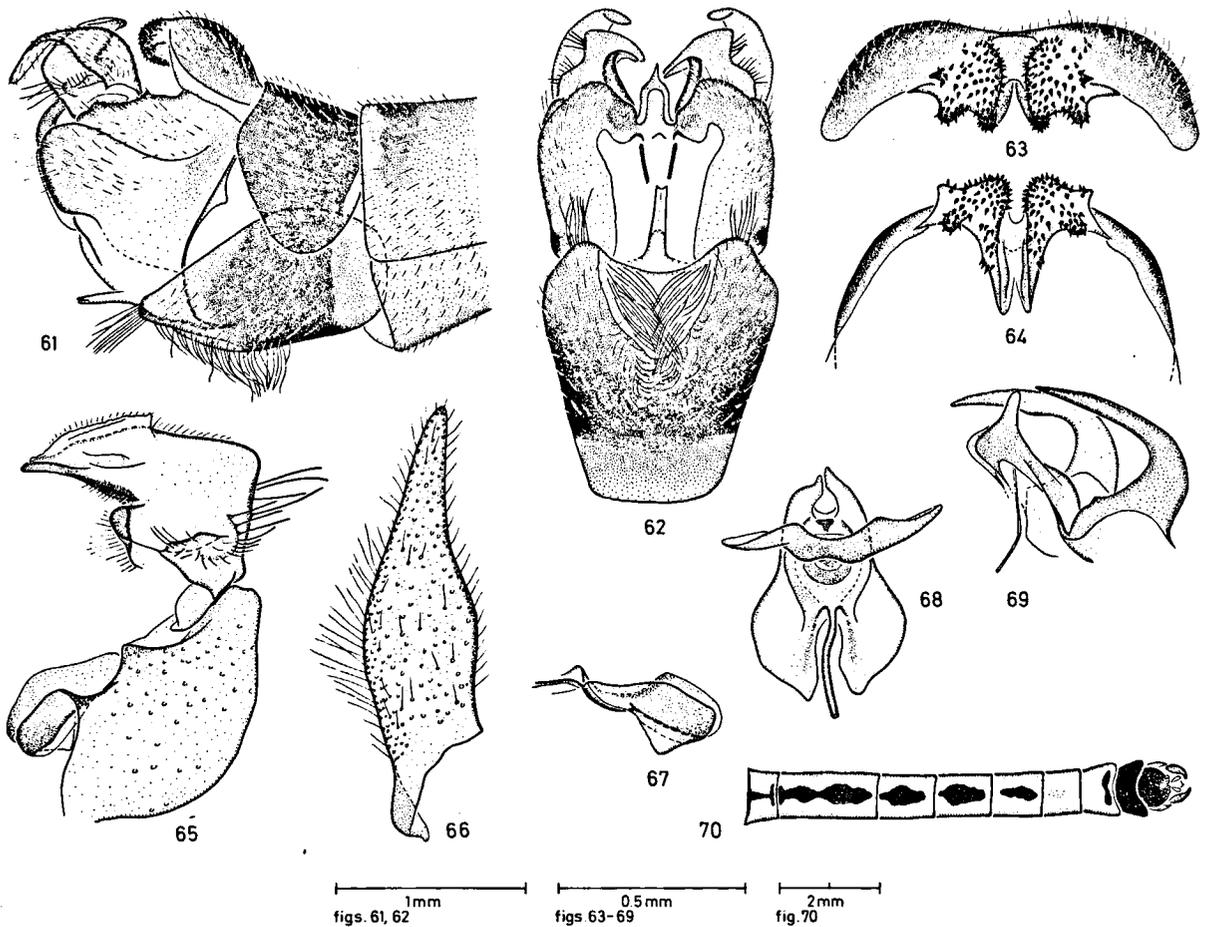
Antennal length: ♂ 4.9 mm.

Body colour bright yellow.

Head (♂): Antennae 13-segmented; flagellar segments two and following very weakly incised; longest verticillar hairs nearly equalling length of segments. Scape yellow, pedicel yellow-brown, flagellum uniformly black-brown. Rostrum shining yellow with on dorsal surface two small light brown stripes. Palps yellowish. Frons and tubercle (sub)opaque, remainder of head shining yellow; vertex with a dark brown, spool-shaped occipital marking, reaching top of tubercle, about as broad as lateral stripes on scutum 1; two small orbital spots on level with tubercle. Genae and postgenae yellow.

Thorax (♂): Pronotum subshining yellowish, remainder of thorax distinctly polished yellow. Stripes on scutum 1 black-brown with somewhat paler margins, lateral ones straight; stripes on scutum 2 with dark brown anterior parts and caudally fading into light reddish brown. Transverse suture with a slight transparent tinge in middle; antero-lateral corners of scutum 2 yellow. Scutellum transparently light brown; narrow anterior stripe and broad caudal marking on mediotergite transparently yellow-brown, posterior margin lined with dark brown. Pleura light to whitish yellow with some yellow-brown markings; paratergite with a light brown narrow dash, posterior part of katatergite light reddish, anatergite transparently light brown. Coxae yellow, femora yellow with narrowly dark brown tips, tibiae yellow-brown with dark brown tips, tarsi brown to dark brown; claws untoothed. Metatarsi of middle and hind legs slightly longer than corresponding tibiae. Wings hyaline with dark brown veins, costal region hyaline-yellow; pterostigma grey-brown with a dark brown spot along the Rs, no macrotrichia; base of radial cells weakly brown-shaded; cell m1 short-petiolate. Halteres yellowish.

Abdomen (♂): Abdomen dorsally marked with a discontinuous dark brown stripe, distinct on tergites 1-5, about as broad as stripes on scutum 2; spots on separate segments fig. 70; tergite 7 with a brown transverse marking on posterior part. Tergites 2-5 on each side marked



Figs. 61-70. *N. oosterbroeki*; ♂. 61. hypopygium, lateral view; 62. hypopygium, caudo-ventral view; 63. tergite nine, caudal view; 64. tergite nine, ventral view; 65. id, outside; 66. od, outside; 67. sp2, from inside; 68. semen pump, dorsal view; 69. adminiculum, lateral view; 70. abdomen, dorsal view.

with a rather broad brown dash. Sternites 2-5 each with a narrow brown line on anterior part. Tergites 8, 9 and largest part of sternite 8 with black-brown darkening, remainder of hypopygium yellowish-brown.

Hypopygium: Hind margin of tergite 9 with a shallow median incision; posterior extension with abundantly black-spined medial swellings and small pointed lateral extensions, ventral surface with long and narrowly extended median protrusions and with lateral ones (figs. 63, 64). Outer dististyle fig. 66; crest of inner dististyle dorso-laterally extended and with a small basal lobe; id with a strongly extended posterior angle and some long brown hairs; lateral projection small and ridge-like, basally

set with brown hairs (fig. 65). Sp2 with two transparent extensions at base (fig. 67). Hind margin of sternite 8 with a deep U-shaped incision, closed by a thin membrane abundantly set with long, thin yellow hairs (fig. 62). Membranous area on ventro-caudal surface of sternite 9 with a long, thin, slightly bifid medisternal appendage, with two very narrow and weakly sclerotized lateral plates and two slightly curved caudo-lateral offshoots (fig. 62). Adminiculum with slender, tapering, dorsally curved gonapophyses; median part with a long and slender top and slight anterior extensions (fig. 69). Semen pump fig. 68. Intromittent organ winding, length about 14.7 mm. Hypopygium not as broad as scutum 1.

Distribution

The species is known from the holotype only, taken in Mt. Rainier National Park, Washington.

Etymology

The species is named in honour of Dr. Pjotr Oosterbroek, who has contributed much to our knowledge of the genus *Nephrotoma* and who encouraged me to undertake this study.

SECTION 2

Nephrotoma eucera (Loew, 1863)

Figs. 71-82, diagram 3, map 6

Loew, 1863: 296-7, descr (as *Pachyrrhina*); Osten Sacken, 1878: 39, loc (as *Pachyrrhina*); Loew, 1879: 4, key (as *Pachyrrhina*); Slosson, 1900: 320, loc (as *Pachyrrhina*); Aldrich, 1905: 97, locs (partim; White Mts., N.H. = ? *eucerooides*); Doane, 1908: 176, key, 179, comp (as *Pachyrrhina*); Alexander, 1915b: 465, comp, 467, morph; Alexander, 1919a: 172, comp; Alexander, 1919b: 782-86, locs, 817, locs, 813, 836, 877, biol, 936, key (partim; Canada, Maine = ? *eucerooides*); Alexander & McAtee, 1920: 396, locs; Rogers, 1930: 10, 13, 15, biol, 15, loc; Brimley, 1938: 319, loc; Alexander, 1941: 284, loc; Alexander, 1942: 224, key, 227, sh descr, distr, loc, comp, biol, 235, note; Rogers, 1942: 19, 46, 61, biol, 61, comp, 62, note; Foote, 1956: 222, loc, biol; Alexander, 1965: 21, distr; Young, 1978: 410, 413, 415, biol, 415, loc, 416, distr, 432, key; Gelhaus, 1982: 85, loc.

Probably and/or partially referring to *N. eucerooides*: Alexander, 1920a: 1017, biol; Dietz, 1921: 263, loc, biol (as *Pachyrrhina*); Alexander, 1922: 61, loc; Johnson, 1925: 34, locs; Leonard, 1928: 699, locs; Alexander, 1929a: 235, locs; Alexander, 1931b: 144, biol; Winn & Beaulieu, 1932: 8, locs; Alexander, 1962: 8, loc, note.

As *Nephrotoma eucerooides*: Foote, 1956: 222, locs, biol; Frommer, 1963: 580, morph, 593, figs 13 & 14 hypop, 615, fig 76 gland ♀; Young, 1978: 409-11, 413, 416, biol, 416, locs, distr, 431, fig wing, 432, key; Gelhaus, 1982: 85, loc.

Notes on literature

The external similarity of the two species *eucera* and *eucerooides*, especially concerning the antennae, has caused a lot of confusion as revealed by the study of different collections (as the Alexander-, Dietz- and MCZ-collections).

Various errors in the literature mentioned under "Probably and/or partially referring to *N. eucerooides*" could be traced back on the basis of locality-data or made largely probable. Some literature published under the name *N. eucerooides*, could be proved to refer to *eucera*: The localities mentioned by Foote (1956) for *eucerooides* (Delaware County, Ohio) could partly be traced back in the collection of Rogers, Michigan and do refer to *eucera*. The figures 13 and 14 of a hypopygium in Frommer (1963) obviously refer to *eucera* instead of *eucerooides*. Many specimens on which Young (1978) based his study were examined by me and it turned out that all his identifications as *eucerooides* in fact are *eucera*; the information in Gelhaus (1982) is based on this.

Material examined

Type material: the original description of *Pachyrrhina eucera* by Loew (1863) indicates that it is based on "♂ et ♀", but no information about the number of specimens is given. In the MCZ were examined one ♂ and two ♀♀ bearing red type labels, no. 10318. The ♂, selected as lectotype by G. W. Byers in 1961, condition good (right antenna intact), is labelled: "eucera m." "Loew Coll." "10318" "Type" "to be lectotype G.W.B.'61". The two ♀-paralectotypes are labelled: "D.C." "Loew Coll." "10318, 2/3" "Type". There are two ♂♂ in the MCZ-collection labelled: "D.C." "Osten Sacken" "eucera", no type labels, presumably not belonging to the type-series of *eucera*. Osten Sacken (1878) mentioned "Distr. Columbia" as type-locality for *eucera*; the localities "New York" and "Illinois", also mentioned for the type-material in the original description, are not found on labels of specimens of *eucera* in the collection of the MCZ.

Other material: 298♂, 144♀, from the following states: Arkansas (1♂, 2♀), Georgia (6♂), Illinois (2♂, 10♀), Indiana (48♂, 20♀), Iowa (4♂), Kansas (123♂, 42♀), Kentucky (4♂, 8♀), Maryland (7♂, 1♀), Michigan (29♂, 21♀), Minnesota (1♀),

Missouri (11♂, 3♀), New Jersey (2♂, 2♀), New York (1♂), North Carolina (10♂, 5♀), Ohio (11♂, 4♀), Pennsylvania (18♂, 4♀), South Dakota (3♂, 1♀), Tennessee (4♂, 4♀), Vermont (1♂), Virginia (13♂, 14♀), West Virginia (1♀), Wisconsin (1♀).

Diagnostic features

Because of their conspicuous antennae (16 or more segments and bicoloured flagellar segments, yellow based and strongly incised) the ♂♂ of *eucera*, *euceroidea* and *polymera* are easily separated from the other North American *Nephrotoma* species; even the ♀♀ are rather easily recognized by the number of antennal segments (14-16). The distinction between *eucera* and *euceroidea* appeared to cause most difficulties. Alexander (1919a, 1942) and Young (1978) distinguished the two species mainly on the basis of different numbers of antennal segments in ♂♂, but this character shows variability and overlap (18-20 segments in *eucera*, 17-18 segments in *euceroidea*; the antennae of the ♀♀ are 15-16 and 14-15 segmented respectively). Apart from the distinct hypopygial differences in ♂♂, *eucera* is also recognized by the vague blackish tint on anterior part of the paratergite, the (light) brown pterostigma with the usually darkened part in cell sc2, the dark yellowish tinge of the wings, the narrow dorsal abdominal stripe and the restricted subterminal darkening. Females of *eucera* are easily confused with those of *brevicornis*, *gracilicornis* and *tenuis*, species with 13 antennal segments in the ♀.

Description

Body length: ♂ 13.5-18 mm, ♀ 19-23 mm.

Wing length: ♂ 14-17.5 mm, ♀ 16-19 mm.

Antennal length: ♂ (7.4)8.2-9.5 mm, ♀ 3.5-4.9 mm.

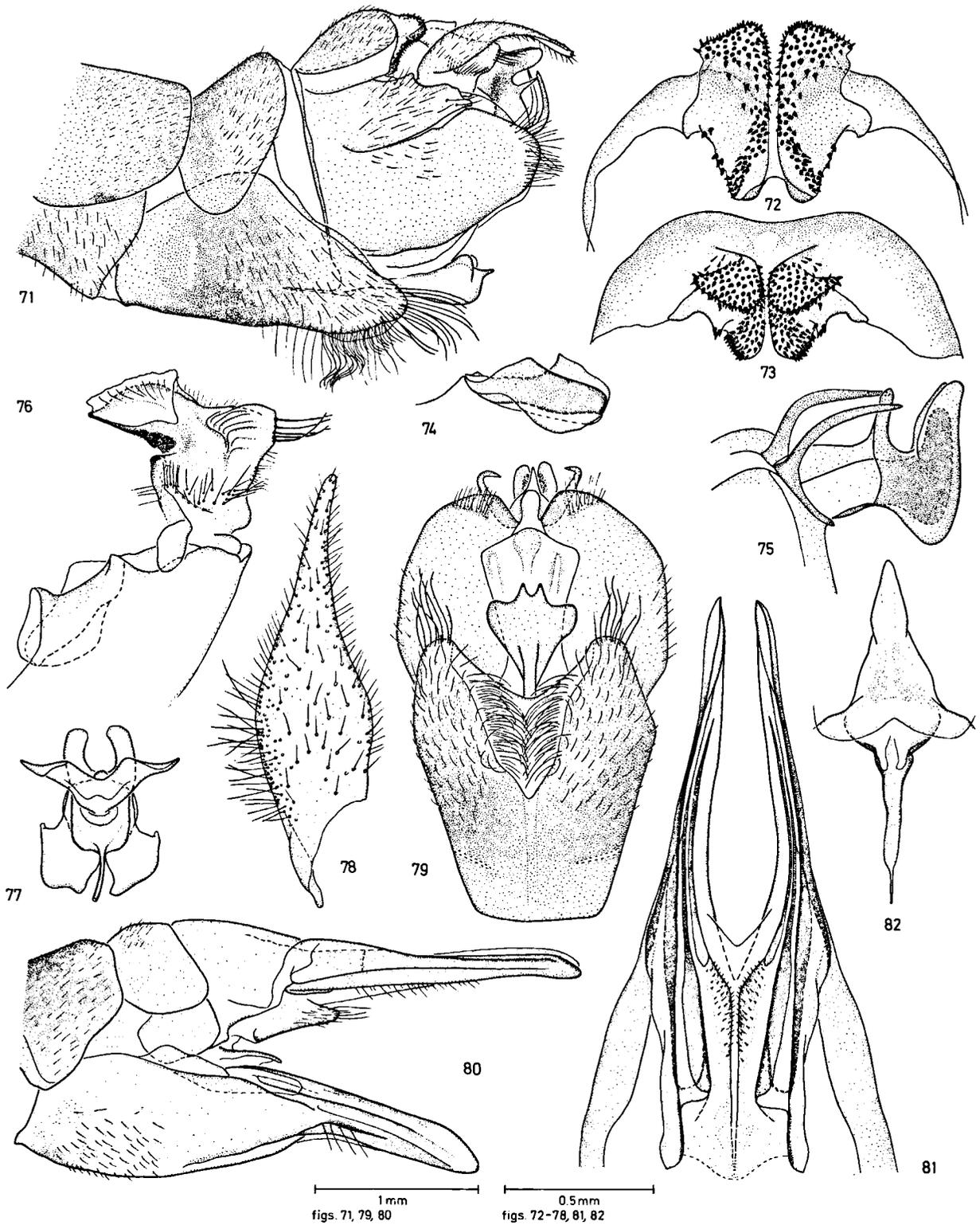
Body colour bright (dark) yellow.

Head: Antennae of ♂ 18 to 20-segmented, of ♀ 15 or 16-segmented; scape and pedicel yellowish, first flagellar segment yellow, usually apically dark tinted, following segments with yellow basal nodes and dark brown to black

apical parts. Flagellar segments in ♂ distinctly reniform with verticillar hairs reaching to or over two-third length of segments; in ♀ segments cylindrical, verticillar hairs slightly longer than segments. Sides of rostrum (dark) brown tinted on ventral half. Palps sordid yellow. Frons, tubercle and small rostral part of vertex opaque yellow; remainder of head shining yellow; the change-over of opaque into shining on vertex sometimes marked with brownish spots and frequently a small transparent brownish triangle in middle of vertex.

Thorax: Entire thorax polished, except dull-yellow median part of pronotum. Stripes red-brown to dark yellow. Sides of prescutum usually weakly, sometimes more strongly grey-black tinted. Transverse suture not or medially pale brownish tinted; antero-lateral corners of scutum 2 dull dark brown or slightly paler. Scutellum, rather broad antero-median stripe and caudal part of mediotergite transparently dark yellow. Yellow to whitish-yellow pleura sometimes with transparently light red-yellow markings; anterior part of paratergite usually with a brownish narrow dash. Legs yellow, narrowly darkened at tips of femora and tibiae, gradually darkened towards end of tarsi. Tibiae of middle and hind legs much shorter than metatarsi. Tarsal claws untoothed. Wings with dark yellowish tinge, costal region dark yellow, tips and bases of radial cells slightly brown shaded; pterostigma light to dark brown, part in cell sc2 usually darker tinted, stigma only sometimes with a few macrotrichia; cell m1 sessile to subsessile, sometimes petiolate.

Abdomen: Dorsal stripe on tergites 1-6 or 1-7 (dark) brown, on first segments less broad than lateral scutal stripes; in ♂ frequently slightly interrupted on posterior parts of tergites, in ♀ continuous and darker brown. Abdomen laterally with a row of brown to black-brown spots, usually a (very) small and a large one on each side of segment. Sternites 2-7 with drop-shaped to oblong black-brown markings, in ♀ usually more protracted on caudal segments. Basal parts of eighth tergite and sternite (dark) brown fuscous, remainder of terminal segments yellowish.



Figs. 71-82. *N. eucera*; 71-79, ♂; 80-82, ♀. 71. hypopygium, lateral view; 72. tergite nine, ventral view; 73. tergite nine, caudal view; 74. sp2, from inside; 75. adminiculum, lateral view; 76. id, outside; 77. semen pump, dorsal view; 78. od, outside; 79. hypopygium, caudo-ventral view; 80. ovipositor, lateral view; 81. hypovalvae, dorsal view; 82. fused valvulae and furca, dorsal view.

Hypopygium: Abundantly black-spined posterior extension strongly protruding beyond weakly incised caudal margin of tergite 9; median protrusions on ventral side black-spined and pronounced, lateral protrusions hardly to weakly developed (figs. 72, 73). Outer dististyle with long and slender apex (fig. 78); inner dististyle with a broad, sharply angled and basally bulbous crest and along posterior margin a strongly bulging and laterally ribbed extension with some long black hairs; lateral shell set with black hairs and without projection (fig. 76). Base of sp2 with two narrow transparent extensions (fig. 74). Hind margin of sternite 8 with deep V-shaped incision, largely closed by a membrane laterally set with long, curved, medially directed yellow hairs (fig. 79); slightly protruded obtuse caudal corners also set with long brown-yellow bristles. Membranous area on ventro-caudal surface of sternite 9 slightly folded, lateral parts more firm; distinctly protruding medisternal appendage strongly bulbous, medially bifid, laterally winged and slightly sclerotized (fig. 79); midventral extension of antecosta short, narrow and membranous. Adminiculum with very slender, dorsally curved gonapophyses; median part strongly modified with anteriorly two large, sclerotized plate-like extensions (fig. 75). Lateral appendages of semen pump posteriorly angled (fig. 77), wings of bifid compressor apodeme more or less flat and rounded. Intromittent organ varying in length from 6.7 to 7.5 mm. Hypopygium usually much broader than scutum 1.

Ovipositor: Slender apex of cerci weakly curved down; hypovalvae parallel-sided with downplaced apex (fig. 80). Rostral extensions of hypovalvae strongly extended; base of major ridge very longdrawn; internal arch not sclerotized; internal shell small and weakly diamond-shaped (fig. 81). Fused valvulae and furca weakly sclerotized, see fig. 82.

Biology (diagram 3)

N. eucera is common to abundant in moist to wet habitats and less common to scarce in

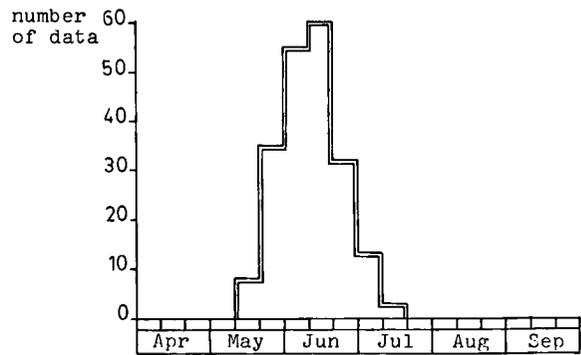
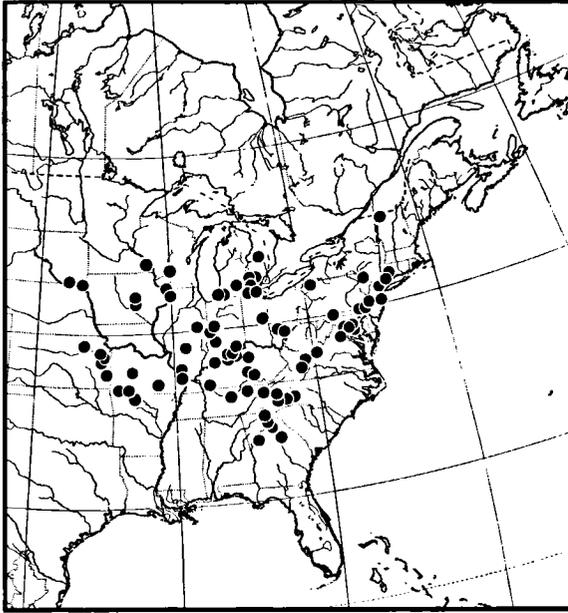


Diagram 3. Period of flight of *N. eucera*.

mesophytic environments. Alexander (1919b) reported the species from wet meadows or grasslands and the grassy banks of streams; Rogers mentioned *eucera* from mesophytic upland woods and the lower talus slopes of a cove (1930), and from low floodplain woods and a low wooded hillside above a hardwood swamp (1942). Wet woodlands, along marshy streams (Foote, 1956), grassy areas around swamp, bottomland woods and mesic hillside woods (Young, 1978) are other reported habitats for *eucera*. The species is commonly associated with luxuriant herbage such as wood nettles, richweed and jewelweeds, and flies up into the trees when alarmed (Rogers, 1942; Young, 1978). The species is found at altitudes up to 3850 feet (1170 m); Rogers (1942) supposed wet to damp, rich soil to be the habitat of the larvae of *eucera* and Young (1978) found larvae in soil covered by damp and friable humus. *N. eucera* flies from mid-May till mid-July. Reports of the species for August, found in the literature, were not confirmed by the study of the different collections. There is one distinct peak-period in the middle of June, affirming one generation a year for this species (cf. Rogers, 1942; Young, 1978). In the examined museum-collections twice as many males as females were found, a phenomenon also seen in other species (see for instance *breviorcornis*, *okefenoke*).

Distribution (map 6)

Contrary to some data in the literature, *N. eucera* is not known from Quebec and New



Map 6. Distribution of *N. eucera*, based on material examined (black dots) and literature (stippled dot).

England except for one locality in Vermont (1♂ from St. Albans, Franklin Co.) and one record in Alexander (1942) from Connecticut (Danbury, Fairfield Co.). Westward the range reaches the southeastern corner of South Dakota (Springfield and Union Co.) and the eastern part of Kansas (Bourbon, Douglas, Franklin and Riley co's.), where the species is very abundant in June (not "rare" as given by Young, 1978, see notes on literature). Hitherto Tennessee and North Carolina were mentioned as the southern limits, but *eucera* is also known from Arkansas (17 mi SE of Yellville in Marion Co.) and Georgia (Fulton, Green, Hall, Lumpkin and Union co's.). Other specimens originated from the following localities and counties: Illinois: 6 counties; Indiana: 8 counties; Iowa: Poweshiek and Tama co's.; Kentucky: 5 counties; Maryland: Montgomery, Prince Georges co's.; Michigan: 9 counties; Minnesota: Winona Co.; Missouri: Barry, Camden, Carter, Taney co's.; New Jersey: Orange Mts., Monmouth Co.; New York: Westchester Co.; North Carolina: Buncombe, Burke, Haywood co's.; Ohio: Athens, Delaware, Hocking co's.; Pennsylvania: Jack

Run (Alleghany N. F.) and Chester, Delaware, Fulton, Montgomery, Wayne co's.; Tennessee: Cocke, Fentress, Knox, Wilson co's.; Virginia: Arlington, Bath, Culpeper, Fairfax, Giles co's.; Washington D.C.; West Virginia: Monroe Co.; Wisconsin: Sauk Co.

***Nephrotoma euceroidea* Alexander, 1919**

Figs. 83, 84-96, diagram 4, map 7

Alexander, 1919a: 172, descr, comp; Alexander, 1922: 59, loc; Alexander, 1924: 60, loc, biol; Alexander, 1925b: 172, loc, biol; Johnson, 1925: 34, loc; Alexander, 1928: 56, locs; Leonard, 1928: 699, locs; Alexander, 1929b: 25, loc, biol; Alexander, 1930: 271, loc; Alexander, 1931: 138, loc; Winn & Beaulieu, 1932: 8, locs; Procter, 1938: 283, locs; Alexander, 1942: 224, key, 227, comp, sh descr, distr, locs, biol; Rogers, 1942: 19, 61, biol, 61, comp, loc; Alexander, 1962: 8, locs; Alexander, 1965: 21, distr.

Nephrotoma clandestina (Dietz, 1921).

Dietz, 1921: 262, note, comp, descr, morph (as *Pachyrhina*); Alexander, 1942: 224, key, 226, sh descr, distr, comp; Alexander, 1965: 21, distr.

Probably and/or partially as *Nephrotoma eucera*: Aldrich, 1905: 97, locs (as *Pachyrhina*; partim, White Mts., N.H. = ? *euceroidea*); Alexander, 1919b: 782-86, locs, 817, locs, 831, 836, 877, biol (partim; Canada, Maine = ? *euceroidea*); Alexander, 1920a: 1017, biol; Dietz, 1921: 263, loc, biol (as *Pachyrhina*); Alexander, 1922: 61, loc; Johnson, 1925: 34, locs; Leonard, 1928: 699, locs; Alexander, 1929a: 235, locs; Alexander, 1931b: 144, biol; Winn & Beaulieu, 1932: 8, locs; Alexander, 1962: 8, loc, note.

Erroneous literature, referring to *Nephrotoma eucera*: Foote, 1956: 222, loc, biol; Frommer, 1963: 580, morph, 593, figs 13 & 14 hypop, 615, fig 76 gland ♀; Young, 1978: 409-11, 413, 416, biol, 416, locs, distr, 431, fig wing, 432, key; Gelhaus, 1982: 85, loc.

Notes on literature

Although regularly compared with each other, the two species *eucera* and *euceroidea* are frequently confused and this has made many literature references unreliable. The publications about *euceroidea* of Foote (1956), Frommer (1963), Young (1978) and Gelhaus (1982) without doubt refer to *eucera* (see literature-notes of *eucera*). Some literature about *eucera* could be checked by way of the material examined; this revealed that these publications, entirely or partly, are referring to *euceroidea*, as indicated in the above-mentioned list.

Material examined

Type material: *Nephrotoma euceroidea* Alexander, 1919 was described from two males, both preserved in the C. P. Alexander-collection, USNM. The holotype, condition rather good (distal segment of both antennae lacking, right wing removed and mounted on slide no. 975), is labelled: "Sport Is. 6/10/10" "Holotype *Nephrotoma euceroidea* C. P. Alexander". On the slide are mentioned the same data and also "...Sacandage R., N.Y...."; the original description adds to this "Fulton Co., New York, altitude 750 feet", and mentions a different date: June 16, 1910. The paratype, both antennae largely lacking, is labelled: "Perth, N.B. 15-VI-15 F.M. McK." "Paratype *Nephrotoma euceroidea* C. P. Alexander".

Pachyrhina clandestina was described by Dietz (1921) from one female, in the original description erroneously mentioned as "Holotype ♂", kept in the ANSP, type no. 6460, condition good, labelled: "Hazleton, Pa. Dr. Dietz Coll. VI 28 '20" (original description says June 24, 1920, misreading likely) "HOLOTYPE" "HOLOTYPE *Pachyrhina clandestina* W. G. Dietz, 6460". New synonymy. In a note in his description of *clandestina* Dietz (1921) claimed that "this form was tabulated in the 'Synoptic Table of Species'" in his publication of 1918, but the name 'clandestina' cannot be found in this paper, in which case *euceroidea* Alexander, 1919, has priority.

Other material: 75♂, 42♀, from the following states and provinces: Connecticut (5♂, 1♀), Maine (10♂, 21♀), Massachusetts (17♂, 4♀), Michigan (4♂), Minnesota (1♂), New Brunswick (1♂), New Hampshire (12♂, 2♀), New Jersey (1♂), New York (5♂, 2♀), North Carolina (2♀), Nova Scotia (3♀), Ontario (2♂), Pennsylvania (10♂, 6♀), Quebec (2♂), Tennessee (1♂), Vermont (3♂, 1♀), Virginia (1♂).

Diagnostic features

By means of antennal characters (see also under *eucera*), the three species *euceroidea*, *eucera* and

polymera are easily separated from other *Nephrotoma* species. Confusion of *euceroidea* with especially *eucera* has often occurred, but seems for females also possible with *brevicornis*, *gracilicornis* and *tenuis*. Identification of *euceroidea* without difficulty is possible by means of the following character-combination: number of antennal segments in ♂ 17-18, in ♀ 14-15, usually distinct black markings on anterior part of the paratergite and the lateral corner of prescutum (fig. 83), brownish-yellow pterostigma and usually distinct (sub)terminal darkening.

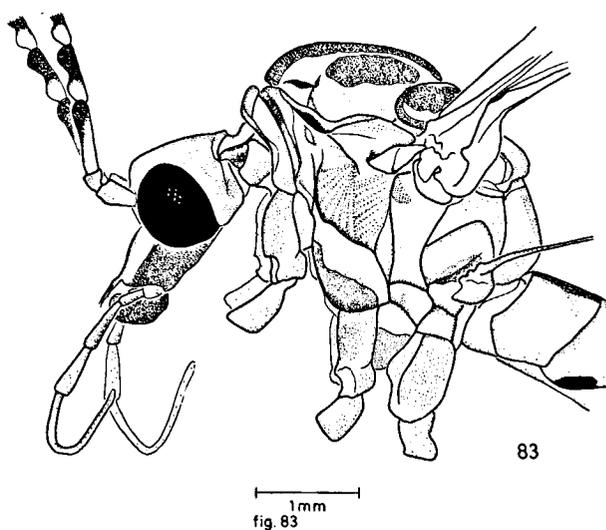


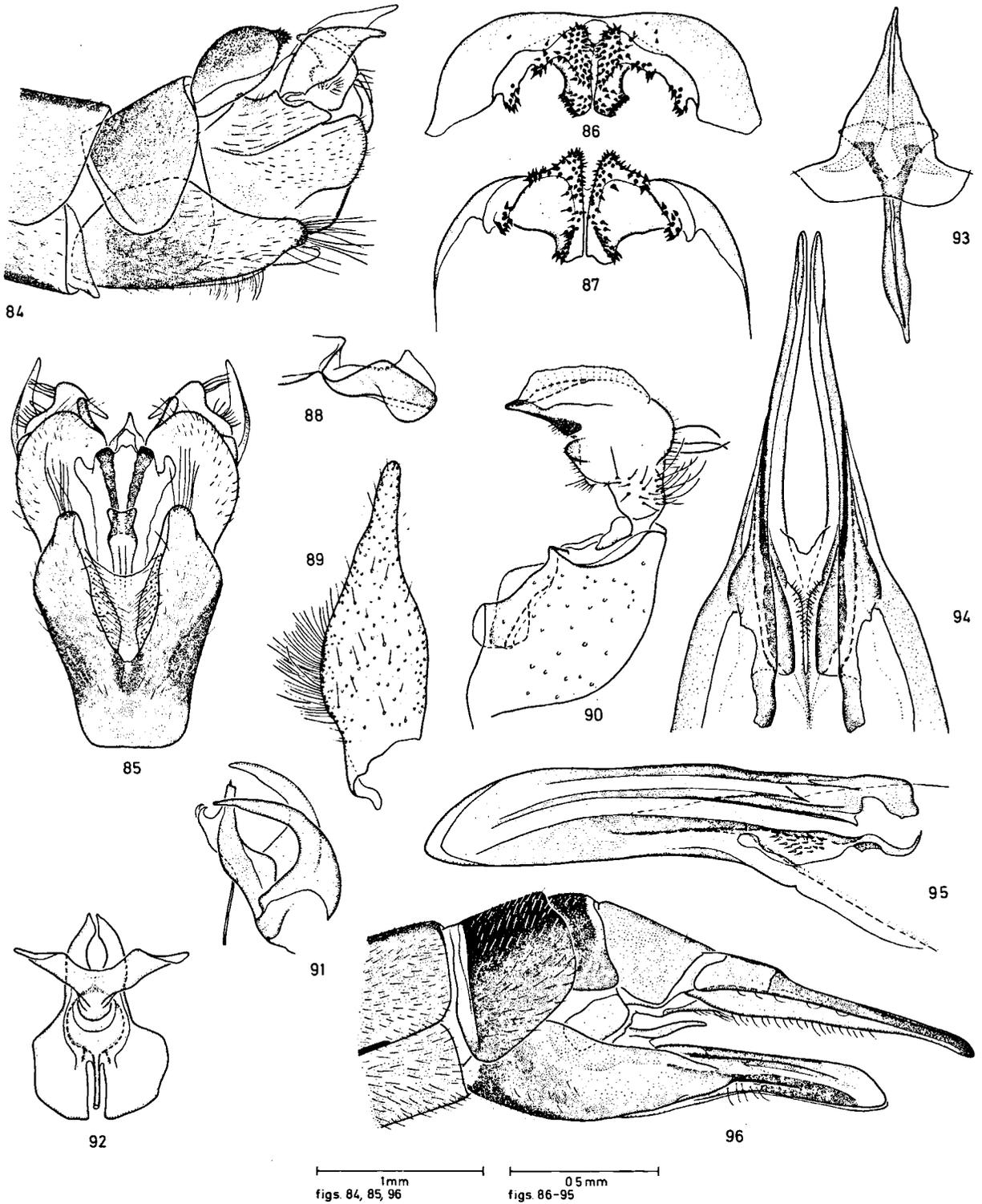
Fig. 83. *N. euceroidea*; head and thorax, lateral view, ♂ from New Hampshire.

Description

Body length: ♂ 13.5-15.5 mm, ♀ 16.5-21 mm.
Wing length: ♂ 14-15.5 mm, ♀ 14-18 mm.
Antennal length: ♂ 6.1-7.5 mm, ♀ 3.0-3.6 mm.

Body colour yellow to dark yellow.

Head: Antennae of ♂ 17 or 18-segmented, second and following flagellar segments reniform, verticillar hairs as long as or slightly longer than segments; antennae of ♀ 14 or 15-segmented, segments more or less cylindrical, verticillar hairs distinctly longer than segments. Scape yellow, pedicel sordid yellow, first flagellar segment yellow with blackened



Figs. 84-96. *N. eucerooides*; 84-92, ♂; 93-96, ♀. 84. hypopygium, lateral view; 85. hypopygium, caudo-ventral view; 86. tergite nine, caudal view; 87. tergite nine, ventral view; 88. sp2, from inside; 89. od, outside; 90. id, outside; 91. aedeagus, lateral view; 92. semen pump, dorsal view; 93. fused valvulae and furca, dorsal view; 94. hypovalvae, dorsal view; 95. left hypovalva, inside; 96. ovipositor, lateral view.

apex and other segments distinctly bicoloured with yellow basal nodes and brown to black apical parts. Sides of rostrum with dark to pale brown ventral half. Palps yellow to brownish-yellow. Frons, tubercle and small rostral part of vertex more or less opaque (dark)yellow; remainder of head shining yellow to dark yellow without distinct dark markings.

Thorax: Entire thorax polished except dull yellow to brown-yellow median part of pronotum. Stripes light red-brown to brown; median one sometimes with indication of a longitudinal yellow line. Transverse suture not or hardly tinted, antero-lateral corners of scutum 2 dull red-brown to dark brown. Scutellum, narrow median stripe and caudal part of mediotergite transparently dark yellow. Pleura yellow with dark to red-yellow markings. Anterior part of paratergite and lateral corner of prescutum both with a conspicuous, small, dark brown to black dash (fig. 83), not always equally distinct. Legs yellow, usually brown at tips of femora and tibiae, gradually darkened towards end of tarsi. Tibiae of middle and hind legs usually shorter than metatarsi, sometimes equal in length. Tarsal claws un-toothed. Wings hyaline yellow-brown, costal region yellow; wingtip and bases of radial cells vaguely brown shaded; pterostigma brownish yellow, only sometimes with a few macrotrichia; cell m1 varying from sessile to long-petiolate.

Abdomen: Dorsal stripe on tergites 1-7 usually dark brown and continuous; in ♀ somewhat broader and more distinct, but not broader than scutellum; spots on separate tergites usually with dark anterior triangle and a somewhat paler oblong spot posteriorly. Tergites 2-7 laterally with row of black-brown spots, two on each side of segments, the anterior one usually smaller and paler or sometimes obliterated. Sternites 2-7 in ♂ usually with black-brown, more or less oval spots, in ♀ posterior spots more protracted. Tergites 8 and 9 and base of sternite 8 in both ♂ and ♀ usually black-brown, sometimes more weakly fuscous; remainder of terminal segments yellowish.

Hypopygium: Hind margin of tergite 9 with

wide U-shaped incision; caudal extensions and thick median and small lateral protrusions on ventral side set with black spines (figs. 86, 87). Details of outer and inner dististyles see figs. 89, 90; id with a distinct crest, a bulbously curved caudal margin with some long black hairs, no projection on the black haired lateral base. Internal half of sp2 with a rather broad transparent extension at base (fig. 88). Hind margin of sternite 8 with deep U- or V-shaped incision, basally largely closed by a membrane laterally set with thin medially directed yellow hairs; distinctly protruded caudal corners set with long yellow bristles (fig. 85). Membranous area on ventro-caudal surface of sternite 9 with narrow, sclerotized lateral plates, curved lateral offshoots and a bluntly two-tipped medisternal appendage (fig. 85); midventral extension of antecosta small, narrow and membranous. Adminiculum with dorsally curved, slender, sometimes tapering gonapophyses; median part with two hook-shaped transparent extensions anteriorly (fig. 91). Semen pump fig. 92. Intromittent organ at most reaching into fourth abdominal segment, length about 17.0 to 18.5 mm. Hypopygium not as broad as scutum 1. Ovipositor: Cerci with very slender apical parts; hypovalvae subapically broad with obtusely pointed tips (figs. 95, 96). Rostral extensions of hypovalvae well developed and extended; internal shell very small and very narrowly prolonged; no internal arch (fig. 94). Fused valvulae with two weakly sclerotized halves; furca slightly stronger sclerotized (fig. 93).

Biology (diagram 4)

N. eucerooides can often be found in the same situations as *eucera* (Rogers, 1942), such as in wet meadows or grasslands, in swampy woods, on herbage along streams (Alexander, 1919b, 1924, 1929b) and in moist deciduous forests. The species is reported from altitudes up to 1700 feet (520 m); there is one record of 3200 feet (975 m), a ♀ from North Carolina. The immature stages are presumably unknown (cf. Alexander, 1920a, 1931b). The flight-period runs from the last week of May to the end of Ju-

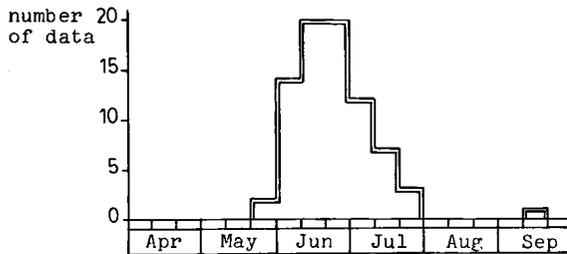
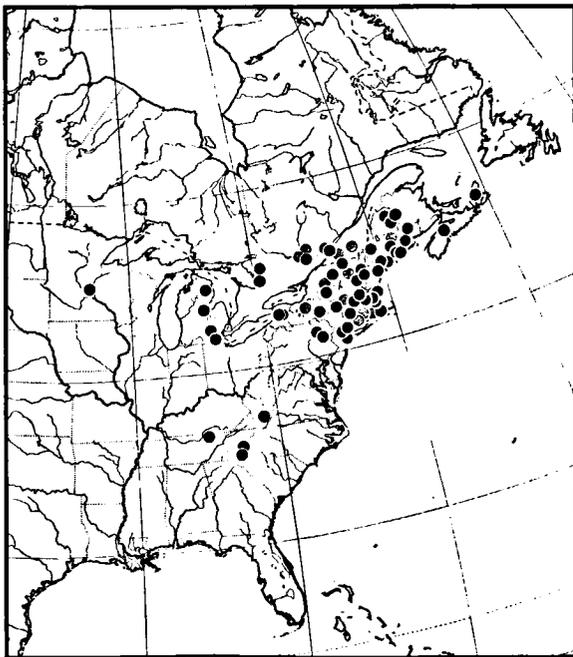


Diagram 4. Period of flight of *N. euceroidea*.

ly and reaches a climax in the second half of June, hence it appears that there is one generation a year (*euceroidea* is known in the literature from the beginning of August as well, and 1 ♀ was examined from Massachusetts, collected on September 12).

Distribution (map 7)

In the literature *euceroidea* is only known from New Brunswick (Perth, locality of paratype) to Michigan (Rogers, 1942) and southward to Pennsylvania (type-locality of *clandestina*); erroneously reported from Kansas (Young, 1978, Gelhaus, 1982). The available data extend this



Map 7. Distribution of *N. euceroidea*, based on material examined (black dots) and literature (stippled dots).

range to Nova Scotia (Baddeck on Cape Breton Isl. and Kentville in Kings Co.) and New Brunswick (Harvey) in the Northeast, to Minnesota (Anoka Co., 1 ♂) in the West and to the mountainous areas of Virginia (Giles Co.), North Carolina (Buncombe, Transylvania co's.) and Tennessee (Fentress Co.) in the South. Other specimens originated from the following localities and counties: Connecticut: Litchfield Co.; Maine: 8 counties; Massachusetts: 6 counties; Michigan; Livingston, Midland, Monroe, Oscoda co's.; New Hampshire: Carroll, Cheshire, Coos, Grafton co's.; New Jersey: Bergen Co.; New York: 7 counties; Ontario: Kearney, Ottawa; Pennsylvania: Carbon, Luzerne co's.; Quebec: Montreal, Terrebonne Co.; Vermont: Franklin Co. Supplementary localities in the literature for Ontario, Quebec, Maine, Vermont, New Hampshire, Massachusetts, Connecticut and New York.

Nephrotoma polymera (Loew, 1863)

Figs. 97-109, diagram 5, map 8

Loew, 1863: 297, descr; Osten Sacken, 1878: 40, distr; Loew, 1879: 4, key; Snodgrass, 1904: 199-200, descr hypop, pl. XI, fig 50 id & od, fig 60 hypop; all as *Pachyrrhina*; Aldrich, 1905: 98, distr; Doane, 1908: 176, key; Tucker, 1909a: 298, loc; Tucker, 1909b: 306, loc; all as *Pachyrrhina*; Alexander, 1915b: 465, note; Dietz, 1918: 105, comp, 112, key (as *Pachyrrhina*); Alexander, 1919b: 786, loc, 818, locs, 831, biol, 936, key; Alexander, 1920a: 1017, biol; Alexander & McAtee, 1920: 396, key, 397, locs; Alexander, 1922: 61, loc; Alexander, 1924: 61, loc, biol; Johnson, 1925: 34, locs; Alexander, 1926: 240, loc; Rogers, 1930: 14, loc, 16, biol; Alexander, 1931b: 145, biol; Dickinson, 1932: 166, 167, locs, 215, key, 219, fig wing, note, distr; Brimley, 1938: 319, locs; Alexander, 1941: 284, loc; Alexander, 1942: 224, key, 232, sh descr, distr, locs; Rogers, 1942: 19, 46, biol, 62, loc, biol; Foote, 1956: 222, biol, loc; Frommer, 1963: 580-81, morph; Alexander, 1965: 22, distr; Young, 1978: 409, 410, 413, biol, 416, locs, biol, distr, 432, key; Gelhaus, 1982: 85, loc.

Material examined

Type material: *Pachyrrhina polymera* (Loew, 1863) was described from "♂ et ♀". In the Loew Collection at the MCZ there is only one specimen (♂) bearing a type label, but there is

also a ♀ labelled simply "Loew Coll.". The male, condition fair, type no. 10305, designated as lectotype by Byers in 1961, is labelled as follows: "Ill." "polymera m." "Loew Coll." "10305" "Type" "to be lectotype G.W.B. '61".

Other material: 164 ♂, 89 ♀, from the following states and provinces: Connecticut (3♂, 1♀), Illinois (3♂, 2♀), Indiana (31♂, 29♀), Kansas (19♂, 7♀), Kentucky (1♂), Maine (1♀), Maryland (6♂, 2♀), Massachusetts (5♂, 2♀), Michigan (32♂, 16♀), Minnesota (3♂), Missouri (1♂, 1♀), New Hampshire (1♀), New Jersey (4♂, 4♀), New York (6♂, 5♀), North Carolina (3♂, 2♀), North Dakota (1♂), Nova Scotia (2♂), Ohio (11♂, 3♀), Ontario (3♂), Pennsylvania (14♂, 4♀), South Dakota (1♀), Tennessee (1♀), Vermont (1♂, 1♀), Virginia (13♂, 5♀), West Virginia (1♂), Wisconsin (1♂, 1♀).

Diagnostic features

The ♂♂ of *polymera*, *eucera* and *euceroidea* can easily be separated from other *Nephrotoma* species because of their conspicuous antennae (more than 16 segments and bicoloured, reniform flagellar segments); the ♀♀ are also distinguishable by the number of antennal segments (14 or 15). Furthermore *polymera* can be recognized by the following characters: the velvety black antero-lateral corners of scutum 2, the usually (dark)brown region in the middle of the transverse suture (fig. 99), the (dark)brown pterostigma usually with many macrotrichia, the bottle-shaped dorsal markings on abdominal tergites and the brown to black subterminal darkening in both sexes.

Description

Body length: ♂ 12.5-15 mm, ♀ 17-19 mm.

Wing length: ♂ 13-14.5 mm, ♀ 14.5-16 mm.

Antennal length: ♂ 6.5-8.3 mm, ♀ 3.0-3.6 mm.

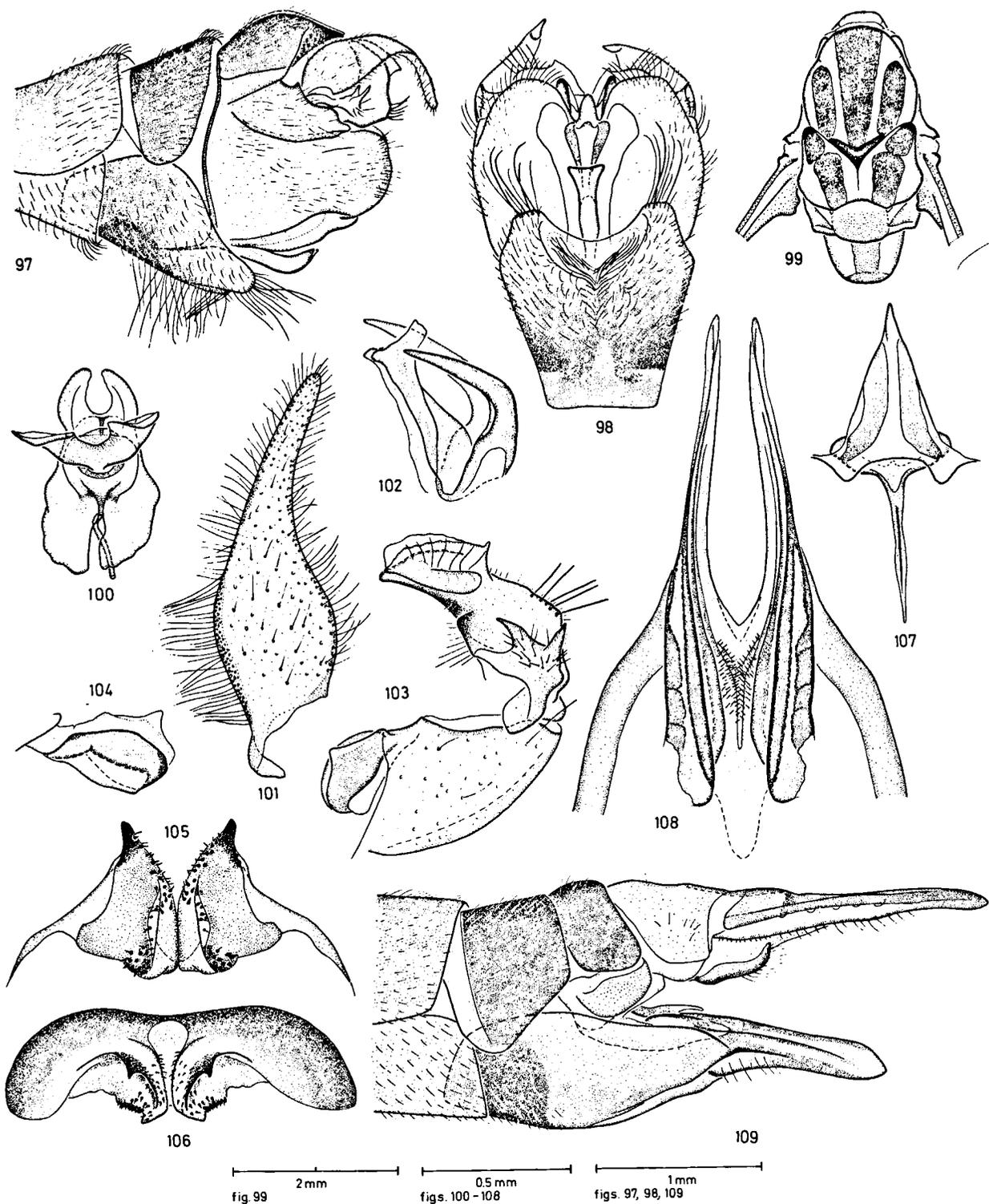
Body colour light yellow.

Head: Antennae of ♂ 16 to 18-segmented, of ♀ 14 or 15-segmented (exceptionally with 13

segments); scape and pedicel yellow, first flagellar segment slightly darkened apically, other segments bicoloured with yellow basal nodes and (dark) brown apical parts. Second and following flagellar segments in ♂ distinctly incised beneath, elongated reniform; verticillar hairs reaching to about two-third length of segments. Antennae of ♀ with cylindrical flagellar segments; verticillar hairs largely exceeding length of segments, sometimes nearly twice as long as segments. Rostrum shining yellow, ventro-lateral parts varying from yellowish to distinct brown. Palps yellow to brown-yellow. Frons and tubercle (sub)opaque yellow, vertex and genae shining yellow, sometimes a light brownish spot in the middle of the vertex.

Thorax: Median part of pronotum subopaque sordid yellow, remainder of thorax polished. Stripes reddish-brown to reddish-yellow. Transverse suture distinctly and broadly light to dark brown tinted in the middle, sometimes vague; antero-lateral corners of scutum 2 velvety brown to black, sometimes more greyish (fig. 99). Scutellum, antero-median stripe and caudal part of mediotergite transparently dark yellow. Pleura yellow to white-yellow, markings indistinct to red-yellow; on paratergite and lateral corners of prescutum occasionally narrow (light) brownish dashes. Legs yellow, femora and tibiae with narrow dark brown apical parts; tarsi brownish-yellow, darkened towards apex. Metatarsi of middle and hind legs not or only slightly longer than tibiae. Tarsal claws untoothed. Wings hyaline-yellow, costal region light yellow; bases and tips of radial cells with distinct brown shade; pterostigma (dark) brown with a few to about 25 macrotrichia; cell m1 sometimes short-, mostly long-petiolate.

Abdomen: Dorsal markings usually on tergites 2-6, very vague to distinctly brown, in ♂ usually paler than in ♀; spots on separate segments more or less bottle-shaped; spots in ♀ usually passing into narrow transverse brown rim along posterior margin, in ♂ this transverse marking sometimes vaguely present on first few segments. Dark to black-brown



Figs. 97-109. *N. polymera*; 97-106, ♂; 107-109, ♀. 97. hypopygium, lateral view; 98. hypopygium, caudo-ventral view; 99. thorax, dorsal view; 100. semen pump, dorsal view; 101. od, outside; 102. adminiculum, lateral view; 103. id, outside; 104. sp2, from inside; 105. tergite nine, ventral view; 106. tergite nine, caudal view; 107. fused valvulae and furca, dorsal view; 108. hypovalvae, dorsal view; 109. ovipositor, lateral view.

lateral markings on tergites 2-7, usually a distinct large and a lighter small dash on each side of segment, in ♀ usually more distinct. Sternites ventrally marked with narrow brown lines, usually discontinuous, in ♂ more vague and sometimes indistinct. Tergites 8, 9 and large basal part of sternite 8 in both sexes distinctly dark brown to black-brown fuscous, remainder of terminal segments yellow to dark yellow.

Hypopygium: Hind margin of tergite 9 with deep U-shaped incision; posterior extension with strongly extended, apically blackened, lateral points; median black-spined protrusions on ventral side strongly curved laterad; no lateral protrusions present (figs. 105, 106). Anterior margin of outer dististyle densely set with very long pale hairs (fig. 101); inner dististyle with a broad, posteriorly acute angled crest, basally with a bulbous lobe; posterior margin of id slightly bulging with some brown bristles; lateral projection with two points (fig. 103). Sp2 with two transparent brims along midventral base (fig. 104). Hind margin of sternite 8 with wide U-shaped incision, largely closed by a membrane set with thin, medially directed yellow hairs (fig. 98). Membranous area on ventro-caudal surface of sternite 9 with a strongly extended and two-tipped medisternal appendage, with two narrow sclerotized lateral plates and two claviform lateral regions (fig. 98); midventral extension of antecosta very small and membranous. Adminiculum with two long and slender, dorsally curved gonapophyses; median part with two small anterior extensions (fig. 102). Semen pump fig. 100. Intromittent organ rather short and weakly winding, length about 9.0 to 10.5 mm. Hypopygium usually slightly broader than scutum 1.

Ovipositor: Cerci with a rather abrupt narrowing on one-third length from apex; ventral base of hypovalvae with a weakly sclerotized bulge on either side (fig. 109). Rostral extensions of hypovalvae weakly developed, lateral shells usually distinctly sclerotized; internal shell indistinct, no internal arch; base of major ridge long (fig. 108). Fused valvulae with two

weakly sclerotized isolated plates; furca fig. 107.

Biology (diagram 5)

N. polymera is a common species in mesophytic habitats, as the "higher and dryer parts of the woods" (Alexander, 1924), flood-plain and bottomland forests, marshy meadows and grassy areas around swamps; the species is rare in shrubs on the banks of streams (Rogers, 1930, 1942; Foote, 1956; Young, 1978). The species can be found at altitudes up to 1800 feet (550 m) (especially in the southern parts of the range).

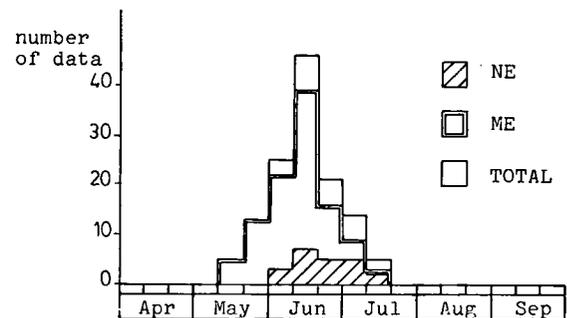
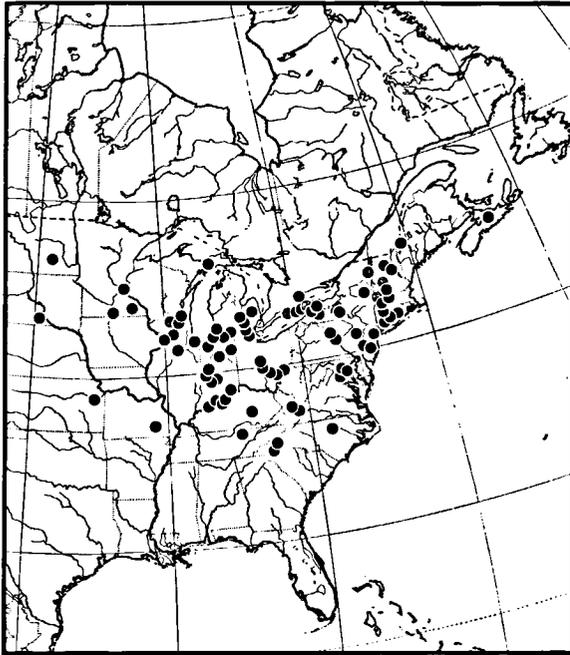


Diagram 5. Period of flight of *N. polymera*.

Larvae of *polymera* were found "beneath leaf-mold, in rich, moist to saturated humus soil in woods" (Alexander, 1920a, 1931b). The species has one generation a year (Rogers, 1942; Young, 1978), is very local (Rogers, 1942) and has a rather short flight-period, from mid-May till the third week of July with a distinct peak in the middle of June; in the northern part of the range *polymera* is only found in June and July. In the literature *polymera* is also known from September 26, Virginia (Alexander & McAtee, 1920) and from August 8, Massachusetts, and 26 Vermont (Johnson, 1925), presumably dubious data.

Distribution (map 8)

Largely in accordance with the published literature, the distribution-range of *polymera* runs from Nova Scotia (Economy Mt. in Colchester Co.) and Maine (Holeb, W of Jackman



Map 8. Distribution of *N. polymera*, based on material examined (black dots) and literature (stippled dots).

in Somerset Co.) westward to North Dakota (Jamestown, City Park), South Dakota (Winner) and Kansas (several localities in Douglas Co.) and southward to Missouri (Big Spring St. Park in Carter Co.), Tennessee (Crooked Cr. in Fentress Co.) and North Carolina (Black Mts. in Buncombe Co., Brevard in Transylvania Co.). Other specimens originated from the following localities and counties: Connecticut: Fairfield, Litchfield, New Haven co's.; Illinois: Carroll, Cook, La Salle, Winnebago co's.; Indiana: 12 counties; Kentucky: Rockcastle Co.; Maryland: Montgomery, Pr. Georges co's.; Massachusetts: Berkshire, Franklin co's.; Michigan: 10 counties; Minnesota: Faribault, Olmsted, Ramsey co's.; New Hampshire: Grafton Co.; New Jersey: Hemlock Falls (not located) and Burlington, Essex co's.; New York: Erie, Fulton, Genesee, Tompkins, Wyoming co's.; Ohio: Athens, Delaware, Franklin, Hocking, Washington co's.; Ontario: Fishers Glen (on L. Erie, south of Simcoe), Ridgeway (on L. Erie, south of Niagara Falls), Toronto; Pennsylvania: Carbon, Lycoming, Philadelphia, Snyder co's.; Vermont:

Caledonia, Windham co's.; Virginia: Fairfax, Giles co's.; West Virginia: Mercer Co.; Wisconsin: Beaver Dam in Dodge Co. In the literature some supplementary localities are given: Ontario: Normandale; Vermont: Norwalk, Woodstock in Windsor Co.; Connecticut: Portland in Middlesex Co.; New York: Essex, Niagara, Rensselaer co's.; Wisconsin: Dane, Jefferson co's.; North Carolina: Raleigh in Wake Co.

SECTION 3

Nephrotoma cornifera (Dietz, 1918)

Figs. 110-117, 118-120, map 9

Dietz, 1918: 110, key, 120, comp, 120-1, descr, comp, pl. IV, fig wing, pl. VI, fig hypop (as *Pachyrhina*); Alexander, 1919b:936, comp; Alexander & McAtee, 1920: 396, key, loc; Brimley, 1938: 319, locs; Alexander, 1940b: 608, comp; Alexander, 1941: 284, distr; Alexander, 1942: 223, key, 226, sh descr, distr; Alexander, 1965: 21, distr.

Material examined

Type material: *Pachyrhina cornifera* was described by Dietz (1918) from four males. The holotype and one paratype were examined in the Dietz-collection at the ANSP. The holotype, condition fair, type no 6446, is labelled: "4-mile Run Va. July 24, 1915" "C P Alexander Collector" "ParaTYPE" "HOLOTYPE *Pachyrhina cornifera* W. G. Dietz 6446". The paratype is labelled: "Pollocksville, N.C. July 8, 1915" "ParaTYPE" "PARATYPE *Pachyrhina cornifera* W. G. Dietz". Dietz (1918) reported the holotype from "Four Mile Run, Virginia" and the three paratypes from "Pollocksville, North Carolina". So the "paratype"-label on the holotype is a mistake, just as Dietz' announcement that the type and one paratype are in the collection of C. P. Alexander. In this collection a wing-slide was found of a *cornifera*-specimen from Pollocksville, N.C., July 8 1915, probably one of the two paratypes supposed to be in the Alexander-collection.

Other material: 9 ♂, 4 ♀, from the following states: Florida (4♂, 3♀), Indiana (3♂, 1♀), Tennessee (1♂), Virginia (1♂).

Diagnostic features

There are scarcely any differences between the three closely related species *cornifera*, *okefenoke* and *urocera*, apart from the peculiarly formed posterior appendages of the inner dististyles of the males. Therefore most problems in identification are caused by females. The species-group is recognized by the short antennae (in both sexes) with the very long verticils, the grey-brownish tint on postgenae, the broken and sometimes vague abdominal dorsal marking and the light brown shaded costal region of the wing. The males of the three species are easily recognized by the shape of the posterior appendage of the inner dististyles: in *cornifera* slender and serpentine, in *okefenoke* long, slender and straight and in *urocera* large, stout and somewhat upcurved and twisted. Females of *cornifera* differ from those of *okefenoke* and *urocera* in the broad sternite 8, the caudal margin of which strongly curves towards the hypovalvae (fig. 120) and in the rather broad and short cerci. Between *okefenoke* and *urocera* there are in dried condition hardly visible differences in the ovipositor, but there are some other differences, although slight and not always equally distinct: the antennal flagellar segments are weakly bicoloured in *okefenoke*, usually distinctly bicoloured in *urocera*; the verticillar hairs in ♀♀ of *okefenoke* are mostly up to twice as long as flagellar segments, in ♀♀ of *urocera* about 1.5 times as long; the median stripe of the scutum in *okefenoke* is anteriorly twice as broad as posteriorly, in *urocera* 1.5 times as broad; the antero-lateral corners of scutum 2 are usually not or weakly brown tinted in *okefenoke*, and usually brown tinted in *urocera*; the pterostigma is yellow-brown to brown in *okefenoke* and (dark) brown with usually a darkened seam along the costal margin in *urocera*.

Description

Body length: ♂ 14-15.5 mm, ♀ 18-20 mm.

Wing length: ♂ 13-15 mm, ♀ 12.5-15.5 mm.

Antennal length: ♂ 2.6-2.8 mm, ♀ 2.4-2.6 mm.

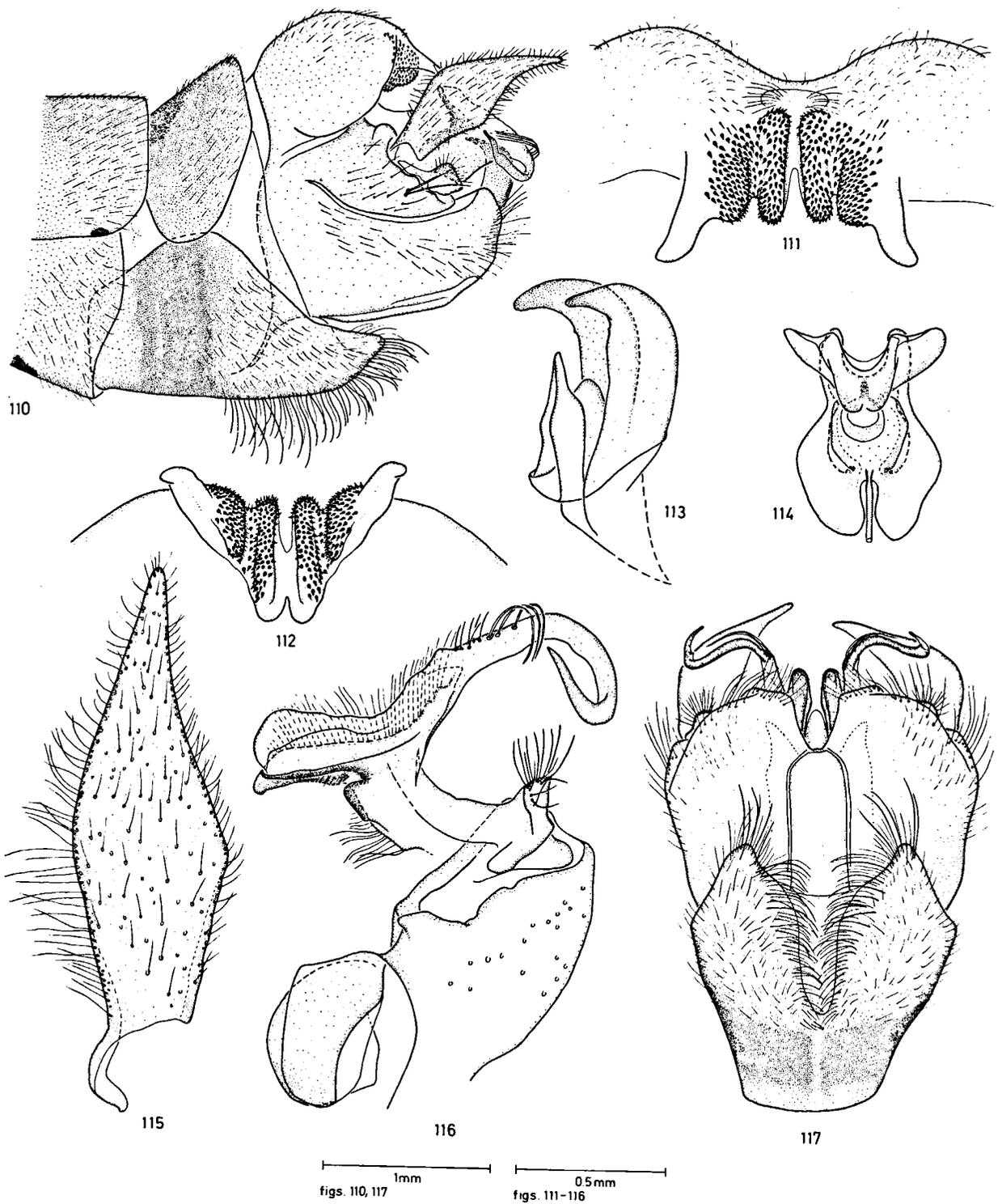
Body colour bright yellow to dark yellow.

Head: Antennae of both sexes very short, 13-segmented; basal three segments yellow, second flagellar segment brown to yellow, remainder completely dark brown, some segments sometimes narrowly yellow at the bases; flagellar segments cylindrical, verticillar hairs in both sexes up to twice length of segments. Sides of rostrum largely dark brown. Palps brownish, first two segments darker. Head yellowish with large grey-brown areas on postgenae. Tubercle and vertex largely shining; no dark occipital marking.

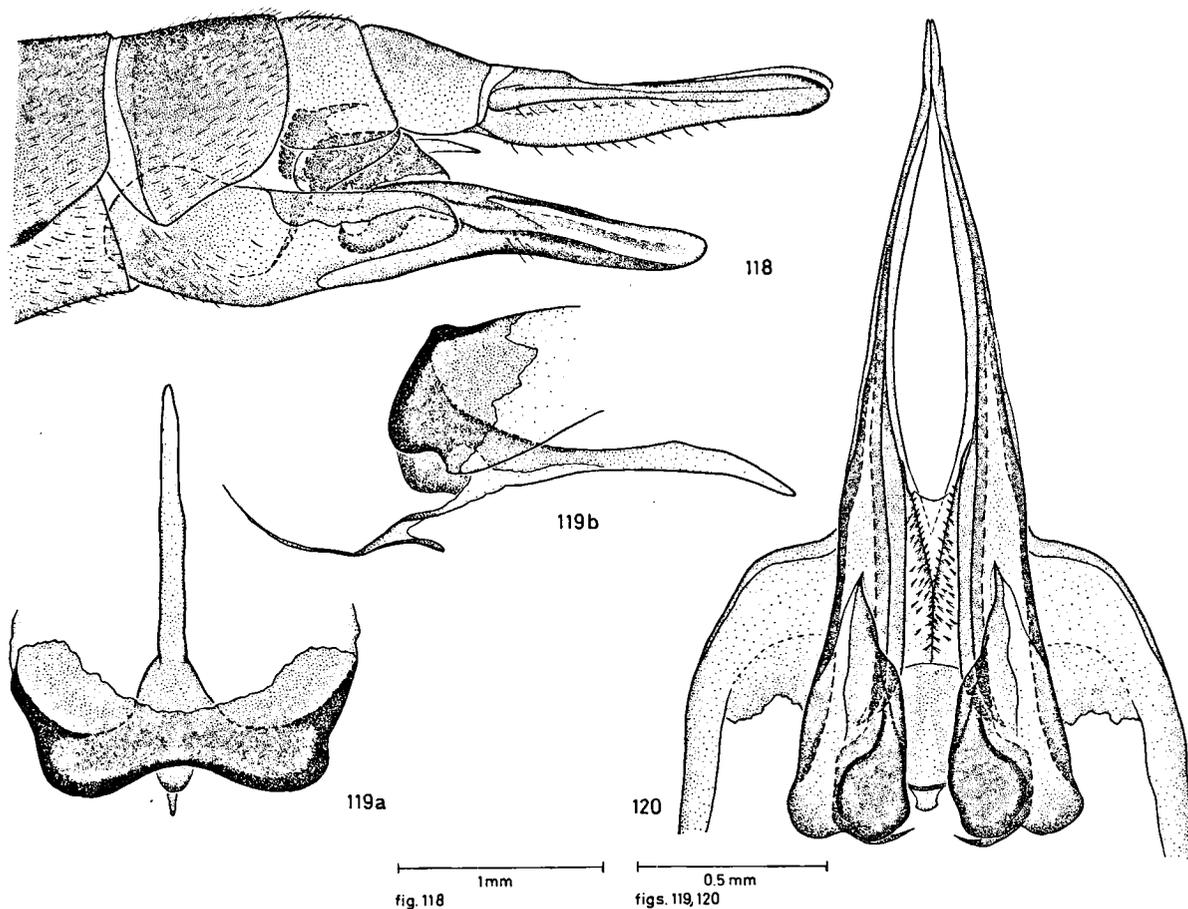
Thorax: Pronotum, prescutum and scutum more or less subshining, rest of thorax distinctly shining. Pronotum yellow, median part usually tinted. Stripes dark yellow to red-brown yellow, median one usually partly or largely divided by a narrow longitudinal yellow line. Transverse suture pale brownish tinted centrally, antero-lateral corners of scutum 2 weakly brownish. Scutellum and mediotergite transparently dark yellow, on both sometimes a weakly indicated narrow median stripe. Pleura mainly whitish-yellow with transparent faint markings. Legs yellow with slightly darkened tarsal segments. Tibiae of middle and hind legs shorter than metatarsi. Tarsal claws untoothed. Wings with a yellow-brown tinge; costal and subcostal region, cell r1 + 2 and top of wing with a (light) brown shade; pterostigma dark brown, without macrotrichia; cell m1 usually petiolate.

Abdomen: Dark to faint brown dorsal stripe discontinuous, not broader than scutellum, formed by oblong to diamond-shaped spots on tergites 1-7. Each segment with laterally an oblong black-brown spot and ventrally a drop-shaped one. Terminal segments without darkening, except some slight one at base of eighth segment.

Hypopygium: Hind margin of tergite 9 with a U-shaped emargination lined with long whitish hairs; posterior extension with strongly ventro-caudally extending, apically bare and basally spined lateral wings and ridge-like spined protrusions in the median (figs. 111, 112). Rostral margin of outer dististyle lined with very long hairs (fig. 115); inner dististyle with a broad, anteriorly extended crest and a conspicuous



Figs. 110-117. *N. cornifera*; ♂. 110. hypopygium, lateral view; 111. tergite nine, caudal view; 112. tergite nine, ventral view; 113. adminiculum, lateral view; 114. semen pump, dorsal view; 115. od, outside; 116. id, outside; 117. hypopygium, caudo-ventral view.



Figs. 118-120. *N. cornifera*; ♀. 118. ovipositor, lateral view; 119. fused valvulae and furca: a, dorsal view, b, lateral view 120. hypovalvae, dorsal view.

serpentine posterior appendage, latero-posterior projection obtuse and set with black hairs (fig. 116). Sp2 with two rather broadly extended transparent shells at base. Sternite 8 with deeply V-shaped, membrane-covered incision and slightly extended caudal corners; both bordered by luxuriant long, brown, curved, medially directed hairs (fig. 117). Membranous area on ventro-caudal surface of sternite 9 rather smooth, without medisternal appendage, with small latero-caudal offshoots; caudal end of sternite 9 extended far beyond basistyle (figs. 110, 117). Adminiculum with broadened and dorsally curved gonapophyses; median part with a strong caudal bulge (fig. 113). Semen pump fig. 114; wings of bifid compressor apodeme with a small ridge anteriorly. Length of intromittent organ about 9.5 to 10.5 mm.

Hypopygium large, much broader than scutum 1.

Ovipositor: Cerci rather broad and short (fig. 118), hypovalvae weakly tapering. Caudolateral margins of sternite 8 strongly and angularly extended (fig. 120). Rostral extensions of hypovalvae strongly developed and transformed in two sclerotized blade-like sheets (figs. 118, 120); internal shell more or less bowl-shaped. Fused valvulae with two strongly sclerotized, upcurved and bag-shaped shells at base; apical extension very long, narrow and weakly sclerotized; furca small (figs. 119a, b).

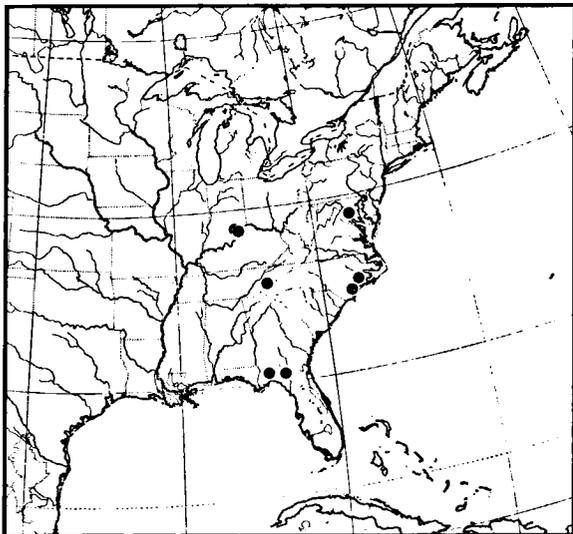
Biology

No data about the habitat of *cornifera* can be found in the literature; in Alexandria, Virginia,

one male was found in a wild city-park. G. W. Byers (in literis) has collected several specimens in Alexandria along small brooks, on a generally shaded area, with mixed deciduous woods and damp sand-clay soil. The few catches of this rare species are from the end of May till the end of September, with a slight peak in July and August.

Distribution (map 9)

Specimens originated from the following localities and counties: Florida: Hamilton Co., 2♂ 3♀ VI-1, Leon Co., 1♂ V-25, 1♂ VII-2; Indiana: Hanover, 1♂ VII-14, 1♀ IX-29, Hensler's Woods (Hanover), 1♂ VIII-22, Clifty Falls Pk, 1♂ VIII-3, all Jefferson Co.; North



Map 9. Distribution of *N. cornifera*, based on material examined (black dots) and literature (stippled dot).

Carolina: Pollocksville, 1♂ paratype VII-8, in Jones Co.; Tennessee: Cades Cove, Great Smoky Mts. N.P., 1♂ VIII-12; Virginia: Alexandria, 1♂ VII-12, 4-mile Run, 1♂ holotype VII-24. The only supplementary locality in the literature is "Willard", Pender Co., North Carolina (Brimley, 1938).

Nephrotoma okefenoke (Alexander, 1915)
Figs. 121-130, 134-136, diagram 6, map 10

Alexander, 1915a: 97-98, descr (as *Pachyrrhina*); Dietz, 1918: 110, key, 120, 121, comp, pl. V, fig hypop (as *Pachyrrhina*); Alexander, 1919b: 833, 878, biol, 936, key, comp; Rogers, 1926: 7, loc, biol; Rogers, 1933: 42, biol, loc, distr, 48, biol; Brimley, 1938: 319, loc; Alexander, 1940b: 608, comp; Alexander, 1941: 284, loc; Alexander, 1965: 22, distr.

Material examined

Type material: *Pachyrrhina okefenoke* was described by Alexander (1915a) from a holotype male and eleven topotypic specimens, males and females. In the C.P. Alexander-collection, USNM, three males, one female and one damaged specimen of undefined sex were examined and also wingslides of a male and a female, all paratypes from: "Billy's Is. Okefenoke Swamp Ga. VI-25-1912". There is one female in the Alexander-collection topotypic with the paratypes but not labelled as paratype. The holotype was not found there. One ♂ paratype was examined in the collection of the ANSP.

Other material: 135 ♂, 62 ♀, from the following states: Florida: (128♂, 55♀), Georgia (5♂, 5♀), North Carolina (2♂), Tennessee (1♀), Virginia (1♀).

Diagnostic features

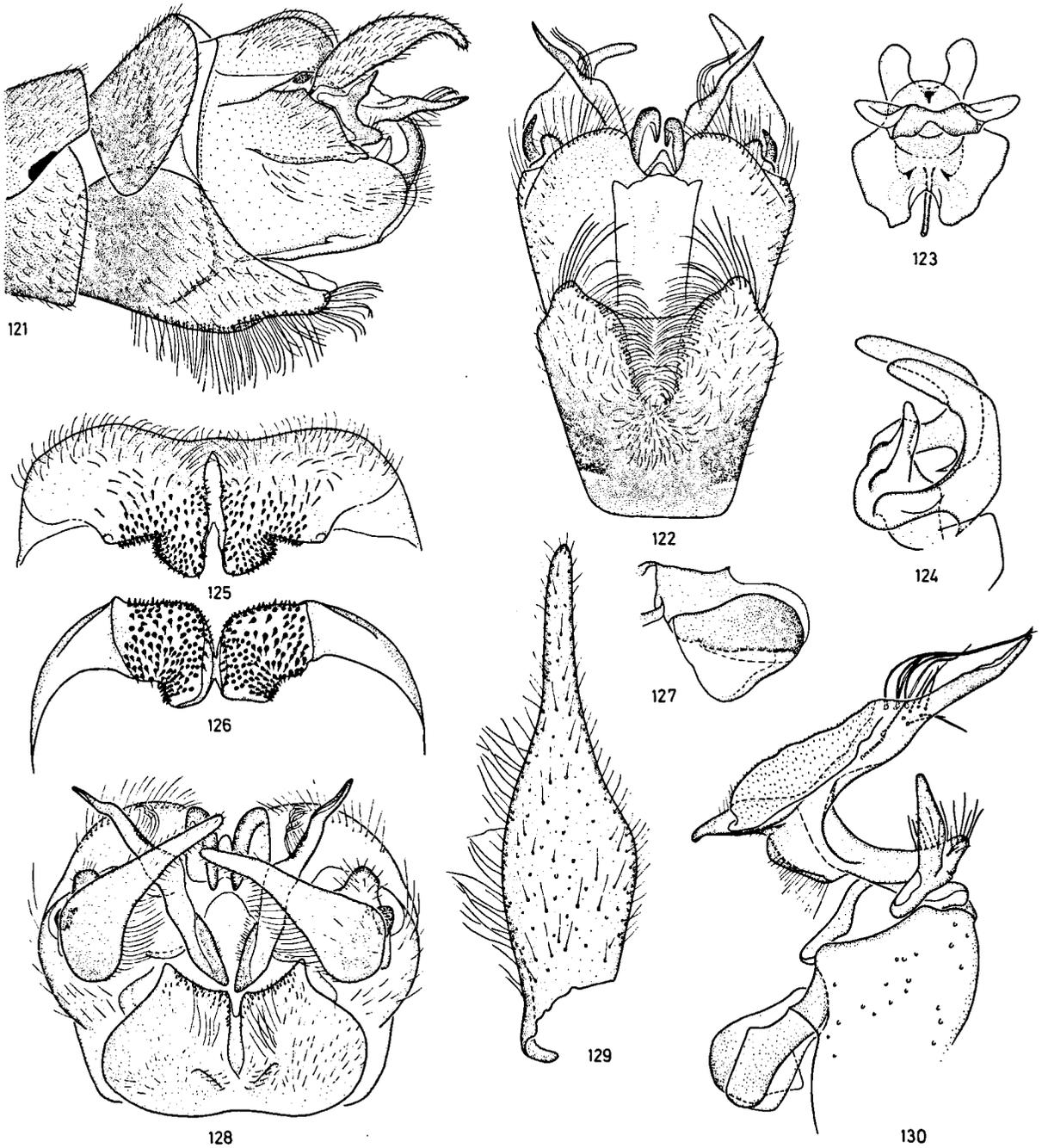
See under the diagnostic features of *cornifera*.

Description

Body length: ♂ 11.5-14.5 mm, ♀ 16-21 mm. Wing length: ♂ 11.5-15 mm, ♀ 11-15.5 mm. Antennal length: ♂ 2.3-2.8 (3.1) mm, ♀ 2.2-2.8 mm.

Body colour deep yellow.

Head: Antennae of both sexes very short, 13-segmented; basal three segments yellow, remainder of flagellum weakly bicoloured, segments brownish with very narrow, sometimes vaguely yellow bases; flagellar segments cylindrical, verticillar hairs in ♂ greatly exceeding length of segments, in ♀ usually up to twice as long as segments. Sides of rostrum largely dark brown. Palps with two



Figs. 121-130. *N. okefenokee*; ♂. 121. hypopygium, lateral view; 122. hypopygium, caudo-ventral view; 123. semen pump, dorsal view; 124. adminiculum, lateral view; 125. tergite nine, caudal view; 126. tergite nine, ventral view; 127. sp2, from inside; 128. hypopygium, dorsal view; 129. od, outside; 130. id, outside.

dark brown basal segments, apical segments lighter. Tubercle and vertex yellow to dark yellow and shining, without dark markings; along the eyes on postgenae large grey-brown areas, sometimes vague.

Thorax: Pronotum, prescutum and scutum more or less subshining; scutellum and mediotergite highly polished, pronotum with a more dark tinted median part. Stripes brownish- to reddish-yellow; median one divided by a longitudinal yellow line, sometimes vague. Transverse suture and antero-lateral corners of scutum 2 usually not, sometimes weakly to more dark brownish tinted. Scutellum and mediotergite transparently yellowish; median stripe on mediotergite sometimes vaguely indicated. Pleura yellow with transparent faint markings. Legs completely yellow, with weakly darkened tibial tips and tarsi. Metatarsi of middle and hind legs distinctly longer than tibiae. Tarsal claws un-toothed. Wings with a yellow-brownish tinge, costal and subcostal region, cell r1 + 2 and tip of wing with a (light) brown shade, base of radial cells usually slightly shaded; pterostigma yellow-brown to brown, sometimes with some macrotrichia; cell m1 usually petiolate, sometimes sessile.

Abdomen: Tergites 1-7 dorsally with small, more or less diamond-shaped dark brown spots on anterior parts, sometimes rather faint. Lateral markings on tergites 2-7 black-brown; usually one distinct dash on each side of segment, sometimes also a vague one anteriorly. Black-brown drop-shaped spots on anterior parts of sternites 2-7. Terminal segments without distinct darkening; eighth segment sometimes basally brownish tinted.

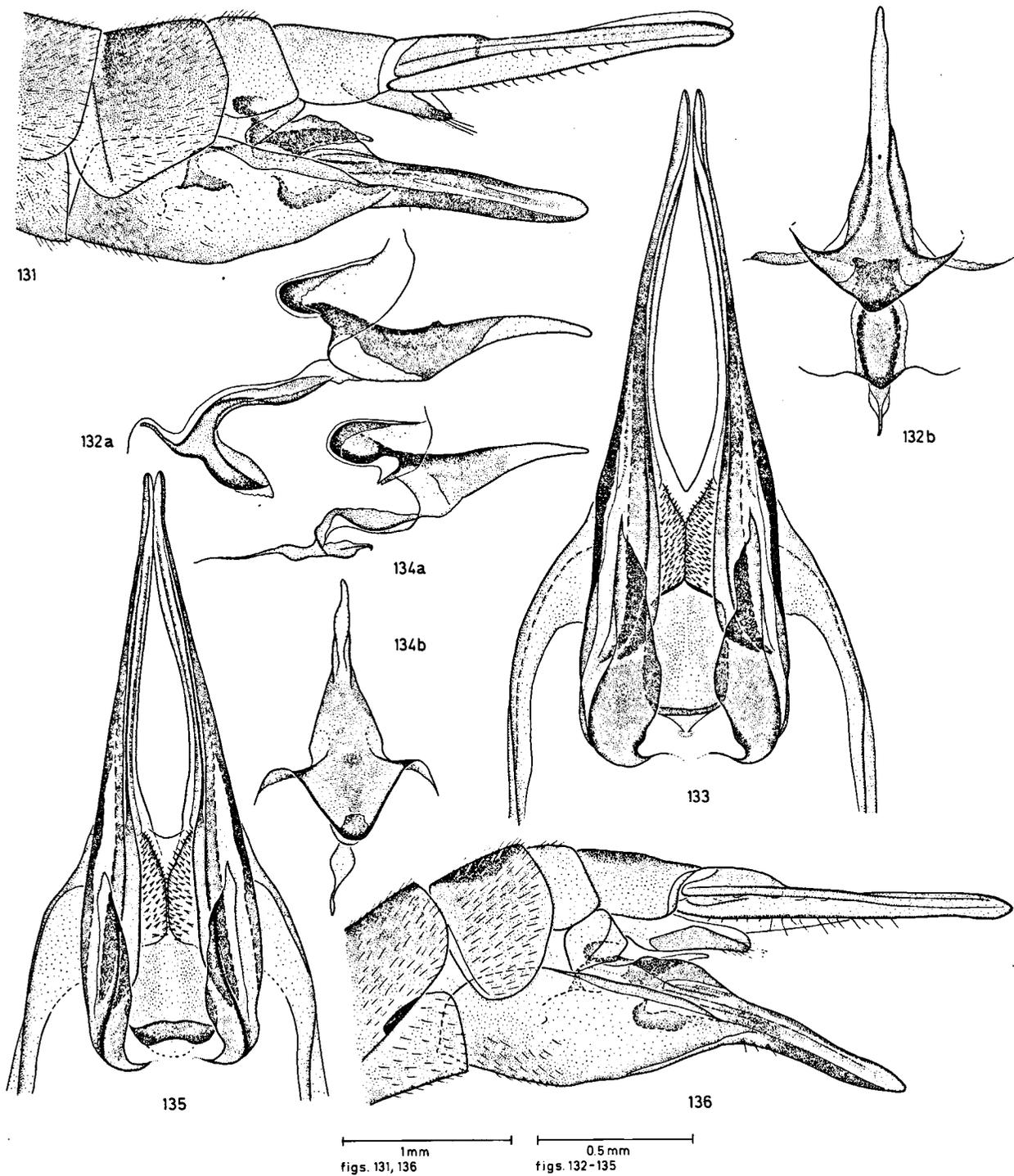
Hypopygium: Hind margin of tergite 9 with deep and narrow incision medially and on both sides slightly latero-caudally extended; black-spined ventral surface with thick median protrusions (figs. 125, 126). Outer dististyle with slender elongated apex, anterior margin lined with long yellow hairs (fig. 129); inner dististyle with a broad, anteriorly extended, pubescent crest and a long straight, slender and pointed posterior appendage, latero-posterior part of id

set with black hairs and bearing a solid upright projection (fig. 130). Sp2 with two basally extended transparent shells, the internal one with a broad basal flap (fig. 127). Hind margin of sternite 8 with deeply U-shaped incision, largely closed by a thin membrane; long, curved and medially directed yellow hairs along borders and base of incision and at slightly extended caudal corners (fig. 122). Membranous area on ventro-caudal surface of sternite 9 smooth, without medisternal appendage, with two weak latero-caudal offshoots (fig. 122); caudal end of sternite 9 extended far beyond basistyle (fig. 121). Adminiculum with somewhat broadened, dorsally curved and bluntly tipped gonapophyses; median part with two small, slightly sclerotized bulges anteriorly (fig. 124). Semen pump with strongly bulging lateral appendages and a longitudinal ridge anteriorly on each wing of bifid compressor apodeme (fig. 123). Length of intromittent organ about 11 to 12.5 mm. Hypopygium large, distinctly broader than scutum 1.

Ovipositor: Cerci long, slender and more or less parallel-sided; hypovalvae weakly tapering (fig. 136). Rostral extensions of hypovalvae strongly developed and transformed in two sclerotized blade-like sheets (figs. 135, 136). Internal shell deeply bowl-shaped. Fused valvulae at base with a sclerotized upcurved baggy extension; furca twofold, ventral part flat and small (figs. 134a, b).

Biology (diagram 6)

This locally quite common species inhabits different kinds of swamps and can also be found near small valley streams and in low hammocks (Alexander, 1915a, 1919b, Rogers, 1933). The immature stages are unknown, but teneral adults were found in a "shaded, brook-margin seepage area" (Rogers, 1933). More than two-thirds of the museum specimens are males; this could be explained by some possible nocturnal activity of the females (Rogers, 1926, who has taken females of *okefenoke* "from sugar and molasse baits, at night"), whereas "crepuscular to somewhat diurnal" activity



Figs. 131-133. *N. urocera*; ♀. 131. ovipositor, lateral view; 132. fused valvulae and furca: a, lateral view, b, dorsal view; 133. hypovalvae, dorsal view. Figs. 134-136. *N. okefenoke*; ♀. 134. fused valvulae and furca: a, lateral view, b, dorsal view; 135. hypovalvae, dorsal view; 136. ovipositor, lateral view.

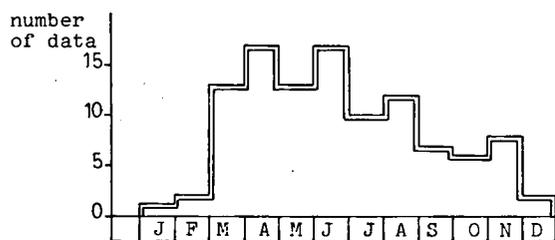
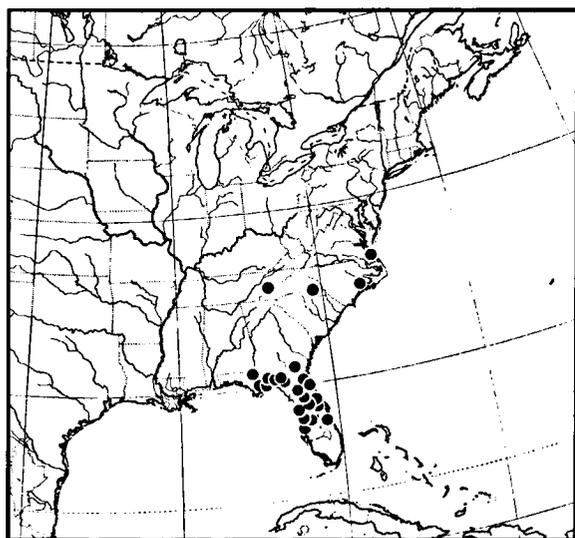


Diagram 6. Period of flight of *N. okefenoke*.

was reported for the adults (Rogers, 1933), which are presumably largely males. The species flies all the year round, but most frequently from March to August.

Distribution (map 10)

Most of the records are from northern and central Florida (20 counties). The other specimens originated from the following localities and counties: Georgia: Okefenokee Swamp; North Carolina: Pollocksville in Jones Co., Charlotte,



Map 10. Distribution of *N. okefenoke*, based on material examined.

Englewood in Mecklenburg Co.; Tennessee: Ramsey Falls Trail in Great Smoky Mts. N.P.; Virginia: Virginia Beach in Princess Anne Co. In the literature, no supplementary localities are provided.

Nephrotoma urocera (Dietz, 1918)

Figs. 131-133, 137-145, map 11

Dietz, 1918: 110, key, 119, descr, comp, 121, comp, pl. IV, fig wing, pl. VI, fig hypop (as *Pachyrhina*); Alexander, 1919b: 936, comp, distr; Rogers, 1930: 11-12, biol, 16, loc, biol; Brimley, 1938: 319, loc; Alexander, 1940b: 608, comp; Alexander, 1941: 284, loc; Alexander, 1965: 22, distr.

Material examined

Type material: Dietz (1918) described *Pachyrhina urocera* from two males, both were examined in the Dietz-collection at the ANSP. The holotype, condition good, type no. 6444, is labelled: "Black Mts. N.C. Coll. Dr. Dietz VI-21-12" "HoloTYPE" "HOLOTYPE *Pachyrhina urocera* W.G. Dietz 6444". The paratype is topotypic, with date: "VI-23-12".

Other material: 19♂, 12♀, from the following states: Alabama (2♂, 2♀), Florida (8♂), Georgia (1♂, 2♀), North Carolina (2♂, 2♀), South Carolina (1♀), Tennessee (6♂, 5♀).

Diagnostic features

See under the diagnostic features of *cornifera*.

Description

Body length: ♂ 12-15 mm, ♀ 17-20 mm.

Wing length: ♂ 12-15 mm, ♀ 12-14.5 mm.

Antennal length: ♂ 2.6-2.9 mm, ♀ 2.3-2.4 mm.

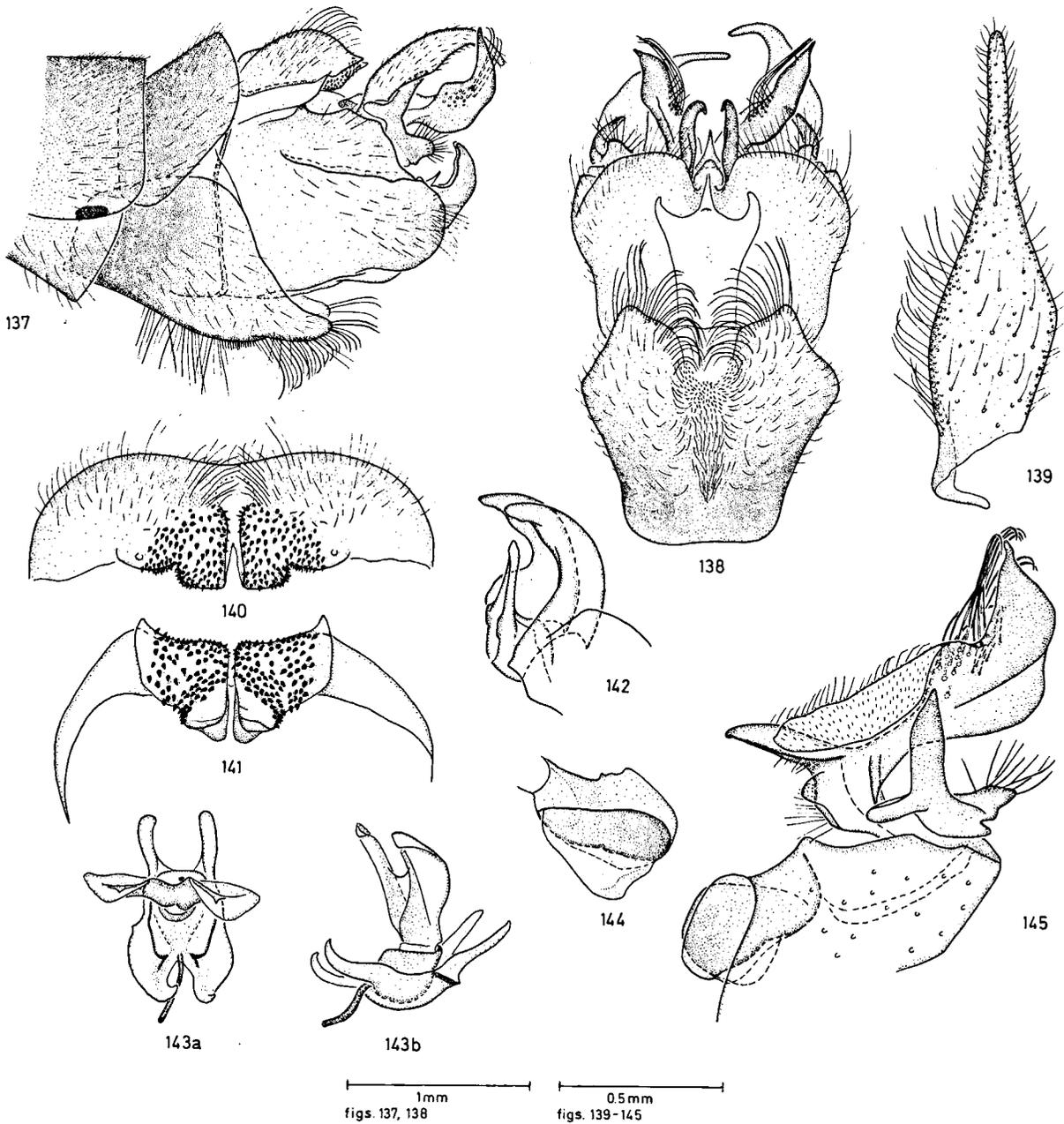
Body colour yellow to dark yellow.

Head: Antennae of both sexes very short, 13-segmented; basal three segments yellow, other segments bicoloured, brown with lighter to yellowish basal nodes; flagellar segments cylindrical, verticillar hairs in ♂ up to 1.5 times length of segments, in ♀ slightly longer, but less than twice length of segments. Rostrum with largely dark brown sides. Palps dark brown, somewhat paler apically. Tubercle and vertex bright to dark yellowish, shining, without a dark occipital marking; large grey- to dark brown areas on postgenae.

Thorax: Pronotum, prescutum and scutum subshining, remainder of thorax more polished;

median part of pronotum usually dark tinted. Stripes red-yellow to red-brown, median one rostrally only weakly dilated and sometimes partly divided by a narrow yellow longitudinal line. Transverse suture untinted to brownish tinted in the middle; antero-lateral corners of scutum 2 brownish, sometimes weakly.

Scutellum transparent dark to brown-yellow; mediotergite transparent yellow, sometimes with a weakly darkened narrow median stripe. Pleura yellow with slight red-yellow markings or markings not indicated. Legs dark yellow, only slightly darkened towards apex of tibial and tarsal segments. Metatarsi of middle and



Figs. 137-145. *N. urocera*; ♂. 137. hypopygium, lateral view; 138. hypopygium, caudo-ventral view; 139. od, outside; 140. tergite nine, caudal view; 141. tergite nine, ventral view; 142. adminiculum, lateral view; 143. semen pump: a, dorsal view, b, lateral view; 144. sp2, from inside; 145. id, outside.

hind legs distinctly longer than tibiae. Tarsal claws untoothed. Wings infumed with brown, costal and subcostal region, cell r1 + 2 and tip of wing with a brownish shade; pterostigma (dark) brown with usually a darkened seam along costal margin, usually with a few macrotrichia; cell m1 subsessile to petiolate.

Abdomen: Tergites dorsally marked with dark brown spots on anterior parts. Tergites with one black-brown dash on each side of segment and sometimes a vague second one anteriorly. Sternites with drop-shaped black-brown spots on anterior parts. Terminal segments without darkening or slightly brown at base of eighth sternite.

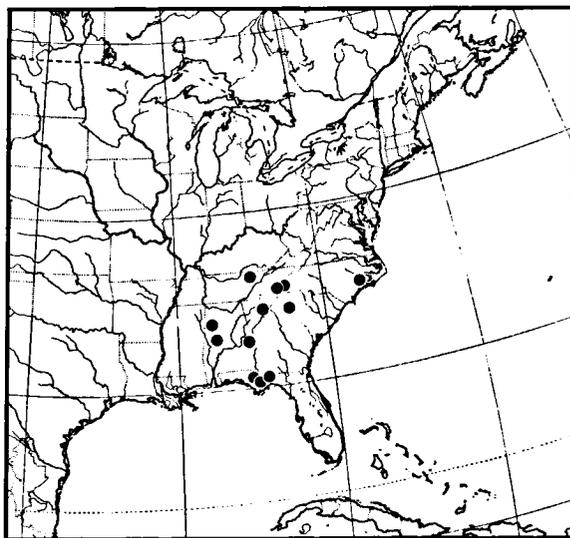
Hypopygium: Hind margin of tergite 9 deeply and narrowly incised in the middle, posterior extension with pronounced lateral corners and abundantly black-spined caudal and ventral surfaces; median ventral protrusions thick (figs. 140, 141). Outer dististyle with slender, elongate apex and row of long yellowish hairs along rostral margin (fig. 139); inner dististyle with a broad pubescent crest and a large, stout, twisted and apically pointed posterior appendage, set with some very long, yellowish hairs; latero-posterior projection strongly pronounced, set with black hairs and with a pointed, finger-like solid extension (fig. 145). Sp2 with two basally extended transparent shells, base of internal one strongly extended (fig. 144). Hind margin of sternite 8 with U-shaped, membrane covered incision; long, curved, medially directed brown-yellow hairs along incision and caudo-lateral corners; at base of incision a small, sometimes slightly bulging area set with short prickle-like dark brown hairs, anteriorly passing into a narrow long-haired area (fig. 138). Vento-lateral surface of sternite 9 with a smooth membranous area, without medisternal appendage and with two finger-like latero-caudal offshoots (fig. 138); caudal end of sternite 9 extended far beyond basistyle (fig. 137). Adminiculum with slightly broadened, tapering and dorsally curved gonapophyses; median part with a long, slender apex and two slight, sclerotized bulges anteriorly (fig. 142). Semen pump with extend-

ed lateral appendages and a vague longitudinal ridge on large wings of bifid compressor apodeme (fig. 143a, b). Length of intromittent organ about 12.0 to 14.0 mm. Hypopygium large, distinctly broader than scutum 1.

Ovipositor: Cerci long, slender, basally slightly broadened; hypovalvae more or less parallel shaped (fig. 131). Rostral extensions of hypovalvae strongly developed and transformed in two large, sclerotized blade-like sheets (figs. 131, 133); internal shell large, bowl-shaped. Fused valvulae at base with a sclerotized upcurved baggy extension, apically narrowly prolonged and weakly sclerotized; medially with a small hole; furca twofold, with a cup-shaped ventral part (fig. 132a, b).

Biology

Rogers (1930) reported for *urocera* in Tennessee: "Numerous in the more open portions of the stream-margin thickets. Also taken in considerable numbers from the open swales". Specimens were taken at altitudes up to 2300 feet (700 m). The immature stages are unknown. The flight-period ranges from the end of May till the beginning of November, with a distinct peak in July.



Map 11. Distribution of *N. urocera*, based on material examined.

Distribution (map 11)

Specimens originated from the following localities and counties: Alabama: 10 mi N of Fayette in Fayette Co., Payne Lake 24 mi SE of Tuscaloosa in Hale Co., Auburn (nr. campus) in Lee Co.; Florida: Calhoun Co., Leon Co., Liberty Co.; Georgia: Amicolola Falls in Dawson Co.; North Carolina: Black Mts. (type material) in Buncombe Co., Crestmont in Haywood Co., Pollocksville in Jones Co.; South Carolina: Due West in Abbeville Co.; Tennessee: Allardt in Fentress Co. No supplementary localities are given in the literature.

SECTION 4

The two species *Nephrotoma macrocera* and *Nephrotoma gnata* are very closely related and separated with certainty only on the basis of some hypopygial characters. However, because of their sympatric distribution they are considered full species.

Nephrotoma macrocera (Say, 1823)

Figs. 146-158, diagram 7, map 12

Say, 1823: 24-25, descr (as *Tipula*); Wiedemann, 1828: 52, descr (as *Tipula*); Osten Sacken, 1878: 40, loc (as *Pachyrhina*); Loew, 1879: 2, key (as *Pachyrhina*); Aldrich, 1905: 98, locs; Doane, 1908: 175, key; Tucker, 1909a: 298, loc; Tucker, 1909b: 306, loc; Alexander, 1910: 247, 253, loc; Johnson, 1913: 41, loc; all (Aldrich to Johnson) as *Pachyrhina*; Alexander, 1915b: 467, comp; Dietz, 1918: 110, key, 118, comp (as *Pachyrhina*); Rogers, 1918: 3, loc (as *Pachyrhina*); Alexander, 1919b: 783, loc (Nova Scotia = ? *tenuis*), 786, loc, 818, locs, 878, biol, 934, comp, 935, key, 936, comp, 977, fig wing; Alexander & McAtee, 1920: 395, key, 397, loc, biol; Dietz, 1921: 260, loc, biol (as *Pachyrhina*); Johnson, 1925: 34, locs; Leonard, 1928: 699, loc; Alexander, 1929a: 236, loc; Rogers, 1930: 10, biol, 16, locs, biol; Dickinson, 1932: 165, locs, 215, key, 217, fig wing, 218, locs; Winn & Beaulieu, 1932: 8, loc; Rogers, 1933: 42, distr, biol, locs, 48, biol; Brimley, 1938: 319, locs; Alexander, 1940b: 606, locs; Alexander, 1941: 284, loc, 289, locs, biol; Alexander, 1942: 223, key, 228, comp, note, 229, sh descr, distr, 230, locs (partim; Saptree Run State Park, Ct, June 14 = *gnata*), syn; Rogers, 1942: 54, note; Foote, 1956: 222, biol, loc; Alexander 1962: 8, syn, loc; Frommer, 1963: 581, morph, 615, fig 79 gland ♀, 617, fig 86 repro syst ♀; Alexander, 1965: 21, distr, syn,

var, ssp; Young, 1978: 409, 411, 412, 413, 416, biol, 416, locs, distr, 432, key; Byers, 1979: 605, biol, loc, distr; Gelhaus, 1982: 85, loc.

Nephrotoma macrocera atrocera (Dietz, 1918).

Dietz, 1918: 110, key, 118, descr; Dietz, 1921: 260, note type, loc; both as *Pachyrhina*; Alexander, 1942: 223, key 230, sh descr, distr, (loc = *gnata*), syn; Alexander, 1965: 21, distr (as *macrocera* var. *atrocera*).

Nephrotoma macrocera virgata (Dietz, 1918).

Dietz, 1918: 109, key; Dietz, 1921: 260, descr; both as *Pachyrhina*; Johnson, 1925: 34, loc; Alexander, 1942: 230, note, sh descr, distr (as *macrocera dietziella*); Alexander, 1962: 8, syn (as *virgata*); Alexander, 1965: 21, distr (as *macrocera* ssp. *dietziella*).

As *tenuis*: Loew, 1863: 298, loc (Sharon Springs, N.Y., ♀-paralectotype); Alexander, 1929a: 236, loc (St. Johns Co., Quebec); Winn & Beaulieu, 1932: 8, loc (St. Johns Co., Quebec).

Notes on literature

With respect to the cited literature above it is relevant to note that:

— Study of the major collections has revealed that, because of the (sub)opaque dorsal surface of the thorax, the species *macrocera* and *tenuis* sometimes have been mixed.

— *N. gnata*, given here species rank, has been synonymized with *macrocera* by many authors, is very similar to *macrocera* and sympatric with it as well.

For these reasons it is not certain whether all the above citations refer to *macrocera* only.

Material examined

Type material: In the original description of *Tipula macrocera* by Say (1823) no information is given about the type-material, although it distinctly concerns a male. Presumably types are not preserved (Stone, 1980), but the description is clear enough to establish a correct diagnosis.

Pachyrhina macrocera atrocera was described by Dietz (1918) from one male, preserved in the ANSP, type no. 6441, condition good, labelled: "Hazleton, Pa. Dr. Dietz Coll. VII 5 '17'" "St. Johns S. of hotel P." (spelling of the word 'hotel' doubtful) "HoloTYPE" "HOLOTY-PE *Pachyrhina macrocera atrocera* W. G. Dietz

6441". The synonymy of *m. atrocera* with *macrocera* was proposed by Rogers (in Alexander, 1942), who considered this specimen a somewhat melanistic individual of *macrocera*, and was confirmed by Byers (1961, in literis). Alexander (1965) considered it a variety of *macrocera macrocera*.

The description of *Pachyrhina macrocera virgata* by Dietz (1921) was based on (at least) 7 females. The holotype, condition fair, preserved in the ANSP, type no. 6445, is labelled: "Wyalusing, Bradford Co. Pa. VIII 3 '16" (the original description says "Palmerton, Carbon County, Pennsylvania"; presumably erroneously copied by Dietz from a nearby *Tipula*-specimen with such a label) "HOLOTYPE" "HOLOTYPE *Pachyrhina macrocera virgata* W. G. Dietz 6445". There are 5 paratypes of *m. virgata* in the ANSP, all bearing blue paratypelabels; three of them are *macrocera*-specimens from: "Wyalusing, Bradford Co. Pa. VIII-4 '16", "Hazleton, Pa. Dr. Dietz Coll. VII-30 '20" and "Casco Bay, Me. VII '13". The two other paratypes are *tenuis*-specimens, both from Hazleton, Pa. with dates: VIII-6 '12 and VII-21 '18. Alexander (1942) replaced the name '*virgata*' by '*dietziella*' because of the preoccupation of '*virgata*' by Coquillett, 1898. New synonymy of *m. virgata* with *macrocera*. (The black margining of the abdominal tergites can be attributed to discolouration, typical for many specimens in the collection of Dietz, see also discussion of *cingulata*).

Other material: Because the females of *macrocera* and *gnata* are hardly distinguishable without dissecting the genitalia, only the data of the males were used, completed with those of a few females; examined are: 324 ♂, 14 ♀, from the following states and provinces: Alabama (5♂), Arkansas (6♂), Connecticut (1♂), Florida (63♂), Georgia (25♂), Illinois (2♂, 1♀), Indiana (13♂), Kansas (56♂, 4♀), Kentucky (6♂), Louisiana (1♂), Maryland (16♂), Massachusetts (1♂, 1♀), Michigan (11♂), Mississippi (5♂), Missouri (11♂), Nebraska (1♂), New Hampshire (5♂, 1♀), New Jersey (1♂), New York (6♂), North Carolina (19♂), Ohio (3♂), Oklahoma (4♂), Ontario (1♀),

Pennsylvania (6♂), South Carolina (2♂), Tennessee (16♂), Virginia (33♂, 6♀), Washington DC (5♂), West Virginia (1♂). Also examined are 232 unidentified females of the *macrocera-gnata* group from the following states and provinces: Alabama (4♀), Arkansas (3♀), Connecticut (4♀), Florida (17♀), Georgia (29♀), Illinois (2♀), Indiana (9♀), Iowa (1♀), Kansas (33♀), Kentucky (3♀), Maryland (8♀), Massachusetts (6♀), Michigan (6♀), Minnesota (5♀), Mississippi (4♀), Missouri (1♀), New Hampshire (1♀), New Jersey (1♀), New York (3♀), North Carolina (30♀), Ohio (1♀), Oklahoma (1♀), Pennsylvania (5♀), Quebec (1♀), South Carolina (5♀), Tennessee (9♀), Vermont (1♀), Virginia (36♀), Washington DC (3♀).

Diagnostic features

The two species *macrocera* and *gnata* are easily recognized by their (sub)opaque vertex and dorsal thoracic surface and their brownish antennal flagella with basally darkened segments, although confusion with *tenuis* (yellow based flagellar segments and shining vertex) has been noted. Some differences between *macrocera* and *gnata* are: the short finger-like lobes of sternite 8 in ♂ of *macrocera* and the much larger cone-like lobes in *gnata*, the length of the first flagellar segment in the ♂ (as long as the second plus half of the third segment in *macrocera* and at most as long as the second plus one-third of the third segment in *gnata*), the complete lack of (sub)terminal darkening in ♀ of *gnata* and the ♀ wing length (exceeding the abdomen by at most 1 mm in *macrocera*, usually by 1.5 mm or more in *gnata*).

Description

Body length: ♂ 11-14.5 mm, ♀ 15-19.5 mm.
Wing length: ♂ 11.5-14.5 mm, ♀ 12-16 mm.
Antennal length: ♂ 7.3-10.1 mm, ♀ 2.8-3.6 mm.

Body colour light yellow.

Head: Antennae of ♂ 13- to 14 segmented, of

♀ 13-segmented; basal two segments yellow, first flagellar segment yellow with darkened apical part, remainder of flagellum with yellow-brown to dark brown segments with more dark, brown to black basal nodes. Antennae of ♂ strongly elongated, flagellar segments slightly incised, first flagellar segment as long as the second plus half of the third one (fig. 158); verticillar hairs at most slightly reaching over half the length of the segments. Antennae of ♀ with cylindrical segments; longest verticillar hairs exceeding length of segments. Rostrum shining, sides dark brown. Palps with dark brown to black basal segments, remainder brown to brown-yellow. Frons, tubercle and vertex opaque yellow; without dark spots on occiput; on postgenae frequently grey-yellow spots.

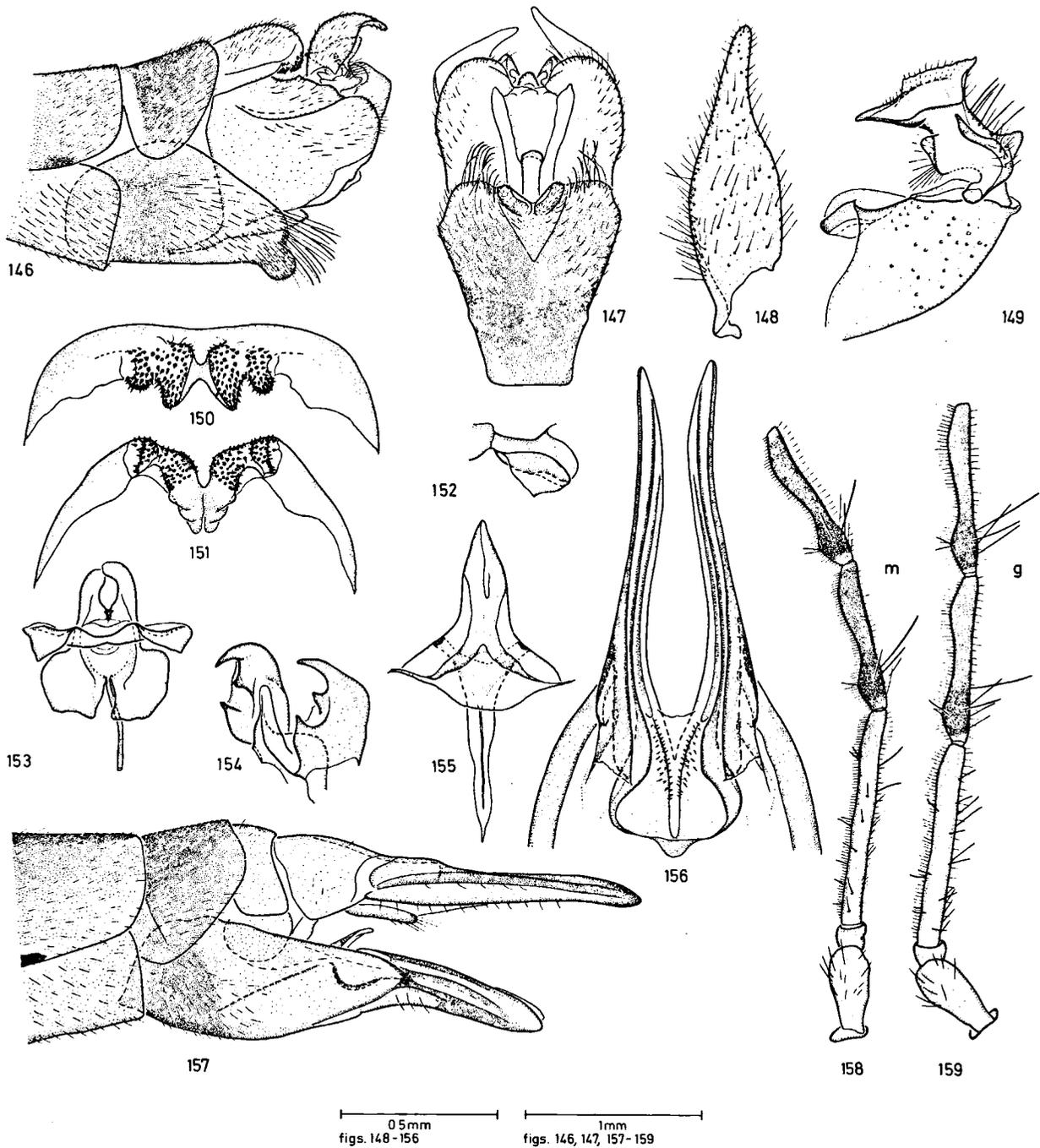
Thorax: Median part of pronotum, prescutum and scutum 1 opaque to subopaque yellow, remainder thoracic parts more or less shining. Stripes usually rather indistinct, about dark yellow to red-brown. Scutellum and mediotergite more or less transparently yellow. Pleura yellow with usually indistinct transparent-like markings, sometimes with weak brownish dash on paratergite. Transverse suture yellow or with slightly dark tint in the middle; antero-lateral corners of scutum 2 without any dark tint. Legs yellow, slightly darkened towards apex, sometimes with narrowly darkened tibial tips. Metatarsi of middle and hind legs longer than tibiae. Tarsal claws untoothed. Wings with a yellowish tinge, costal region dark yellow; pterostigma yellow to brown, usually with some macrotrichia (up to about 15) but sometimes none; cell m1 usually short petiolate, sometimes (sub) sessile.

Abdomen: Dorsal stripe on tergites (1)2-7 usually vague and ill-defined, ranging from brownish-yellow to distinctly brown; small anterior parts of the separate spots narrow and usually somewhat darker, posterior parts much broader. In ♀ stripe usually more distinct than in ♂, posterior margins of tergites in ♀ sometimes distinctly banded with brown. Tergites 2-7 usually with one black-brown dash on each side of segment, sometimes with a very vague second one anteriorly. Black-brown

markings on anterior parts of sternites 2-7 small, oval-shaped, sometimes more protracted. Tergite 8, sometimes also tergites 7 and/or 9 and base of sternite 8 varying from weak to black-brown fuscous, usually more distinct in ♂ than in ♀. Remainder of (sub)terminal segments yellow or reddish yellow.

Hypopygium: Hind margin of tergite 9 with deep and wide U-shaped incision; caudo-ventral area of the posterior extension abundantly set with black spines, on ventral side with strong medial and lateral protrusions (figs. 150, 151). Outer dististyle fig. 148; inner dististyle with a broad and posteriorly extended, acute crest, posterior margin set with long black hairs and with a distinct bulge basally, lateral projection slender and pointed, basally set with short black hairs (fig. 149). Base of sp2 with a transparent triangular extension (fig. 152). Sternite 8 with shallow V-shaped incision, covered by a membrane that is caudally extended in two short, fingerlike and hairy lobes; caudo-lateral margin of sternite 8 set with long yellow-brown bristles (figs. 146, 147). Membranous area on ventro-caudal surface of sternite 9 with superficially extending medisternal appendage and two short lateral offshoots (fig. 147); median extension of antecosta membranous and spatulate. Adminiculum with cone-shaped, caudally bulging median part and with broad, acutely tipped and curved gonapophyses, internally set with some thorns (fig. 154). Semen pump with strongly extended, more or less triangular lateral appendages (fig. 153). Intromittent organ at most reaching into third abdominal segment, varying in length from 13.8 to 17.6 mm. Hypopygium usually not as broad as scutum 1.

Ovipositor: Cerci more or less parallel-sided and slightly acutely tipped; hypovalvae also parallel-sided and obtuse ended (fig. 157). Rostral extensions of hypovalvae short, sclerotized portion not extending basal curve of major ridge; internal shell broad, proximally prolonged and upcurved; internal arch slightly sclerotized; lateral shells not always distinctly sclerotized (fig. 156). Fused valvulae and furca fig. 155.



Figs. 146-157. *N. macrocera*; 146-154, ♂; 155-157, ♀. 146. hypopygium, lateral view; 147. hypopygium, caudo-ventral view; 148. od, outside; 149. id, outside; 150. tergite nine, caudal view; 151. tergite nine, ventral view; 152. sp2, from inside; 153. semen pump, dorsal view; 154. adminiculum, lateral view; 155. fused valvulae and furca, dorsal view; 156. hypovalvae, dorsal view; 157. ovipositor, lateral view. Fig. 158. *N. macrocera*, ♂, basal segments of left antenna. Fig. 159. *N. gnata*, ♂, basal segments of left antenna.

Biology (diagram 7)

According to the literature *macrocera* can be found in mesophytic habitats, usually in the shaded parts of quite open woods and in the vicinity of running water (Alexander, 1919b; Rogers, 1930; Young, 1978), but how far the biological notes in the literature really concern *macrocera* cannot be determined. Rogers (1933) reported diurnal to crepuscular activity for the adults and he found immature stages in "wet to saturated silt, rill margins and marshes".

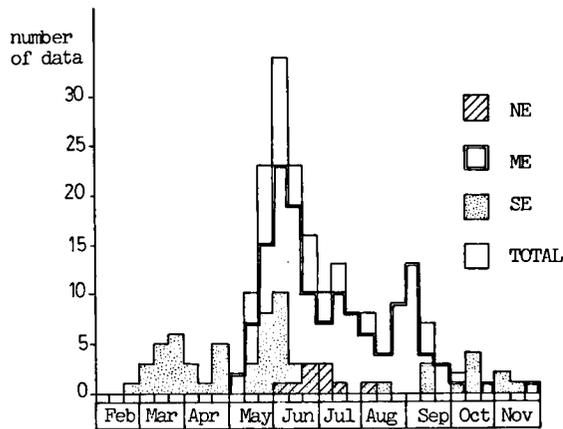
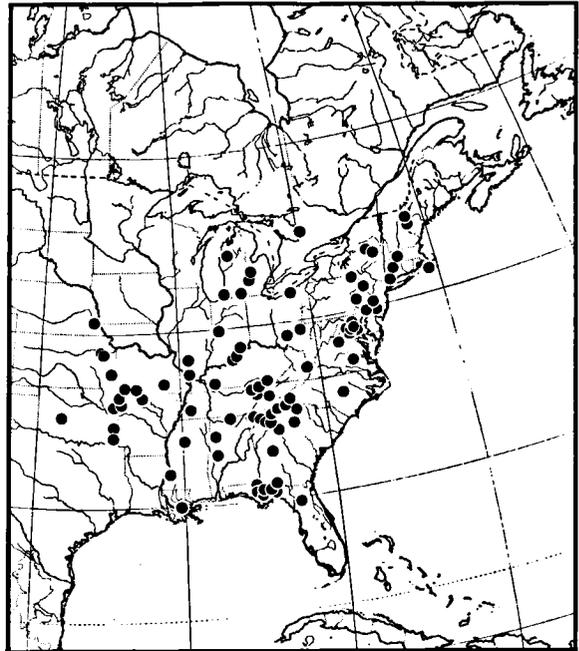


Diagram 7. Period of flight of *N. macrocera*.

Males of *macrocera* are found at altitudes up to 2300 feet (700m) (females of the *macrocera-gnata* group up to 6600 feet (2010m)). The species is usually common to abundant (Alexander & McAtee, 1920; Rogers, 1930; Young, 1978) and flies in the northern part of its range in June and July, with one record in August, and in the southern part from March till November. In the central part of the range there is one distinct peak in the first half of June, but the extensive length of the flight-period of *macrocera* (end of April till October) indicates more than one generation a year in this region (Rogers, 1930; Young, 1978). The difference in seasonal distribution of some species between the northern and southern part of the range was also mentioned by Alexander (1919b: 834).

Distribution (map 12)

The present distribution-range, based mainly on ♂-specimens, covers largely the range of



Map 12. Distribution of *N. macrocera*, based on material examined.

macrocera already known in the literature and stretches from New Hampshire (Coos and Carroll co's.) westward to Nebraska (Arbor Lodge Park in Otoe Co.), Kansas (Bourbon and Douglas co's.) and Oklahoma (Muse in Le Flore Co., Hinton in Caddo Co., Adair Co., McCurtain Co.) and southward to Louisiana (Norco in St. Charles Parish), Mississippi (Rocky Springs Park in Clairborne Co., Grenada L. in Grenada Co.), Alabama (Fayette, Hale and Madison co's.) and northern Florida (7 counties). Other specimens originated from the following localities and counties: Arkansas: Benton, Marion, Montgomery, Washington co's.; Connecticut: Litchfield Co.; Georgia: 8 counties; Illinois: Union, Washington co's.; Indiana: Floyd, Harrison, Jefferson, Parke co's.; Kentucky: Christian, Whitley co's.; Maryland: Montgomery, Pr. Georges co's.; Massachusetts: Dukes Co.; Michigan: Berrien, Branch, Ingham, Lake, Shiawassee co's.; Missouri: Barry, Carter, Taney co's.; New Jersey: Gloucester Co.; New York: Fulton, Herkimer, Westchester co's.; North Carolina: Buncombe, Johnson, Macon,

Transylvania co's.; Ohio: Lake, Meigs co's.; Ontario: Gull Lake (Muskoka District); Pennsylvania: Delaware, Lebanon, Luzerne, Montgomery co's.; South Carolina: Abbeville, Spartanburg co's.; Tennessee: Blount (Great Smokey Mts. N.P.), Fentress, Haywood, Knox, Morgan, Scott co's.; Virginia: Arlington and Fairfax, Giles, Madison, Pr. George, Pr. William co's.; Washington D.C.; West Virginia: Tyler Co.

Some additional border-localities of ♀-specimens of the *macrocera-gnata* group are: Quebec: St. John's Co.; Maine: Casco Bay in Cumberland Co.; Vermont: Amsden; Minnesota: Faribault Co. and Itasca State Park in Clearwater Co.; Iowa: Hardin Co. The unreliable data from the literature are omitted from the map.

***Nephrotoma gnata* (Dietz, 1918)**

Figs. 159, 160-168, diagram 8, map 13

Dietz, 1918: 109, key, 118, descr (as *Pachyrhina macrocera gnata*); Dickinson, 1932: 215, key, 218, note (as *macrocera gnata*); Alexander, 1942: 223, key, 230, sh descr, syn, distr (as *macrocera gnata*); Alexander, 1965: 21, syn.

Nephrotoma hirsutula (Dietz, 1918).

Dietz, 1918: 110, key (as *lapsus pilosula*), 118-119, descr, 119, comp (as *Pachyrhina*); Alexander, 1919b: 826, loc, 936, comp, sh descr, distr; Dietz, 1921: 261, date (as *Pachyrhina*); Alexander, 1942: 223, key, 228, comp, sh descr, distr, note syn; Alexander, 1965: 21, syn.

As *macrocera atrocera*: Alexander, 1942: 230, loc (Saptree Run St.P., Ct., June 14).

Material examined

Type material: *Pachyrhina macrocera gnata* was described by Dietz (1918) from one male, preserved in the ANSP, type no. 6442, condition fair, labelled: "Beaver Dam Wis. VIII-4-09" (the original description says "Beaver Falls", but this error was already rectified by Dickinson, 1932) "HOLOTYPE" "HOLOTYPE *Pachyrhina macrocera gnata* W. G. Dietz 6442". *N. gnata* was placed in strict synonymy of *macrocera* by Rogers (in Alexander, 1942), Byers (1961, in literis) and Alexander (1965), but is taken out of synonymy here.

Dietz (1918) described *Pachyrhina hirsutula* from two males, both preserved in the ANSP, type no. 6443. The holotype, condition fair, is labelled: "Hazleton, Pa Dr. Dietz Coll. V-23 '16" "HOLOTYPE" "HOLOTYPE *Pachyrhina hirsutula* W. G. Dietz 6443". The other topotypic male, with same date, bears the labels: "AlloTYPE" "PARATYPE *Pachyrhina hirsutula* W. G. Dietz 6443". The hypopygial similarity of *hirsutula* with *gnata* was not recognized by Dietz, while Rogers (in Alexander, 1942), Byers (1961, in literis) and Alexander (1965) considered it a synonym of *macrocera*. Now *hirsutula* is placed in the synonymy of *gnata*.

Other material: 78 ♂, 5 ♀, from the following states: Alabama (1♂), Arkansas (2♂), Connecticut (2♂), Florida (1♂), Georgia (7♀), Iowa (2♂), Maryland (1♀), Massachusetts (2♂), Michigan (1♂), New Jersey (3♂), New York (1♂, 1♀ in copula), North Carolina (21♂), Ohio (1♂), Pennsylvania (8♂), South Carolina (1♂), Tennessee (5♂), Virginia (18♂, 3♀), West Virginia (2♂). Unidentified females of the *macrocera-gnata* group are listed under *macrocera*.

Diagnostic features

See under the diagnostic features of *macrocera*.

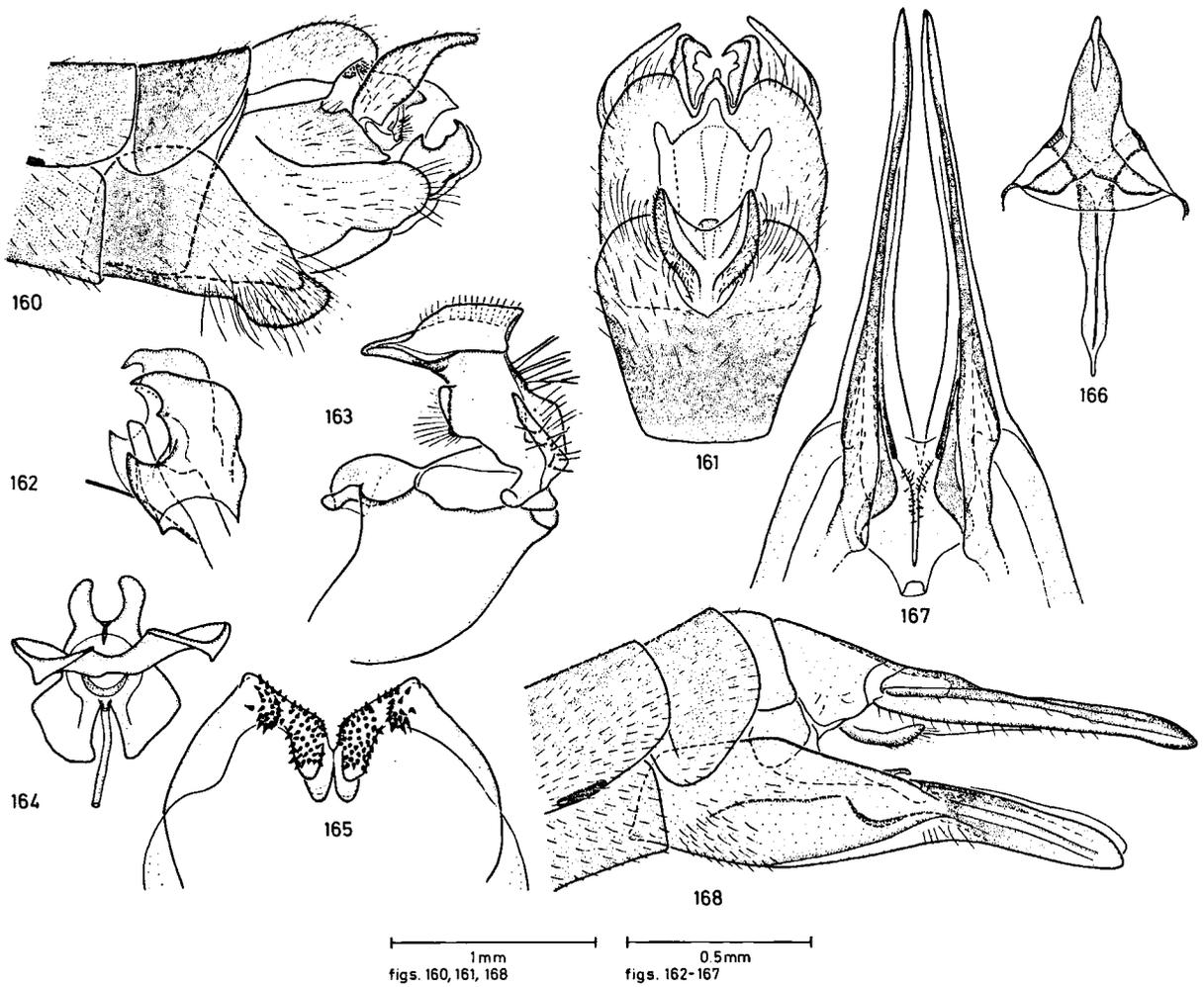
Description

Body length: ♂ 11-14 mm, ♀ 16-17.5 mm.

Wing length: ♂ 12-14 mm, ♀ 13-16 mm.

Antennal length: ♂ 8.3-11.4 mm, ♀ 2.7-3.2 mm.

In general appearance *gnata* is so close to *macrocera* that the description of *macrocera* also serves for *gnata* with the following exceptions: Body colour more saturated yellow. Antennae of ♂ usually 14-segmented; length of first flagellar segment equals about the length of the second one plus one-third of the third segment (fig. 159). The paratergite is unmarked; the transverse suture is usually distinctly darkly tinted in the middle. Wings distinctly infused with yellow. In the ♀ there is no (sub)terminal darkening.



Figs. 160-168. *N. gnata*; 160-165, ♂; 166-168, ♀. 160, hypopygium, lateral view; 161, hypopygium, caudo-ventral view; 162, adminiculum, lateral view; 163, id, outside; 164, semen pump, dorsal view; 165, tergite nine, ventral view; 166, fused valvulae and furca, dorsal view; 167, hypovalvae, dorsal view; 168, ovipositor, lateral view.

Hypopygium: Posterior extension of tergite 9 strongly resembling that of *macrocera*, median ridges on ventral side slightly more developed (fig. 165). The basal bulge on the posterior margin of the inner dististyle is slightly less pronounced than in *macrocera* (fig. 163). The hairy lobes on the hind margin of sternite 8 are much larger than in *macrocera* and usually with the tips far apart (figs. 160, 161). Adminiculum fig. 162. Length of intromittent organ varying from 17.7 to 21.1 mm.

Ovipositor: Lateral view as in *macrocera* (fig. 168). Rostral extensions of hypovalvae weakly developed and sclerotized, gradually changing

into membranous extension; broad internal shell proximally prolonged and upcurved, internal arch hardly sclerotized; lateral shells rather indistinct (fig. 167). Base of fused valvulae more broadly sclerotized than in *macrocera* (fig. 166).

Biology (diagram 8)

In the literature nothing can be found concerning the habitat of *gnata*. The species is frequently caught at the same localities as *macrocera* and sometimes on the same date. The males of *gnata* are frequently found at high altitudes, up to

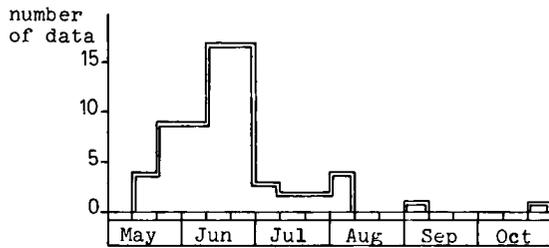
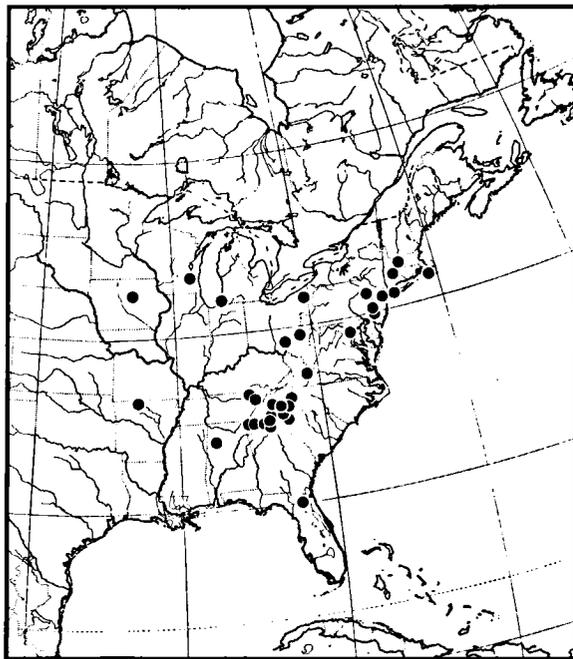


Diagram 8. Period of flight of *N. gnata*.

4900 feet (1490 m); the flight-period ranges from mid-May till the first week of September (one record of October 29, Florida) with one distinct peak in the second half of June.

Distribution (map 13)

The known distribution-range of *gnata* coincides largely with that of *macrocera*, but is less extensive and stretches from Massachusetts (Martha's Vineyard Island in Dukes Co. and Orient Spr. in Hampshire Co.) and Connecticut (Kent Falls in Litchfield Co. and Saptree Run State Park) westward to Wisconsin (Beaver dam in Dodge Co., holotype) and Iowa



Map 13. Distribution of *N. gnata*, based on material examined.

(Hardin Co.) and southward to Arkansas (Buffalo River, 17 mi SE of Yellville in Marion Co.), Alabama (10 mi N of Fayette in Fayette Co.) and Florida (Bradford Co.). Relatively many captures were from the mountainous regions of Virginia (Giles Co.), North Carolina (Buncombe, Clay, Haywood, Transylvania, Yancey co's.), Tennessee (Great Smoky Mts N.P. and Fentress, Morgan co's.), South Carolina (Greenville Co.) and Georgia (Neel Gap on border of Union and Lumpkin co's. and Murray, Towns, Union, White, Whitfield co's.). The other specimens originated from the following localities and counties: Maryland: Plummers Isl. in Montgomery Co.; Michigan: Berrien Co.; New Jersey: Union Co.; New York: Sea Cliff in Nassau Co.; Ohio: Meigs Co.; Pennsylvania: Crawford, Luzerne, Montgomery, Philadelphia co's; West Virginia: 3.1 mi NE of Friendly in Tyler Co. Some additional localities of ♀-specimens of the *macrocera-gnata* group are already mentioned under *macrocera*.

SECTION 5

Nephrotoma cingulata (Dietz, 1918)

Figs. 169-182, diagram 9, map 14

Dietz, 1918: 111, key, 129, 131, comp, 131-2, descr, 133, comp, biol, 137, comp, pl. V, fig wing, pl. VII, fig hypop (as *Pachyrhina*); Alexander, 1919b: 826, distr, 937, comp, sh descr, distr, comp; Dietz, 1921: 261, biol (as *Pachyrhina*); Alexander, 1942: 224, key, 226, sh descr, distr, biol, note; Alexander, 1965: 21, distr.

As *Nephrotoma xanthostigma* (nec Loew, 1864): Dietz, 1918: 111, key, 133, 134, comp (as *Pachyrhina*); Alexander, 1919b: 782, 784, 787, locs, 819, locs, 831, 836, 877, biol, 936, key, 937, comp, 977, fig wing; Alexander & McAtee, 1920: 396, key, 398, locs; Dietz, 1921: 261, loc, biol (as *Pachyrhina*); Leonard, 1928: 699, locs; Rogers, 1930: 11-12, biol, 17, locs, biol; Procter, 1938: 283, locs; Alexander, 1942: 224, key, 226, comp, note, 230, comp, 235, comp, sh descr, distr, locs; Alexander, 1962: 9, locs; Frommer, 1963: 581, comp, morph.

As *Nephrotoma xanthostigma* (nec Loew, 1864), not certain: Alexander, 1928: 57, locs; Alexander, 1929a: 236, loc; Alexander, 1931: 138, locs; Winn & Beaulieu, 1932: 8, locs; Brimley, 1938: 319, locs; Alexander, 1941: 248, loc; Alexander, 1965: 22, distr.

Notes on literature

As already observed by Rogers (in Alexander, 1942) the present species is "... commonly recognized by authors as being *xanthostigma*, but is not identical with the type-specimen of Loew's species". Study of their collections reveals that Alexander and Dietz have mistaken the species *cingulata* for *xanthostigma* from the beginning, as did most subsequent authors. Data in the literature of *xanthostigma* mentioned as 'not certain' could not be traced back to the specimens, but it seems most probable that they refer to specimens of *cingulata*.

Material examined

Type material: *Pachyrhina cingulata* was described by Dietz (1918) from one male (holotype) and ten topotypic females. The male and 8 females were examined at the ANSP. The holotype, condition fair, type no. 6459, is labelled: "Hazleton, Pa. Dr. Dietz Coll. VII-21-13" (the original description says July 11) "HoloTYPE" "HOLOTYPE *Pachyrhina cingulata* W. G. Dietz 6459". The allotype is from "VIII-18-'15" and 6 other ♀ paratypes from "VII-7-'13/VII-24-'12/VII-24-'15/VII-25-'13/VIII-6-'12/VIII-8-'12". One ♀ paratype ("14.2.15") is not *cingulata* but presumably *N. ferruginea*, although its bad condition doesn't allow a positive identification. There is one slide of *cingulata* in the Alexander-collection (only wing), from Hazleton Pa., August 20 1917, labelled "paratype"; no dates for the paratypes were given by Dietz (1918), but he stated in 1921 that *cingulata* was "... not taken since 1915".

Other material: 146 ♂, 108 ♀, from the following states and provinces: Alabama (1♂, 1♀) Arkansas (1♂), Connecticut (7♂, 1♀), Florida (1♂), Georgia (2♀), Indiana (1♀), Kentucky (1♀), Maine (5♂, 1♀), Maryland (1♂, 3♀), Massachusetts (20♂, 8♀), Michigan (2♂, 1♀), Minnesota (1♀), Mississippi (1♂, 1♀), New Hampshire (1♂, 1♀), New Jersey (8♂, 7♀), New York (7♂, 9♀), North Carolina (18♂, 16♀), Nova Scotia (1♀), Ohio (1♂, 1♀), Pennsylvania (25♂,

8♀), Quebec (1♂), Rhode Island (1♀), South Carolina (3♂, 1♀), Tennessee (25♂, 12♀), Vermont (1♂), Virginia (17♂, 30♀).

Diagnostic features

N. cingulata is very distinct from the other *Nephrotoma* species because of the bright and shining orange-yellow body colouration with the large black spots on the sides of the abdomen. Other characteristics of *cingulata* are the yellow antennae with basally narrowly darkened flagellar segments, the frequently brown shadings on anterior vertex and postgenae, the unspotted orange-yellow pleura and dull yellowish antero-lateral corners of scutum 2, the dark yellow tinged wings and the rather weakly brown dorsal spots on the anterior parts of tergites.

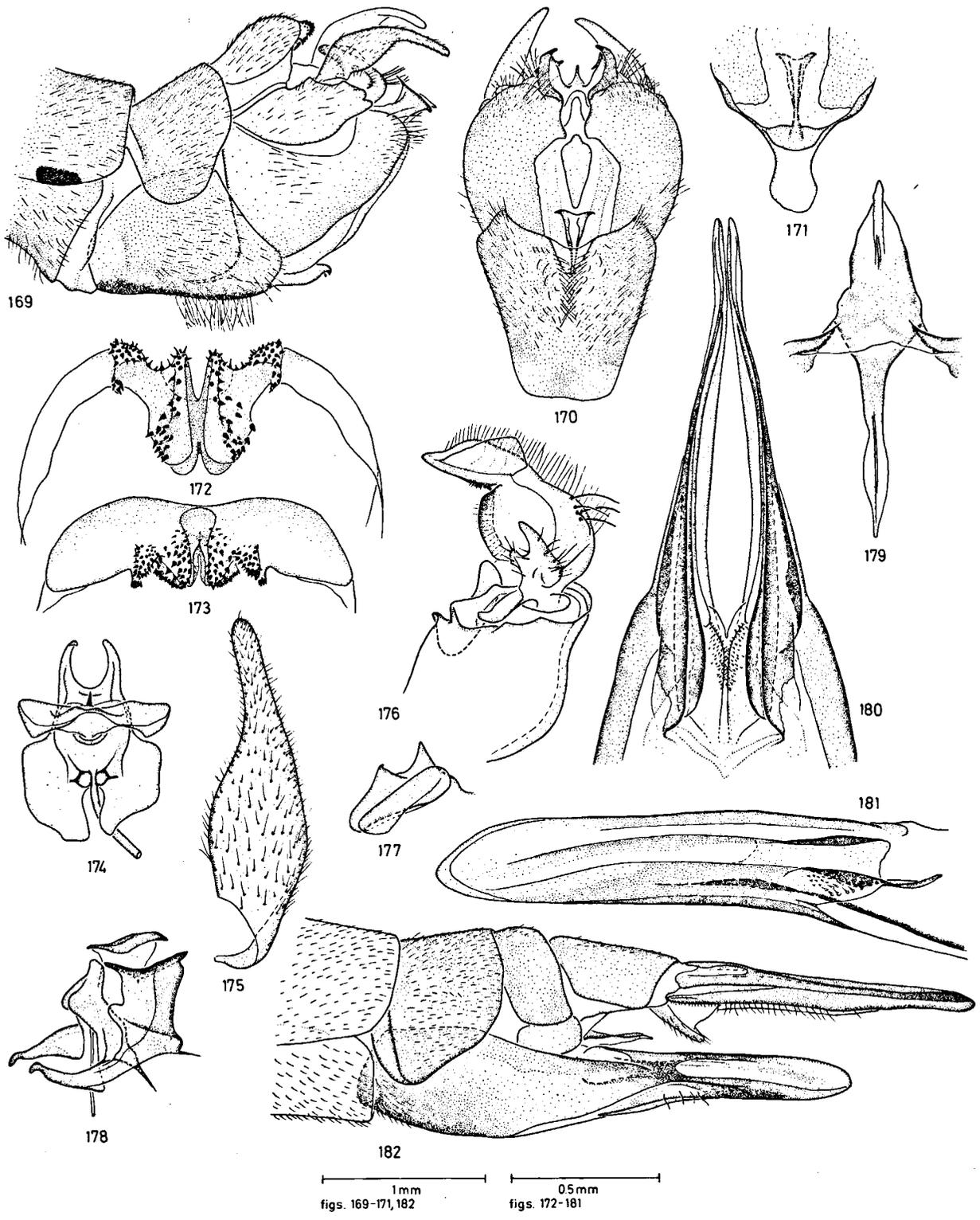
Description

Body length: ♂ 12.5-15 mm, ♀ 17-20.5 mm. Wing length: ♂ 11.5-14 mm, ♀ 13-15.5 mm. Antennal length: ♂ 6.5-7.8 mm, ♀ 2.9-3.5 mm.

Body conspicuously shining, colour orange-yellow.

Head: Antennae in ♂ sometimes 13-, usually 14-segmented, in ♀ 13-segmented; yellow, from second or third flagellar segment with narrowly blackened bases; in ♂ second and following flagellar segments distinctly incised beneath, length of verticillar hairs mostly slightly more than half length of segments; in ♀ flagellar segments cylindrical, verticillar hairs reaching to about length of segments. Sides of rostrum largely dark brown. Palps with first two segments dark brown, remainder lighter brown to sordid yellow. Frons, weakly developed tubercle and rostral part of vertex opaque dark yellow; remainder of head shining orange. Occiput without dark coloured marking; along border between opaque and shining area usually brownish spots, on postgenae along eyes large (dark) brown areas.

Thorax: Pronotum yellow, median part opaque and sometimes vaguely brownish-tinted. Rest of thorax highly polished. Stripes dark



Figs. 169-182. *N. cingulata*; 169-178, ♂; 179-182, ♀. 169. hypopygium, lateral view; 170. hypopygium, caudo-ventral view; 171. midventral extension of antecosta of sternite nine, from inside; 172. tergite nine, ventral view; 173. tergite nine, caudal view; 174. semen pump, dorsal view; 175. od, outside; 176. id, outside; 177. sp2, from inside; 178. adminiculum, lateral view; 179. fused valvulae and furca, dorsal view; 180. hypovalvae, dorsal view; 181. left hypovalva, inside; 182. ovipositor, lateral view.

orange-yellow, usually ill-defined. Transverse suture and antero-lateral corners of scutum 2 without any dark tint. Scutellum and mediotergite about concolourous with stripes or somewhat lighter. Pleura completely orange-yellow with markings hardly indicated; paratergite sometimes with narrow brown stripe. Legs yellow, slightly darkened on tarsal segments. Tibiae of middle and hind legs distinctly shorter than metatarsi. Tarsal claws untoothed. Wing with a strong yellow tinge, costal region dark yellow; pterostigma yellow-brown, usually with a variable number (2-12) of macrotrichia; bases of radical cells usually lightly shaded with brown; cell m1 varying from sessile to long-petiolate.

Abdomen: Tergites 1-6 or 1-7 with small brownish spots on anterior parts, frequently only distinct on tergites 2-4 or 2-5. Lateral stripe consists of one oblong black spot on each side of segments 2-7, with sometimes a vague small one anteriorly. Sternites 2-7 conspicuously marked with oval to oblong black spots anteriorly. Terminal segments concolourous with rest of abdomen or somewhat reddened; usually sternite 8 basally and sternite 9 apically somewhat darker.

Hypopygium: Posterior margin of tergite 9 with V-shaped median incision; posterior extension with distinct black-spined caudal projections, passing into the black-spined medial and lateral protrusions on ventral side (figs. 172, 173). Details of inner and outer dististyles figs. 175, 176; crest of the id strongly broadened posteriorly, lateral projection ending in a solid point, posterior margin strongly bulging and set with some long black setae. Sp2 with very narrow external and broader internal transparent brim (fig. 177). Median incision of hind margin of sternite 8 (fig. 170) rather small, V-shaped, covered by thin membrane and bordered with rather long yellow hairs. Membranous area on ventro-caudal surface of sternite 9 laterally set with short, fine setae and medially very weakly sclerotized; medisternal appendage distinctly protruding and sharply two-pointed (fig. 170); midventral extension of antecosta broadly spoon-shaped (fig. 171). Gonapophyses of ad-

miniculum strongly broadened, apex with two pointed extensions, base with long pointed anterior projection; median part cone-like with a bulge anteriorly (fig. 178). Semen pump with strongly extended lateral wings and narrow caudal ones (fig. 174). Intromittent organ very winding, in length varying from 11.5 to 15 mm. Hypopygium usually somewhat broader than scutum 1.

Ovipositor: Cerci narrowed apically; hypovalvae parallel-sided with rounded tips (fig. 182). Ventral incision of membranous area of sternite 9 very deep and narrow. Rostral extensions of hypovalvae weakly developed, internal arch not sclerotized, internal shell shortly prolonged (figs. 180, 181). Fused valvulae and furca see fig. 179.

Biology (diagram 9)

N. cingulata inhabits moist and wet localities such as marshes, wet meadows and grasslands and the grassy banks of streams (Dietz, 1918, 1921; Alexander, 1919b). Rogers (1930) reported the species from swales, open marshes and partially

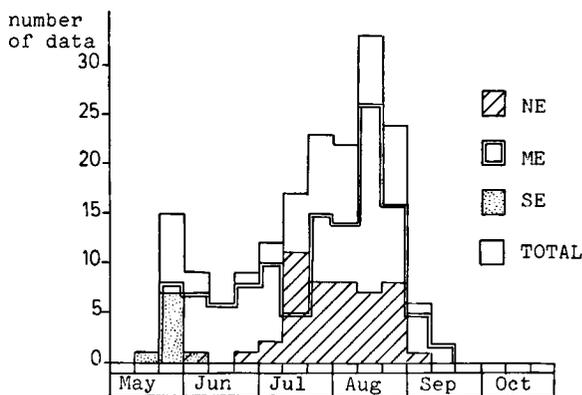


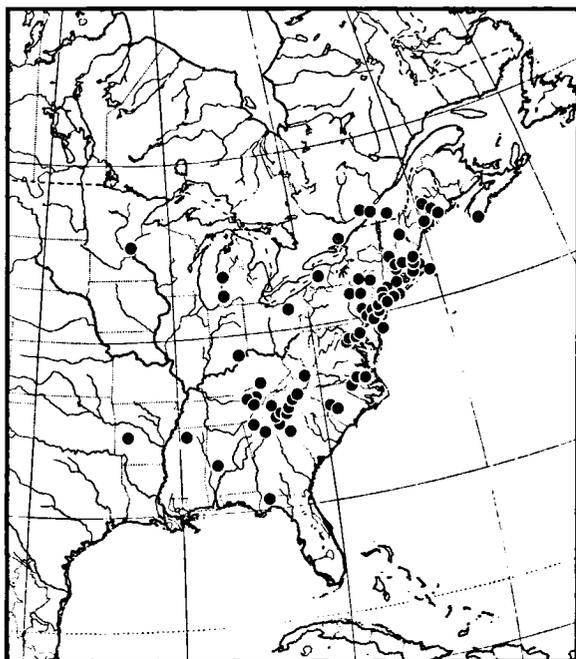
Diagram 9. Period of flight of *N. cingulata*.

cleared banks of upland brooks. Specimens were taken at altitudes up to 4000 feet (1220 m). The immature stages are unknown. *N. cingulata* is "not rare" to "numerous" in the mentioned habitats. The period of flight is from mid-May to mid-September; in the extreme northern part of the distribution-range the peak covers July and August, while in the extreme southern

part the species only occurs in May-June; in the middle part of the range there is a distinct peak period in August.

Distribution (map 14)

The present known distribution ranges from southern Quebec, Maine and Nova Scotia to extreme northern Florida and westward into Minnesota and Arkansas. Specimens originated from the following localities and counties: Alabama: Hale Co.; Arkansas:



Map 14. Distribution of *N. cingulata*, based on material examined (black dots) and literature (stippled dots).

Montgomery Co.; Connecticut: New Haven Co.; Florida: Leon Co.; Georgia: Lumpkin, Murray co's.; Indiana: Jefferson Co.; Kentucky: Laurel Co.; Maine: Hancock, Kennebec, Penobscot co's.; Maryland: Anne Arundel, Prince Georges co's.; Massachusetts: 9 counties; Michigan: Van Buren, Muskegon co's.; Minnesota: Anoka Co.; Mississippi: Lafayette Co.; New Hampshire: Grafton Co.; New Jersey: 7 counties; New York: Broome, Erie, Nassau, Richmond, Suffolk, Sullivan, Westchester co's.; North Carolina: 9 counties;

Nova Scotia: Barrington; Ohio: Summit Co.; Pennsylvania: Berks, Delaware, Luzerne, Lycoming, Montgomery co's.; Quebec: Montreal; Rhode Island: not further specified; South Carolina: Abbeville, Oconee co's.; Tennessee: Great Smoky Mts. N.P., Fentress, Morgan, Scott co's.; Vermont: Bennington Co.; Virginia: Arlington, Fairfax, Giles, Nansemond, Southampton co's. Literature data for Maine, Quebec and Ontario are from Alexander (1928, 1931, 1962).

Discussion

Dietz (1918) created the existing taxonomic confusion about *xanthostigma*, in reality a synonym of *sodalis*, by recognizing normally coloured *cingulata*-specimens, which he wrongly determined as *xanthostigma*, and discoloured specimens with more or less black-banded abdominal segments (typical for many specimens, of several species, in Dietz' collection), which he described as the new species *cingulata*. His key reflected this mistake and appears to be the basis of all later confusion.

***Nephrotoma rogersi* Byers, 1968**

Figs. 183-194, map 15

Byers, 1968: 395-98, descr, figs 1-6, 398, comp, 399, biol, distr, note.

Material examined

Type material: The description of *Nephrotoma rogersi* by Byers (1968) was based on a ♂ holotype, an allotype and 22 paratypes (15 ♂, 7 ♀). The holotype, condition good, preserved in the UMMZ, is labelled: "FLORIDA Calhoun Co. no. 3 XI-5-1938 J. S. Rogers" "HOLOTYPE *Nephrotoma rogersi* ♂ George W. Byers". The original description adds to this "about 1 mile west of Blountstown". The topotypic allotype, 9 topotypic paratypes (6 ♂, 3 ♀), 8 paratypes (4 ♂, 4 ♀) from other localities in Florida (1.5 mi E of Astor Park in Lake Co., 5 mi NW of Bronson and Otter Creek both in Levy Co., 5 mi W of Telogia in Liberty Co., 4 mi NW of Dunnellon in Marion

Co., Welaka in Putnam Co.), all preserved in the UMMZ, except 2♂ in the UKaL, a topotypic ♂ paratype in the USNM and a topotypic ♂ paratype (wingslide) in the Alexander Collection were also examined.

Other material: 3♂, 1♀, topotypic with the holotype and 1♂ from South Carolina: Myrtle Beach in Horry Co. (collection MCZ).

Diagnostic features

The dark brown (sub)costal tinge of the wings in *rogersi* separates it easily from all other nearctic *Nephrotoma* species; there is also some (sub)costal darkening in *cornifera*, *okefenoke* and *urocera*, but to a far lesser extent. In antennal features (brown flagellar segments with usually darker basal nodes) *rogersi* most closely resembles *sodalis*. Some other characteristics of *rogersi* are: the completely dark brown postgenae, the short dark pilosity on some parts of the scutum, the distinct longitudinal yellow line on median stripe of the thorax, the brown shading on the sides of the mediotergite, the indistinct dorsal and very distinct inverse drop-shaped ventral abdominal markings and the black-brown midventral band and bordering of the incision on sternite 8 in the ♂ and the dark brown bordering of the incision of sternite 8 in the ♀.

Description

Body length: ♂ 15-17 mm, ♀ 16-19.5 mm.
Wing length: ♂ 12-14.5 mm, ♀ 11-13 mm.
Antennal length: ♂ 4.5-5.6 mm, ♀ 2.6-3.2 mm.

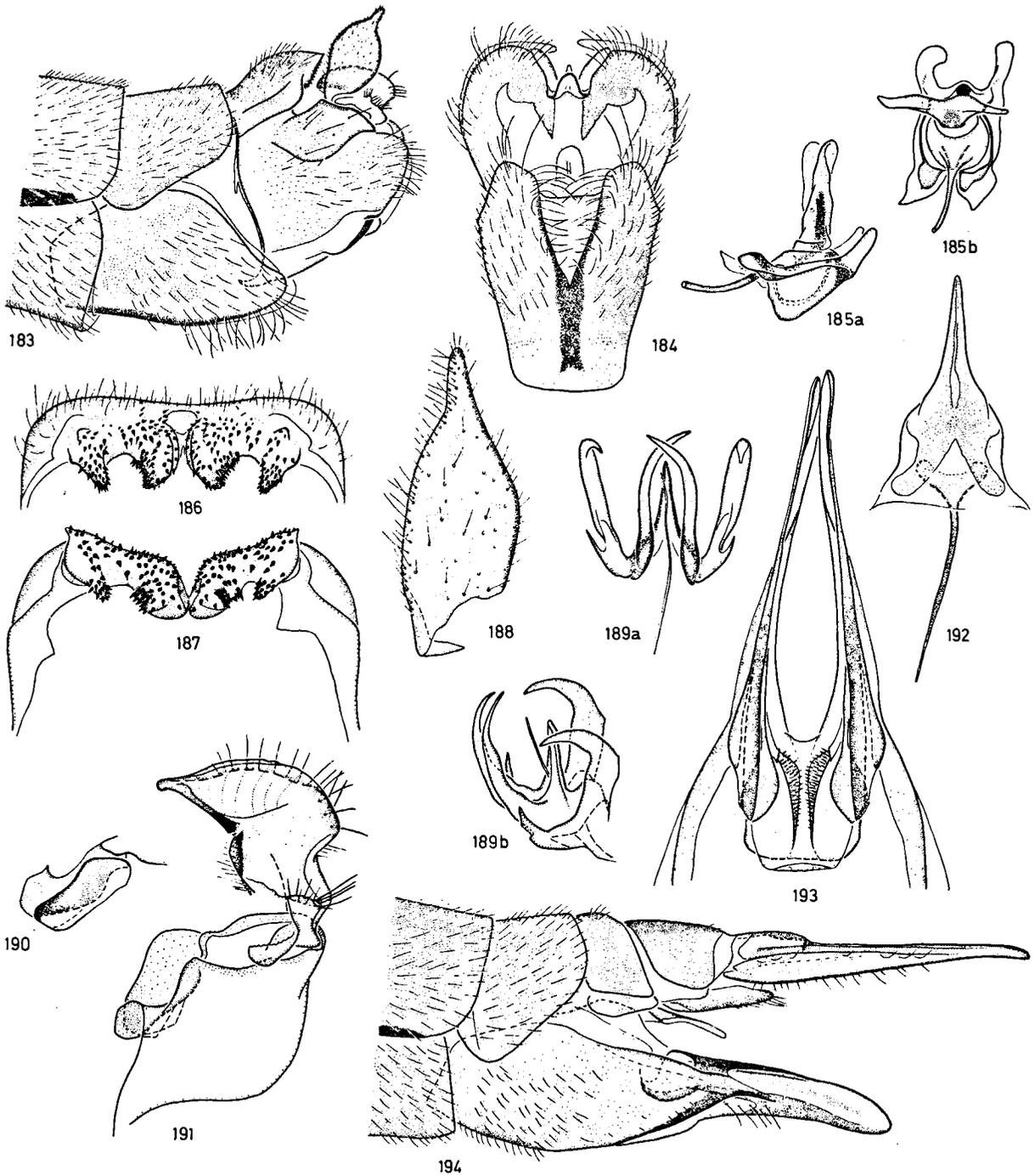
Body colour dark yellow to brownish yellow.

Head: Antennae of both sexes 13-segmented; scape and pedicel yellow to sordid yellow, first flagellar segment usually largely or only apically darker, remainder of flagellum brownish; first few flagellar segments sometimes much paler to yellowish or with a narrow pale ring at both ends; basal nodes frequently darker than rest of segments. Antennae of ♂ with hardly incised, somewhat elongated segments; verticillar hairs reaching to at most two-third length of

segments. Antennae of ♀ with cylindrical segments and verticillar hairs reaching to 1.5 times length of segments. Rostrum shining with (dark) brown sides and dark yellow dorsal surface. Palps (dark) brown. Frons and tubercle more or less opaque yellow, vertex shining dark yellow without dark markings; postgenae shining and completely brown.

Thorax: Median part of pronotum and prescutum subshining, remainder of thorax distinctly polished. Pronotum dark to brownish yellow. Stripes (dark) red-brown, median one divided by a longitudinal yellow line. Between stripes, on caudo-lateral surface of scutum 1 and on antero-lateral corners of scutum 2 some short, dark pilosity. Transverse suture brownish tinted, antero-lateral corners of scutum 2 lightly to distinctly red-brown; median yellow area of scutum 2 slightly diverging caudad. Scutellum yellow, not transparent, with usually weak median shading; mediotergite with transparent yellow caudo-lateral spots and brown shading on sides. Pleura bright dark yellow with indistinct, transparent to light brown markings. Legs dark yellow to brown, tips of femora and tibiae narrowly darkened, tarsi dark brown coloured towards apex. Metatarsi of middle and hind legs longer than corresponding tibiae. Tarsal claws untoothed. Wings with a strong brownish tinge, costal and subcostal region dark brown, cell r1 + 2 and tips of other radial cells brown shaded; pterostigma dark brown with a small clear area at proximal side, usually with some macrotrichia; cell m1 sessile to short-petiole.

Abdomen: Tergites 2-5(6) dorsally marked with very vague, small brownish spots on anterior parts, sometimes obsolete; in ♀ usually with distinct, narrow, transparent brownish bands along posterior margins. Tergites 2-7 on each side marked with a black-brown oblong dash and a more vague and narrow one anteriorly. Sternites 2-7 with inverse drop-shaped, sometimes tailed, black-brown spots on anterior parts. In ♂ usually only weak darkening on tergite 9 and slightly darkened lateral margins on tergite 8.



1mm
figs. 183, 184, 194

0.5mm
figs. 185-193

Figs. 183-194. *N. rogersi*; 183-191, ♂; 192-194, ♀. 183. hypopygium, lateral view; 184. hypopygium, caudo-ventral view; 185. semen pump: a, lateral view, b, dorsal view; 186. tergite nine, caudal view; 187. tergite nine, ventral view; 188. od, outside; 189. adminiculum: a, anterior view, b, lateral view; 190. sp2, from inside; 191. id, outside; 192. fused valvulae and furca, dorsal view; 193. hypovalvae, dorsal view; 194. ovipositor, lateral view.

Hypopygium: Tergite 9 with widely V-shaped incised hind margin and a distinct posterior extension with pronounced lateral corners; median protrusions on ventral side strongly directed outwardly, lateral protrusions directed inwardly; both as well as caudal area of extension abundantly set with black spines (figs. 186, 187). Outer dististyle brown fuscous (fig. 188); inner dististyle with more or less extended anterior apex, with a hardly dorsally extended but basally bulbous crest and more or less S-curved posterior margin; lateral projection a small ridge only, set with black setae (fig. 191). Sp2 with two rather narrow transparent extensions along ventral base (fig. 190). Hind margin of sternite 8 with deep V-shaped incision, largely closed by a membrane; obtuse caudo-lateral corners and incision-margin bordered with rather sparse but long, medially directed brown hairs; a black-brown band along incision and midventral line (fig. 184). Membranous area on caudo-ventral surface of sternite 9 very broad, weakly bulging medially and with two sickle-shaped latero-caudal offshoots (fig. 184); midventral extension of antecosta very short. Adminiculum with slender, dorsally curved gonapophyses with pointed anterior extensions basally; median part with very slender dorsal apex and at anterior base two long and slender extensions, which are strongly pointed, upcurved and apically crossing (fig. 189a, b). Semen pump with modest lateral appendages and black-fuscous internal structures (fig. 185a, b). Intromittent organ short, not winding, length about 4.5 mm. Hypopygium not as broad as scutum 1.

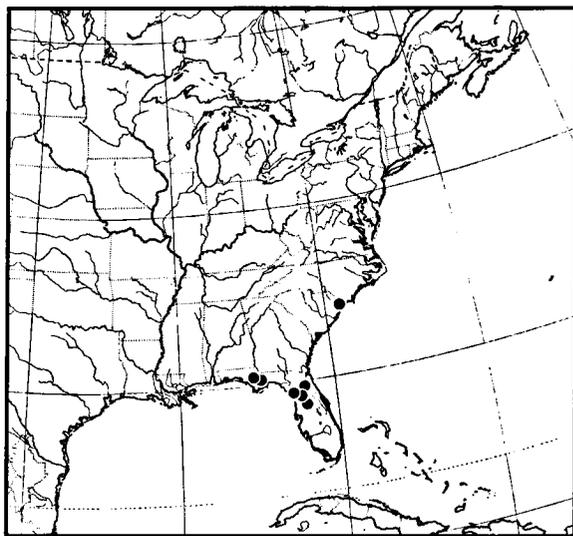
Ovipositor: Cerci with very slender tips; hypovalvae parallel-sided and obtusely pointed; membranous incision of sternite 8 largely bordered with a narrow, dark fuscous band, a slight brown tinge on midventral surface (fig. 194). Rostral extensions of hypovalvae not developed, base of major ridge bulbous, internal shell strongly curved upwards (fig. 193). Fused valvulae weakly sclerotized, furca with very long and slender tail (fig. 192).

Biology

According to Byers (1968) "there emerges a clear correlation of the occurrence of *N. rogersi* with pine flatwoods, generally moist, often adjacent to open water of swamps." All the specimens were collected in late summer and autumn (VIII-3 to XI-18).

Distribution (map 15)

All the known localities are mentioned under 'material examined'.



Map 15. Distribution of *N. rogersi*, based on material examined.

Nephrotoma sodalis (Loew, 1864)

Figs. 195-206, diagram 10, map 16

Loew, 1864: 64, descr, 65, 66, comp (as *Pachyrrhina*); Osten Sacken, 1878: 40, distr (as *Pachyrrhina*); Loew, 1879: 3, key (as *Pachyrrhina*); Aldrich, 1905: 98-99, distr (as *Pachyrrhina*); Doane, 1908: 175, key (as *Pachyrrhina*); Dietz, 1918: 111, key, 127, 129, comp (as *Pachyrrhina*); Rogers, 1918: 3, biol, loc (as *Pachyrrhina*); Alexander, 1919b: 782, 784, 818, locs, 936, key; Alexander & McAtee, 1920: 396, key, 397, locs; Johnson, 1925: 34, loc; Leonard, 1928: 699, loc; Alexander, 1929a: 236, locs; Dickinson, 1932: 166, locs, 216, key, 220, locs, note; Winn & Beaulieu, 1932: 8, locs; Brimley 1938: 319, loc; Alexander, 1941: 284, loc; Alexander, 1942: 223, key, 228, comp, 230, syn, 232, sh descr, distr, locs; Rogers, 1942: 20, 46, biol, 63, biol, loc; Alexander, 1962: 8, locs; Alexander, 1965: 22 distr, syn, subsp (as *sodalis sodalis*); Cole, 1969: 53, distr (as *sodalis sodalis*); Byers, 1979: 606, loc, biol, distr.

Nephrotoma xanthostigma (Loew, 1864).

Loew, 1864: 65, descr (as *Pachyrrhina*); Osten Sacken, 1878: 40, distr (as *Pachyrrhina*); Loew, 1979: 3, key (as *Pachyrrhina*); Aldrich, 1905: 99, distr (as *Pachyrrhina*); Doane, 1908: 175, key (as *Pachyrrhina*); Johnson, 1925: 35, locs; Dickinson, 1932: 156, fig wing, 221, distr.

N. xanthostigma, certainly or probably referring to *N. cingulata*: Dietz, 1918: 111, key, 133, 134, comp (as *Pachyrrhina*); Alexander, 1919b: 782, 784, 787, locs, 819, locs, 831, 836, 877, biol, 936, key, 937, comp, 977, fig wing; Alexander & McAtee, 1920: 396, key, 398, locs; Dietz, 1921: 261, loc, biol (as *Pachyrrhina*); Alexander, 1928: 57, locs; Leonard, 1928: 699, locs; Alexander, 1929a: 236, loc; Rogers, 1930: 11-12, biol, 17, locs, biol; Alexander, 1931: 138, locs; Winn & Beaulieu, 1932: 8, locs; Brimley, 1938: 319, locs; Procter, 1938: 283, locs; Alexander, 1941: 248, loc; Alexander, 1942: 224, key, 226, comp, note, 230, comp, 235, comp, sh descr, distr, locs; Alexander, 1962: 9, locs; Frommer, 1963: 581, comp, morph; Alexander, 1965: 22, distr.

Nephrotoma sodalis nictans (Dietz, 1918).

Dietz, 1918: 111, key, 129, descr, comp (as *Pachyrrhina*); Alexander, 1965: 22, distr; Cole, 1967: 53, distr.

Nephrotoma obliterated (Dietz, 1918).

Dietz, 1918: 111, key, 133-34, descr, comp, 134, comp, pl. V, fig wing, pl. VII, fig hypop (as *Pachyrrhina*); Alexander, 1919b: 826, distr, 937, comp, sh descr, distr, comp; Alexander, 1942: 224, key, 230, comp, sh descr, distr, syn; Alexander, 1965: 22, syn.

Nephrotoma wyalusingensis (Dietz, 1918).

Dietz, 1918: 111, key, 134-35, descr, comp, pl. V, fig wing, pl. VII, fig hypop (as *Pachyrrhina*); Alexander, 1919b: 826, distr, 937, comp, sh descr, distr; Alexander, 1942: 224, key, 235, comp, sh descr, distr, note; Alexander, 1965: 22, distr, note.

Material examined

Type material: Loew (1864) based his description of *Pachyrrhina sodalis* on only "♀". In the MCZ there is one specimen from Connecticut bearing a type-label; this ♀-holotype, condition poor (all legs missing, both antennae incomplete), type no. 10269, is labelled: "Ct" "Loew Coll." "sodalis m." "10269" "Type".

The description of *Pachyrrhina xanthostigma* by Loew (1864) was based on "♂ et ♀". There are a ♂ and remains of a ♀ on the same pin preserved in the MCZ, type no. 10313. The ♂ was selected as lectotype by Byers in 1961, condition fair; the ♀ is badly damaged (abdomen, antennae and nearly all legs lacking); the labels

are: "xanthostigma m." "Loew Coll." "10313" "Type" "♂ (upper specimen) to be lectotype G.W.B. 1961". The type-locality mentioned in the original description is "Illinois". Rogers (in Alexander, 1942) emphasized already the confusion between *xanthostigma* and *cingulata*, but Byers (1961, in literis) was the first who suggested the synonymy of *xanthostigma* with *sodalis*.

Pachyrrhina sodalis nictans Dietz, 1918, was described from one male, preserved in the ANSP, type no. 6456, condition fair, labelled: "Bear Creek, Col VI 29 14" "Oslar, Bear Creek Morrison Col." "HOLOTYPE" "HOLOTYPE *Pachyrrhina sodalis nictans* W. G. Dietz 6456". This darkly tinted specimen shows presumably a post-mortem discolouration, as is frequently found in specimens from the Dietz-collection; the synonymy of *sodalis nictans* with *sodalis* was already proposed by Byers (1961, in literis).

Pachyrrhina obliterated Dietz, 1918, was described from four males and two females. In the ANSP, type no. 6461, are preserved: the ♂ holotype, condition rather good, labelled: "Wyalusing, Bradford Co. Pa. VIII 3 '16" "HOLOTYPE" "HOLOTYPE *Pachyrrhina obliterated* W. G. Dietz 6461"; the topotypic ♀ allotype and one ♂ paratype (last one with date: VIII-4 '16) and one ♀ paratype from "Ottawa, Can. 26.VII.1912". The two other ♂ paratypes were not found there labelled as such, although there is one ♂ labelled "Wyalusing, Bradford Co. Pa., VIII-4-'16" and one damaged specimen of unidentified sex from "Mich, Schoolcraft Co. Floodwood VII 1915" in the ANSP-collection; the labels of both exactly refer to the missing paratypes. *N. obliterated* was already considered a synonym of *sodalis* by Rogers (in Alexander, 1942), Byers (1961, in literis) and Alexander (1965).

Dietz (1918) based his description of *Pachyrrhina wyalusingensis* on a ♂ holotype and a ♀ allotype. Both specimens, originally preserved in the ANSP (no type number), were seen by Byers in 1961 (in literis), who refers to the poor condition of both and gives the following labels for the holotype: "Wyalusing, Bradford Co.,

Pa., VIII-3-'16" "Holotype" "Pach. wyalusiensis Dietz" final label in Dr. Dietz's handwriting; the spelling of the species-name on this label differs from that in the original description). The topotypic allotype is from another date: VIII-4-'16. During a visit to the ANSP in 1982, the mentioned type-material of *wyalus-ingensis* could not be found. The synonymy with *sodalis* was proposed by Byers (1961, in literis).

Other material: 143 ♂, 115 ♀, from the following states and provinces: Alabama (1♂), Alaska (1♂), Alberta (2♂, 3♀), Colorado (13♂, 35♀), Connecticut (5♂, 3♀), Georgia (1♂), Indiana (2♂), Iowa (1♂), Maine (7♂, 1♀), Manitoba (2♂), Massachusetts (5♂, 5♀), Michigan (62♂, 35♀), Minnesota (7♂, 2♀), Nebraska (1♂, 1♀), New Hampshire (2♂, 2♀), New Jersey (3♂, 2♀), New Mexico (1♂), New York (3♂, 3♀), North Carolina (2♀), North Dakota (1♂), Ohio (4♂), Ontario (8♂, 11♀), Pennsylvania (1♂, 2♀), Quebec (4♂), Tennessee (1♀), Vermont (1♂, 2♀), Virginia (1♂), Washington DC (1♀), Wisconsin (2♀), Wyoming (1♀), Yukon (4♂, 1♀).

Diagnostic features

Although there frequently has been confusion between *xanthostigma* (= *sodalis*) and *cingulata* (see also the literature-notes under *cingulata*), both having antennae with basally darkened flagellar segments, *sodalis* can be separated from *cingulata* by its yellowish body colouration (compared to bright orange-yellow), by the much longer antennal verticils in both sexes of *sodalis*, the yellow palps (compared to brown ones), the differently marked vertex and the dull black-brown antero-lateral corners of scutum 2 (yellowish in *cingulata*). Some other diagnostic characters of *sodalis* are the faint pterostigma, the toothed tarsal claws of the male and the usually distinct transverse brown band on the anterior part of abdominal tergite 2.

Description

Body length: ♂ 11.5-16 mm, ♀ 16.5-22.5 mm.
Wing length: ♂ 11.5-14.5 mm, ♀ 13-16.5 mm.

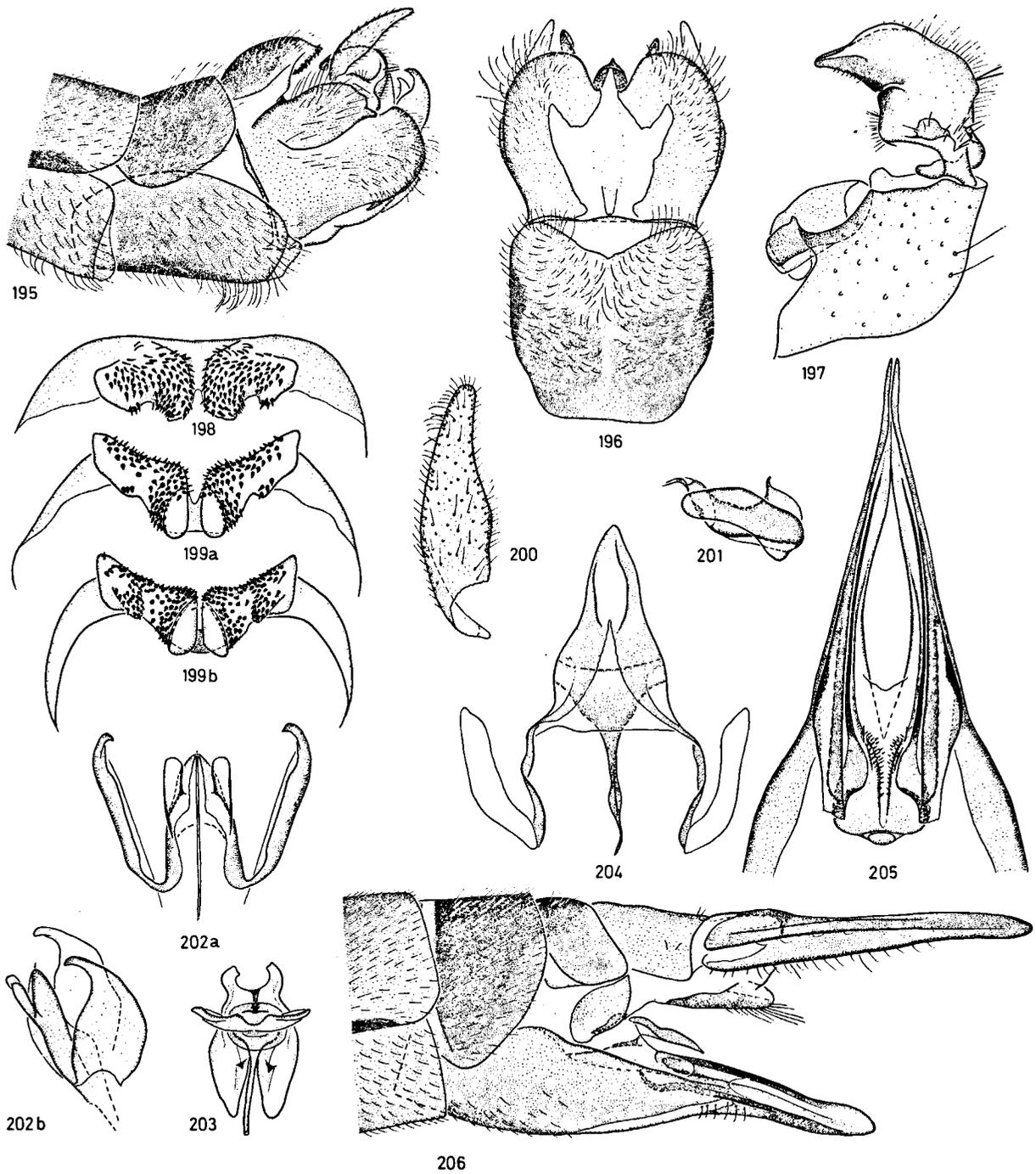
Antennal length: ♂ 3.7-4.7 mm, ♀ 2.7-3.4 mm.

Body colour dark to pale yellow.

Head: Antennae of both sexes 13-segmented; scape and pedicel yellow, first flagellar segment sordid yellow, other segments ranging from yellowish-brown to dark brown, usually with slightly darker basal nodes. Flagellar segments of ♂ weakly incised, longest verticillar hairs reaching to beyond length of segments; antennal segments of ♀ cylindrical, verticillar hairs largely longer than segments. Rostrum short and shining yellow with distinctly to weakly brown sides. Palps yellow to brownish-yellow. Frons and tubercle opaque yellow; vertex and postgenae shining yellow without dark markings, light triangular base of vertex sometimes lined with a brownish tint.

Thorax: Median part of pronotum not or light brown tinted and dull; remainder of thorax polished. Stripes (light) reddish-brown. Transverse suture in the middle marked with a usually pale brown triangular spot; antero-lateral corners of scutum 2 usually dull black-brown, sometimes greyish tinted. Scutellum transparently brownish to dark yellow, just as narrow anterior stripe and broad caudal marking on mediotergite. Pleura dark to whitish-yellow with weakly brown-yellow to red-yellow markings; lateral parts of prescutum with a usually distinct, narrow, brown, oblique line. Legs yellow, slightly to distinctly darkened apically. Ratio tibia/metatarsus of middle and hind legs variable, usually about equal in length. Tarsal claws of ♂ toothed. Wings hyaline to slightly yellowish tinted, costal region light yellow; pterostigma yellow to light brown with occasionally a few macrotrichia; cell m1 rarely subsessile, mostly long-petiolate.

Abdomen: Posterior margin of tergite 1 usually narrowly lined with brown; anterior part of tergite 2 usually with a (dark) brown transverse band, generally more distinct in ♂; in ♀ sometimes narrow brown bands along posterior margins of other tergites; dorsal markings on tergites 2-7 ranging from dark brown elongate spots to largely obliterated ones. Tergites 2-7 on each side marked with two (dark) brown



Figs. 195-206. *N. sodalis*; 195-203, ♂; 204-206, ♀. 195. hypopygium, lateral view; 196. hypopygium, caudo-ventral view; 197. id, outside; 198. tergite nine, caudal view; 199. tergite nine, ventral view; 200. od, outside; 201. sp2, from inside; 202. adminiculum: a, anterior view, b, lateral view; 203. semen pump, dorsal view; 204. fused valvulae and furca, dorsal view; 205. hypovalvae, dorsal view; 206. ovipositor, lateral view.

dashes, the anterior one frequently smaller and paler, sometimes obliterated. Ventral markings ranging from distinct, caudally tailed dark brown dots on anterior parts of each segment to nearly obliterated markings with only a vague spot left on second sternite. Usually tergites 8, 9 and basal part of sternite 8 in ♂, and tergite 8, sometimes 9 in ♀ (dark) brown fuscous with remainder of the (sub)terminal segments more pale, brownish-yellow to yellow; sometimes darkening hardly visible.

Hypopygium: Hind margin of tergite 9 with U-shaped incision; posterior extension with weakly to distinctly pronounced caudo-lateral corners, ventral side with outwardly directed median protrusions and inwardly directed, sometimes hardly extended lateral ones; black spines abundant on both ventral and caudal surface (figs. 198, 199a, b). Outer dististyle fig. 200; inner dististyle with a narrow crest, posterior margin broadly rounded, lower part of anterior beak angularly extended; lateral projection ridge-like (fig. 197). Base of sp2 with two transparent extensions; anterior attachment with basistyle pointedly extended (fig. 201). Hind margin of sternite 8 with very shallow membrane-closed incision; hairs yellow, on caudal and median surfaces longer ones (figs. 195, 196). Membranous area on caudo-ventral surface of sternite 9 more or less smooth and with two pointed latero-caudal offshoots (fig. 196); midventral extension of antecosta very short. Adminiculum with basally broadened and apically slender and curved gonapophyses; median part with two flat, finger-like extensions anteriorly (fig. 202a, b). Semen pump with only weakly dilated lateral appendages and slightly extended caudal ones (fig. 203). Intromittent organ short, not winding, length ranging from 3.9 to 4.5 mm. Hypopygium not as broad as scutum 1.

Ovipositor: Both cerci and hypovalvae only weakly narrowed apically (fig. 206). Coxopodites of tergite 9 slightly diamond-shaped, connected with fused valvulae by a sclerotized rod. Rostral extensions of the hypovalvae hardly developed, base of major ridge shortly bulbous; internal shell broadly hollowed and

with narrow interior prolongation (fig. 205). Weak sclerotizations of fused valvulae at base narrowly passing into rods; furca plain (fig. 204).

Biology (diagram 10)

Information about the biology of *sodalis* in the literature is rather poor and principally relates to Michigan only. The species was usually abundant on low moist ground of river-bottoms and along grassy banks and shore lines of streams (Rogers, 1918, 1942). Byers (1979) also found some specimens in grassy areas in Minnesota. Rogers (1942) considered *sodalis*

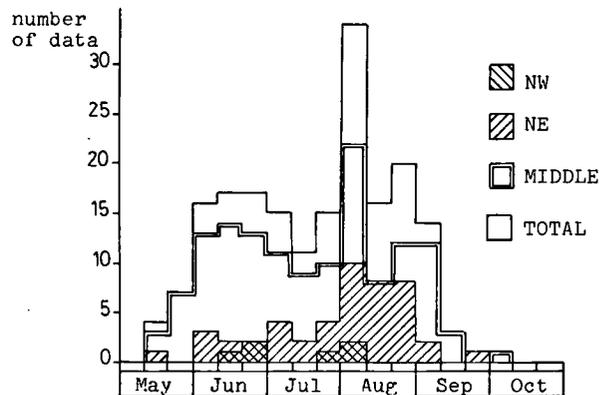
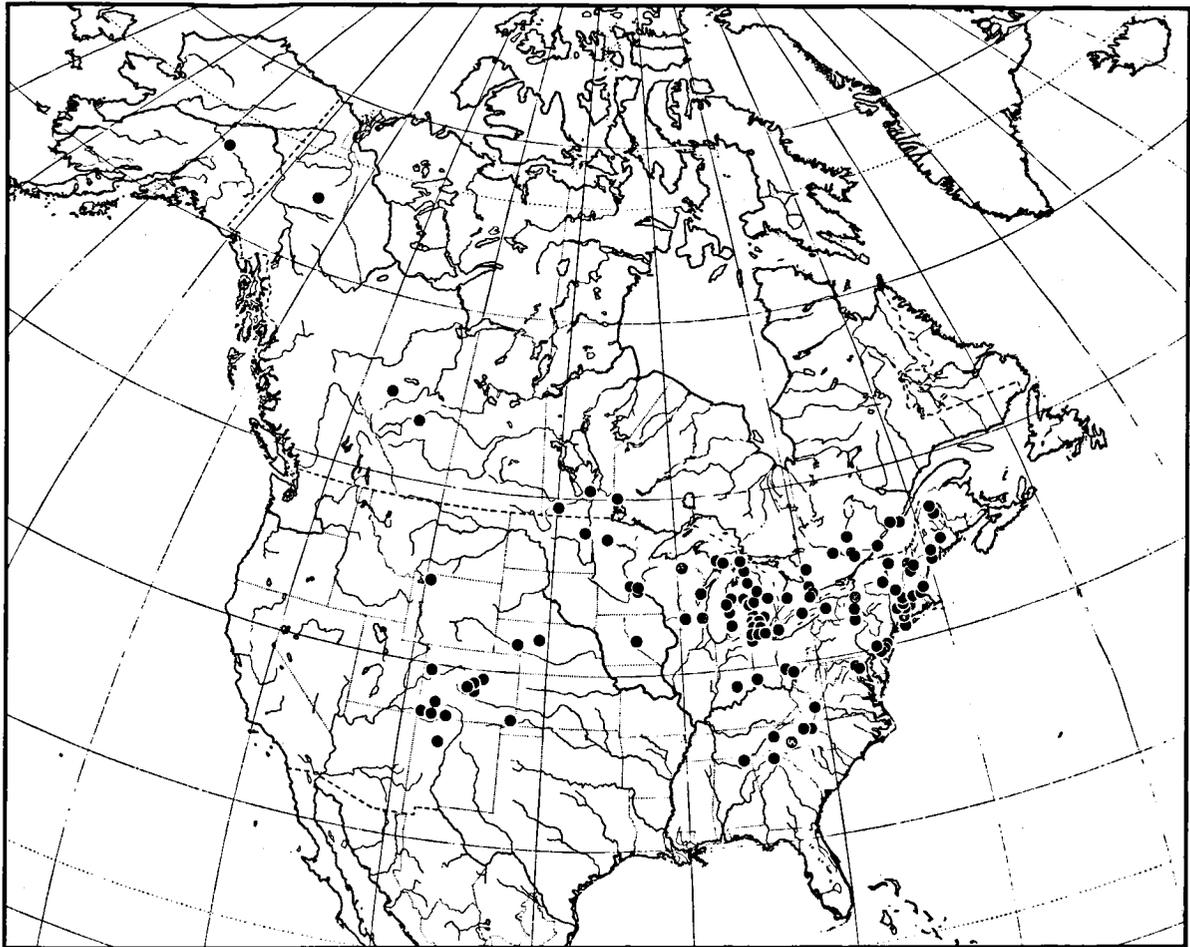


Diagram 10. Period of flight of *N. sodalis*.

“characteristic of open or partly cleared situations, less characteristic of wooded flood plains or situations grown with tall rank herbage”. The immature stages are unknown, but Rogers (1942) mentioned that “males sought for emerging females within a few feet of the brook margins”. There was only one specimen of which the altitude was given: 1500 feet (450 m) (♂, Minnesota). The flight-period of *sodalis* ranges from mid-May till the end of September (one record on October 2). The few records from the northwestern part of the range all lie between mid-June and mid-August. The extended flight-period and the slightly two-peaked diagram points in the direction of two generations a year for *sodalis*, as distinctly found by Rogers (1942) in Michigan.



Map 16. Distribution of *N. sodalis*, based on material examined (black dots) and literature (stippled dots).

Distribution (map 16)

The distribution-range of *sodalis* given in the literature is limited to the eastern half of North America (Alexander, 1942, 1965; Byers, 1979), while the holotype of *sodalis nictans* is reported from Colorado. Nevertheless, within the collections of Dietz, Rogers, Alexander and others several specimens of *sodalis* can be found from far more western and northwestern localities. The present-known range stretches from Maine to northern Georgia and Alabama westward to New Mexico, Colorado and Wyoming and to the northwest up to Alberta, Yukon and Alaska. Specimens originated from the following localities and counties: Alabama: Jackson Co.; Alaska: Fairbanks (1♂); Alberta: Little

Smoky River (2♂, 1♀), Edmonton (1♀), Sandy Point (1♀); Colorado: 4 mile Creek (probably Park-Teller co's., W of Colorado Springs) and Arapahoe, Archuleta, Baca, Garfield, Jefferson, La Plata, Montezuma, Ouray, Park co's.; Connecticut: Hartford, Litchfield co's.; Georgia: Neel Gap (border of Union/Lumpkin co's.); Illinois: unspecified (type-locality of *xanthostigma*); Indiana: Jackson Co.; Iowa: Story Co.; Maine: Aroostook, Kennebec, Penobscot, Sagadahoc co's.; Manitoba: Aweme (25 miles S of Brandon), Teulon; Massachusetts: Essex, Hampden, Hampshire, Middlesex, Worcester co's.; Michigan: 23 counties; Minnesota: Clearwater, Hennepin, Ramsay co's.; Nebraska: Garden, Thomas co's.; New Hampshire: Carroll, Grafton co's.;

New Jersey: Burlington, Camden, Gloucester co's.; New Mexico: Sandoval Co. (1♂); New York: Erie, Suffolk, Tompkins, Warren co's.; North Carolina: Watauga, Wilkes co's.; North Dakota: Grand Forks Co.; Ohio: Athens, Hamilton, Hocking, William co's.; Ontario: Gull Lake (Muskoka District), Huron Co., Malachi-Minaki, Ottawa, Peel Co., Pembroke, Pt. Pelee, Port Credit, St Williams on L. Erie, Toronto; Pennsylvania: Bradford, Delaware co's.; Quebec: Beaulieu (SW point of Ile d'Orleans), Kazabazua (about 80 mi NNW of Ottawa), Montreal, Ste Anne de la Perade; Tennessee: Knox Co.; Vermont: Bennington, Chittenden co's.; Virginia: Giles Co.; Washington DC; Wisconsin: Brown Co.; Wyoming: Park Co.; Yukon: Mayo Landing on Alaska Hwy (4♂, 1♀).

SECTION 6

Nephrotoma gracilicornis (Loew, 1864)

Figs. 207-219, diagram 11, map 17

Loew, 1864: 66, descr, comp (as *Pachyrrhina*); Osten Sacken, 1878: 40, distr (as *Pachyrrhina*); Loew, 1879: 3, key (as *Pachyrrhina*); Aldrich, 1905: 98, distr (as *Pachyrrhina*); Doane, 1908: 175, key (as *Pachyrrhina*); Johnson, 1913: 41, loc (Jacksonville, Florida = not *gracilicornis*) (as *Pachyrrhina*); Dietz, 1918: 111, key (as *Pachyrrhina*); Alexander, 1919b: 818, loc, 935, key; Alexander & McAtee, 1920: 396, key; Leonard, 1928: 699, loc; Alexander, 1941: 287, syn; Alexander, 1942: 223, key, 228, comp, sh descr, distr, syn, 233, note; Rogers, 1942: 19, 46, biol, 62, biol, loc; Alexander, 1965: 21, distr, syn; Byers, 1979: 605, biol, loc, syn, distr, 612, loc.

Nephrotoma festina (Dietz, 1918).

Dietz, 1918: 110, key, 126-7, descr, 127, comp (as *Pachyrrhina*), 128, comp (as *P. perfida*), pl. V, fig wing; Alexander, 1919b: 826, distr, 937, sh descr, distr; Alexander & McAtee, 1920: 396, key, 397, loc; Brimley, 1938: 319, loc; Alexander, 1941: 284, distr, 287, syn; Alexander, 1942: 223, key, 228, sh descr, distr, syn, 233, comp; Alexander, 1965: 21, syn.

Nephrotoma temeraria (Dietz, 1918).

Dietz, 1918: 110, key, 128, descr, comp (as *Pachyrrhina*); Alexander, 1919b: 826, distr, 937, sh descr, distr; Dickinson, 1932: 167, loc, 216, key, 220, fig wing, note; Alexander, 1942: 223, key, 233, comp, distr, note; Alexander, 1965: 21, distr (as *gracilicornis* ssp. *temeraria*); Byers, 1979: 605, syn (as *gracilicornis temeraria*).

Nephrotoma tenuis fuscostigmata Alexander, 1940.

Alexander, 1940b: 606-8, descr, 607, fig id, 608, note, comp; Alexander, 1965: 22, distr.

Presumably as *N. occipitalis*: Alexander, 1919b (partim): 786, loc; Alexander & McAtee, 1920 (partim): 397, loc; Dietz, 1921: 261, loc (as *Pachyrrhina*).

Material examined

Type material: Loew (1864) based his description of *Pachyrrhina gracilicornis* on "♂ & ♀"; preserved in the MCZ are one ♂ and one ♀ bearing red type-labels, no. 10266. The male was selected as lectotype by Byers in 1961; it is a damaged specimen (abdomen broken off and glued to label), labelled as follows: "225" "N.Y." "Loew Coll." "gracilicornis m" "10266" "Type" "to be lectotype GWB '61". The damaged ♀ paralectotype (the abdomen lacking) is labelled: "N.Y." "Loew Coll." "10266" "Type". There are six other specimens (3♂, 2♀, 1?) in the Osten Sacken collection, four of them from New York, apparently not belonging to the type-series of *gracilicornis*. The locality "N.Y.", found on the labels of the type-material, is not mentioned in the original description.

Pachyrrhina festina was described by Dietz (1918) on the basis of four males, all in the ANSP, type no. 6464. The holotype, condition good, is labelled: "Plummers I Md 28.VIII.12" "W L McAtee Collector" "HoloTYPE" "HOLOTYPE *Pachyrrhina festina* W. G. Dietz 6464". The three paratypes are from: "Aweme Manitoba E. Criddle 8-15-10 MCVanDuzee". The synonymy of *festina* with *gracilicornis* was at first proposed by Alexander (1941) and confirmed by Rogers (in Alexander, 1942) and Byers (1961, in literis). The name "*perfida*" is considered a *nomen nudum*; it was used by Dietz (1918) in the description of *temeraria* for comparison and never mentioned before and presumably refers to *festina*, as suggested by Alexander (1942, 1965).

Pachyrrhina temeraria was described by Dietz (1918) from one female, examined in the ANSP, type no. 6455, condition fair, labelled: "Schoolcraft Co. Mich. Floodwood VII-1915 J. S. Rogers" "HoloTYPE" "HOLOTYPE *Pachyrrhina temeraria* W. G. Dietz 6455". Rogers (in Alexander, 1942) considered

temeraria at most as a race of *gracilicornis*; Alexander (1965) designed it as a subspecies of *gracilicornis*, and Byers (1979) proposed the synonymy of *temeraria* with *gracilicornis*.

Nephrotoma tenuis fuscostigmata Alexander, 1940 was described from one male, to be found in the C. P. Alexander-collection, USNM. The condition of the specimen is fair to good, right wing, left antenna and hypopygium dissected and mounted on slide no. 6991, labelled as follows: "Smokey Mts., Tenn. Alt. 2700 ft. VII-6-1939 Art Cole" "Holotype *Nephrotoma tenuis fuscostigmata* C. P. Alexander". The original description adds to this "Chimneys Camp". New synonymy. Examination of the dissected genitalia of the holotype reveals the synonymy of *tenuis fuscostigmata* with *gracilicornis*.

Other material: 144 ♂, 94 ♀, 4?, from the following states and provinces: Connecticut (1♂), Illinois (1♂, 2♀), Indiana (3♂, 1♀), Manitoba (1♂, 3♀), Maryland (6♂, 8♀, 3?), Massachusetts (6♂), Michigan (95♂, 49♀), Minnesota (3♂, 6♀), Missouri (1♂), New Brunswick (1♂), Newfoundland (2♀), New Hampshire (1♀), New Jersey (1♀), New York (3♂, 2♀), North Carolina (10♂, 2♀), North Dakota (1♀), Nova Scotia (1♂), Ohio (2♂, 2♀), Ontario (3♂, 8♀), Pennsylvania (2♂, 1?), South Dakota (1♀), Tennessee (1♂), Vermont (3♂), Virginia (4♀), Washington DC (1♂, 1♀).

Diagnostic features

N. gracilicornis more or less resembles many other species; particularly the females are easily confused with species that also have: unspotted to pale spotted pleura, dark yellow to red-brown thoracic stripes and yellow-based antennal segments, such as *breviorcornis*, *eucera*, *euceroidea*, *okefenoke*, *urocera* and *tenuis*. An important distinguishing character of *gracilicornis* is the typical dorsal marking on the anterior segments of the abdomen (fig. 209), but this is not always equally distinct. Other diagnostic characters are the very long verticils of the antennae in ♂ and ♀, the red-brown to dark brown tinted antero-lateral corners of scutum 2,

the (dark) brown pterostigma, the broad dark brown and continuous abdominal dorsal stripe and the usually strong (sub)terminal darkening.

Description

Body length: ♂ 12-15.5 mm, ♀ 16-20 mm.

Wing length: ♂ 12.5-15 mm, ♀ 13.5-15.5 mm.

Antennal length: ♂ 2.8-3.5 mm, ♀ 2.4-3.1 mm.

Body colour bright yellow.

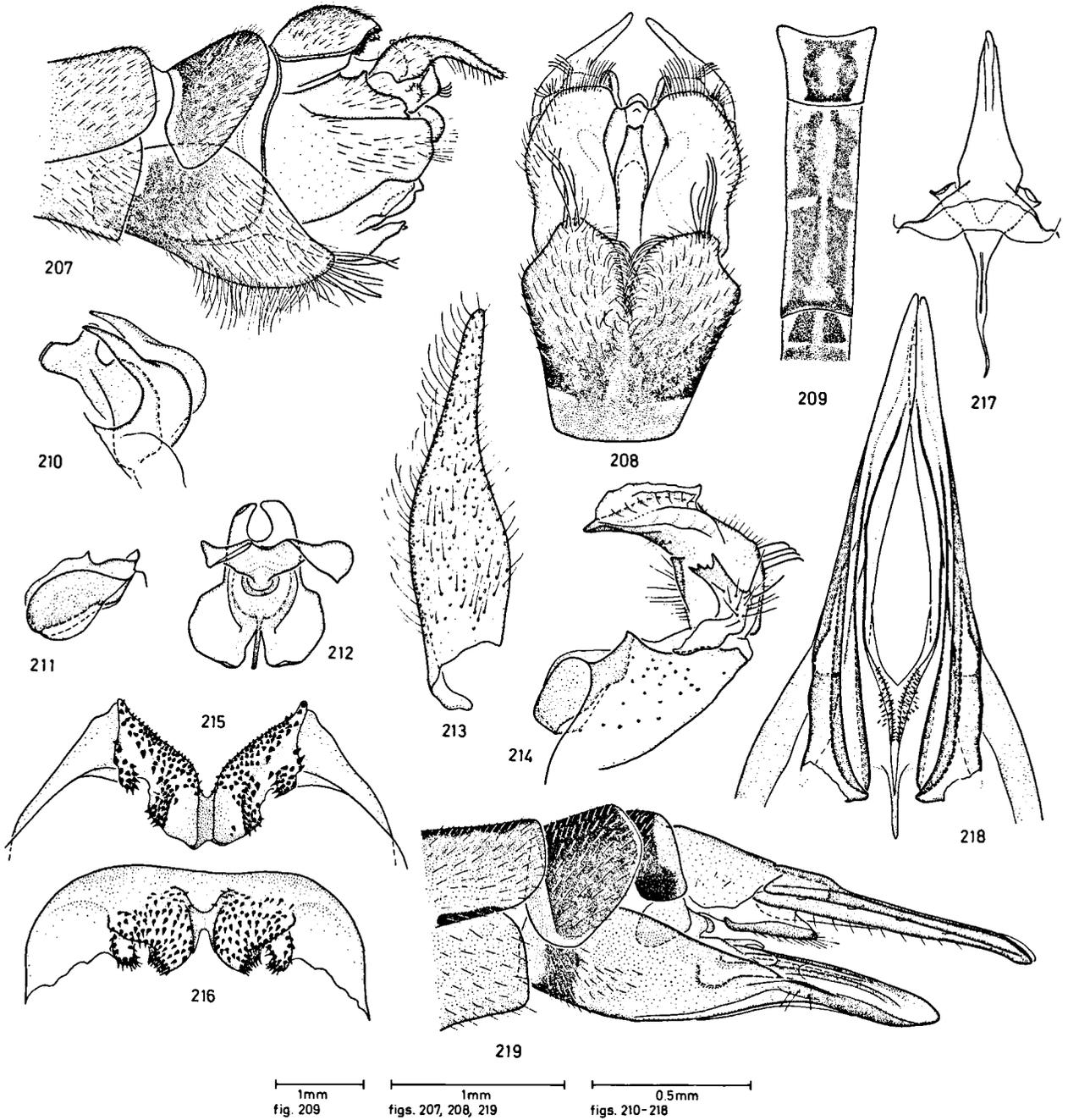
Head: Antennae of both sexes 13-segmented, flagellar segments cylindrical; verticillar hairs in ♂ distinctly exceeding length of segments, in ♀ 1.5 times length of segments. Usually first three, sometimes four, antennal segments yellow, remainder of flagellum yellow-brown to dark brown coloured with bases of first 6 to 8 segments slightly to more or less distinctly yellowish. Lower sides of rostrum (dark) brown. Palps sordid yellowish with slightly to distinctly darkened basal segments. Frons, tubercle and small rostral part of vertex opaque yellow, remainder of head polished yellow; vertex with brownish tint centrally, light grey-brown spots along caudo-dorsal eye-margin.

Thorax: Entire thorax more or less polished; pronotum yellow, median part subopaque and sordid to grey-brown. Stripes light to dark red-brown; median one often divided by a narrow longitudinal yellow line. Transverse suture slightly brownish tinted; antero-lateral corners of scutum 2 dull red-brown to dark brown. Scutellum and markings on mediotergite transparently dark yellow, sometimes narrow brownish median stripe on scutellum and anterior part of mediotergite. Pleura yellow to whitish-yellow, markings transparent-like, sometimes more reddened. Narrow brown dash on anterior part of paratergite sometimes vague; extreme lateral corners of prescutum frequently grey-brownish tinted. Legs yellow, only darkened towards end of tarsi. Metatarsi of middle and hind legs longer than tibiae. Tarsal claws untoothed. Wings hyaline-yellow, costal region light yellow; pterostigma usually dark brown, sometimes slightly paler, number

of macrotrichia varying from 0 to 12; wingtip sometimes infumed with brown; cell m1 long to short petiolate, occasionally sessile.

Abdomen: Dorsal stripe on tergites 1-7 brown

to dark brown, continuous, sometimes more vague; in ♀ about as broad as mediotergite, in ♂ slightly less broad; separate tergites usually with somewhat darker anterior triangle and



Figs. 207-219. *N. gracilicornis*; 207-216, ♂; 217-219, ♀. 207. hypopygium, lateral view; 208. hypopygium, caudo-ventral view; 209. proximal segments of the abdomen, dorsal view; 210. adminiculum, lateral view; 211. sp2, from inside; 212. semen pump, dorsal view; 213. od, outside; 214. id, outside; 215. tergite nine, ventral view; 216. tergite nine, caudal view; 217. fused valvulae and furca, dorsal view; 218. hypovalvae, dorsal view; 219. ovipositor, lateral view.

oblong, sometimes caudally broadened posterior spot. On the anterior tergites usually spots with a narrow, lighter tinted median stripe (fig. 209), not always equally distinct; in ♀ tergites sometimes brown bordered posteriorly. Tergites 2-7 laterally with dark brown elongate spots, two on each side of segment, sometimes fused, the anterior one smaller and paler. Sternites 2-5, 6 or 7 with dark brown to black spots on anterior parts, posteriorly small oval spots more protracted. Tergite 8 distinct, tergite 9 variably distinct brown to dark brown fuscous in ♂ and ♀; sternite 8 basally fuscous, in ♂ distinct, in ♀ sometimes weak; remainder of terminal segments yellowish.

Hypopygium: Hind margin of tergite 9 deeply and widely U-shaped incised, strong latero-caudal extensions acute; medio-caudal region and thick, laterally directed median protrusions and lateral ones on ventral side abundantly set with black spines (figs. 215, 216). Details of the outer and inner dististyles see figs. 213, 214; id with a broad, posteriorly acutely angled and basally thickened crest, an angularly extended anterior part of the lateral shell and a flat, multi-pointed lateral projection, basally set with some black hairs. Inner half of sp2 with a rather broad transparent extension at base (fig. 211). Hind margin of sternite 8 with narrow incision, closed by a thin membrane and lined with medially directed yellowish hairs; rather obtuse caudal corners set with some long yellow bristles (fig. 208). Membranous area on ventro-caudal surface of sternite 9 with two lightly sclerotized lateral plates, a small pubescent bulge at caudal end, finger-like lateral offshoots and a two-tipped, distinctly extended medisternal appendage (fig. 208); midventral extension of antecosta narrow and rather long. Adminiculum with dorso-anteriorly curved and distinctly tapering gonapophyses; median part with a bulbous extension on caudal side and two obtuse, flap-like extensions anteriorly (fig. 210). Semen pump with widely extended lateral appendages (fig. 212). Intromittent organ weakly winding, reaching into fifth or fourth abdominal segment; in length varying from

10.3 to 13.0 mm. Hypopygium usually not as broad as scutum 1.

Ovipositor: Cerci slightly parallel-sided, long, slender and with weakly downcurved tips; hypovalvae parallel-sided, ending in a blunt point (fig. 219). Rostral extensions of hypovalvae hardly developed, lateral bulge fusing into a well-developed, sclerotized lateral shell; internal shell very narrow and upcurved; no internal arch (fig. 218). Fused valvulae and furca weakly sclerotized, details see fig. 217.

Biology (diagram 11)

Rogers (1942) found that *gracilicornis* in Michigan was "common to abundant along nonmarshy banks of brooks and creeks, and in the lower parts of flood-plain and lake-margin woods". The greatest numbers were taken from the luxuriant herbage of a partially cleared flood-plain wood. The species was also "rare in

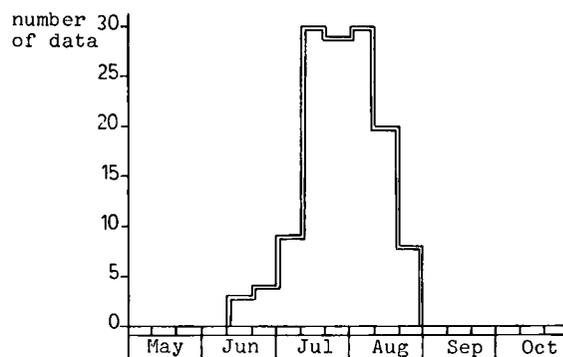
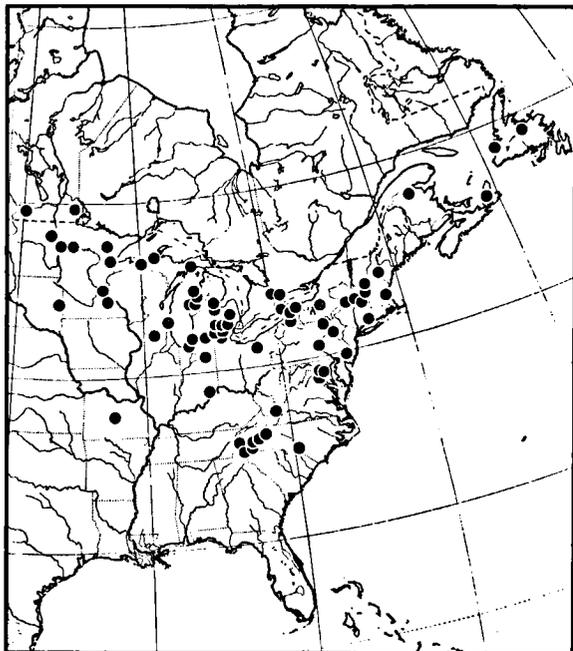


Diagram 11. Period of flight of *N. gracilicornis*.

deeply shaded situations". Byers (1979) found the species "rare or uncommon in low vegetation near swamp and lake margins" in Minnesota. *N. gracilicornis* can be found at altitudes up to 3850 feet (1170 m), especially in the southern part of the distribution-range: the Appalachian Mountains in Virginia, Tennessee and North Carolina. The immature stages are unknown, but according to Rogers (1942) they live "probably in wet to moist soil". The flight-period of *gracilicornis* runs from mid-June to the end of August with a climax in the second half of July and the first week of August, apparently with a single generation a year (Rogers, 1942).

Distribution (map 17)

In the literature New York and Ontario were mentioned as the most northern limits of *gracilicornis*, but now the species is known from several localities from New England to Newfoundland and ranges westward to eastern North and South Dakota and southern Manitoba and southward to Missouri, Tennessee and North Carolina. Specimens



Map 17. Distribution of *N. gracilicornis*, based on material examined (black dots) and literature (stippled dots).

originated from the following localities and counties: Connecticut: New Haven Co.; Illinois: Winnebago Co.; Indiana: Huntington, Jefferson, La Porte co's.; Manitoba: Aweme (25 miles south of Brandon), W. Hawk Lake; Maryland: Plummers Isl. in Montgomery Co.; Massachusetts: Berkshire, Essex co's.; Michigan: 18 counties; Minnesota: St. Anthony Pk. (near St. Paul) and Carlton, Clearwater, Goodhue, Norman, St. Louis co's.; Missouri: Waynesville; New Brunswick: Robinsonville; Newfoundland: Port au Port, Exploits River near Bishop's Falls; New Hampshire: Carroll Co.; New Jersey:

Gloucester Co.; New York: Potter Swamp (probably Albany Co.) and Cattaraugus, Erie, Genesee, Nassau, Rensselaer co's.; North Carolina: Avery, Buncombe, Jackson, Watauga, Yancey co's.; North Dakota: Grand Forks Co.; Nova Scotia: Cape Breton (Baddeck); Ohio: Summit Co.; Ontario: Belfountain in Peel Co., Ridgeway (on L. Erie, south of Niagara Falls), Toronto; Pennsylvania: Bradford, Luzerne, Perry co's.; South Dakota: Brookings Co.; Tennessee: Sevier Co. (G.S.M.N.P.); Vermont: Windham, Windsor co's.; Virginia: Arlington, Giles Co.; Washington DC. The easternmost locality in North Carolina is Marston in Richmond Co. (Brimley, 1938).

Nephrotoma tenuis (Loew, 1863)

Figs. 220-232, diagram 12, map 18

Loew, 1863: 297-98, descr (as *Pachyrhina*); Osten Sacken, 1878: 40, locs (as *Pachyrhina*); Loew, 1879: 2, key (as *Pachyrhina*); Aldrich, 1905: 99, distr (as *Pachyrhina*); Doane, 1908: 175, key (as *Pachyrhina*); Dietz, 1918: 110, key, 119, comp, 121, comp, pl. VI, figs hypop (as *Pachyrhina*); Alexander, 1919b: 782-784, 786, 818, locs, 830, 877, 878, biol, 934, comp, 936, key, pl. XLIV, fig wing; Alexander & McAtee, 1920: 396, key, 397, locs; Dietz, 1921: 261, biol, loc, comp (as *Pachyrhina*); Alexander, 1922: 61, loc; Alexander, 1924: 60, loc; Alexander, 1925b: 172, loc; Johnson, 1925: 34, locs; Leonard, 1928: 699, locs; Alexander, 1929a: 236, locs (partim; St. Johns Co., Quebec = *macrocera*); Alexander, 1930: 272, loc; Rogers, 1930: 11, biol, 16, loc, biol; Dickinson, 1932: 165-169, locs, 215, key, 218, fig wing, locs, note; Winn & Beaulieu, 1932: 8, locs (partim; St. Johns Co., Quebec = *macrocera*); Brimley, 1938: 319, loc; Procter, 1938: 283, locs; Alexander, 1940b: 606, loc, 607, fig id (as *tenuis tenuis*), 608, subsp; Erikson, 1940: 172, biol; Alexander, 1941: 284, 289, loc; Alexander, 1942: 223, key (as *tenuis tenuis*), 233, sh descr, distr, locs, 234, comp, syn; Rogers, 1942: 20, 46, biol, 63, loc, biol; Alexander, 1962: 8, locs; Alexander, 1965: 22, distr, syn, subsp (as *tenuis tenuis*); Byers, 1968: 398, comp; Byers, 1979: 606, biol, distr, loc.

Nephrotoma tenuis hamata (Dietz, 1918).

Dietz, 1918: 110, key, 121, comp, sh descr, pl. VII, fig hypop (as *Pachyrhina*); Alexander, 1942: 223, key, 234, comp, syn; Alexander, 1965: 22, syn.

Nephrotoma tenuis nigroantennata (Dietz, 1921).

Dietz, 1921: 261, comp, sh descr (as *Pachyrhina*); Alexander, 1942: 223, key, 234, comp, syn; Alexander, 1965: 22, syn.

As breviorcornis: Alexander, 1942: 225, loc (Union, Aug. 17-18, 1928).

As macrocera: Alexander, 1919b: 783, loc (Nova Scotia = ? *tenuis*).

As macrocera virgata: Dietz, 1921: 260, loc (Hazleton, Pa., VIII-6'12 and VII-21'18, 2 ♀ paratypes).

Notes on literature

In the literature *tenuis* has been confused to a certain extent with *macrocera* and *breviorcornis*, among others. Erroneous references could be traced back in part only.

Material examined

Type material: The description of *Pachyrrhina tenuis* Loew, 1863 was based on "♂ et ♀". In the MCZ there are a male and a female bearing type-labels, no. 10311; the ♂, condition good, selected as lectotype by Byers in 1961, is labelled: "Sharon Springs" (New York, Schoharie County) "tenuis m." "Loew Coll." "10311" "Type" "to be lectotype G.W.B. '61". The ♀ paralectotype is not *tenuis* but *macrocera*, labels as follows: "Sharon Springs" "Loew Coll." "10311/2" "Type" "paralectotype *tenuis* (Loew) = *macrocera* (Say) det. I. Tangelder 1982". There are several other specimens of *tenuis* in the Loew- and Osten Sacken-collections in the MCZ, but all without type-labels.

Pachyrrhina tenuis hamata Dietz, 1918 was described from a male holotype, condition fair, preserved in the ANSP, type no. 6447, labels as follows: "Sullivan Co NY VIII/12" "HOLOTYPE *Pachyrrhina tenuis hamata* W. G. Dietz 6447". The synonymy of *tenuis hamata* with *tenuis* was already proposed by Rogers (in Alexander, 1942), Byers (1961, in literis) and Alexander (1965).

Pachyrrhina tenuis nigroantennata Dietz, 1921 was described from a male holotype, condition good, preserved in the ANSP, type no. 6454, labels as follows: "Hazleton, Pa. Dr. Dietz Coll. VII 6 '20" "HOLOTYPE *Pachyrrhina tenuis nigroantennata* W. G. Dietz 6454" "Pach. *tenuis* var. *nigro-antennata* Dtz.". As for the previous species, *tenuis nigroantennata* was

already considered a synonym of *tenuis* by Rogers (in Alexander, 1942), Byers (1961, in literis) and Alexander (1965).

Other material: 203 ♂, 157 ♀, from the following states and provinces: Alabama (2 ♀), Connecticut (2 ♂, 2 ♀), Delaware (1 ♂, 2 ♀), Georgia (3 ♂, 3 ♀), Indiana (2 ♂), Kentucky (1 ♂), Maine (13 ♂), Maryland (2 ♂, 2 ♀), Massachusetts (12 ♂, 7 ♀), Michigan (31 ♂, 22 ♀), Minnesota (2 ♂), New Hampshire (2 ♂, 4 ♀), New Jersey (4 ♂, 8 ♀), New York (12 ♂, 13 ♀), North Carolina (24 ♂, 15 ♀), Nova Scotia (3 ♂), Ohio (2 ♂, 2 ♀), Ontario (10 ♂, 13 ♀), Pennsylvania (18 ♂, 12 ♀), Quebec (1 ♀), Rhode Island (1 ♀), South Carolina (1 ♂), Tennessee (6 ♂, 11 ♀), Vermont (4 ♂, 3 ♀), Virginia (43 ♂, 31 ♀), West Virginia (4 ♂, 3 ♀), Wisconsin (1 ♂).

Diagnostic features

Because of the subshining dorsal thoracic surface of *tenuis*, confusion with *macrocera* and *gnata* is possible; distinct differences are the yellow-based flagellar segments and largely shining vertex in *tenuis* compared to the basally darkened brownish flagellar segments and the opaque vertex in *macrocera* and *gnata*. There is also some resemblance and confusion especially of females possible with some species that have unspotted to pale spotted pleura, dark yellow to red-brown thoracic stripes and yellow-based antennal segments, such as *breviorcornis*, *eucera*, *euceroides* and *gracilicornis*. Apart from the subshining dorsal thorax, *tenuis* differs from them by a combination of the following characters: the broad, dark brown lateral parts of the rostrum, the grey-brown caudo-ventral spots on postgenae, the yellow antero-lateral corners of scutum 2, the yellowish pterostigma and the more or less complete lack of (sub)terminal darkening.

Description

Body length: ♂ 12.5-15 mm, ♀ 16-21.5 mm.
Wing length: ♂ 11.5-13.5 mm, ♀ 13-16 mm.
Antennal length: ♂ 2.7-3.6 mm, ♀ 2.3-2.9 mm.

Body colour of dried specimens light yellow to yellow; in life strongly tinged with green.

Head: Antennae of both sexes 13-segmented (rarely 12-segmented in ♀); flagellar segments in ♂ with weakly bulbous basal nodes, in ♀ segments cylindrical. First three antennal segments usually yellow, remainder of flagellum largely bicoloured: segments light to dark brown with yellow basal nodes; length of verticillar hairs in both sexes up to or slightly over length of flagellar segments. Sides of rostrum broadly brown to dark brown. Palps with the first two segments dark brown, remainder much paler. Frons, tubercle and narrow rostral part of vertex opaque yellow, remainder of vertex and postgenae shining yellow without dark markings except sometimes vague orbital spots; on caudo-ventral part of postgenae usually greyish-brown spots along the eyes.

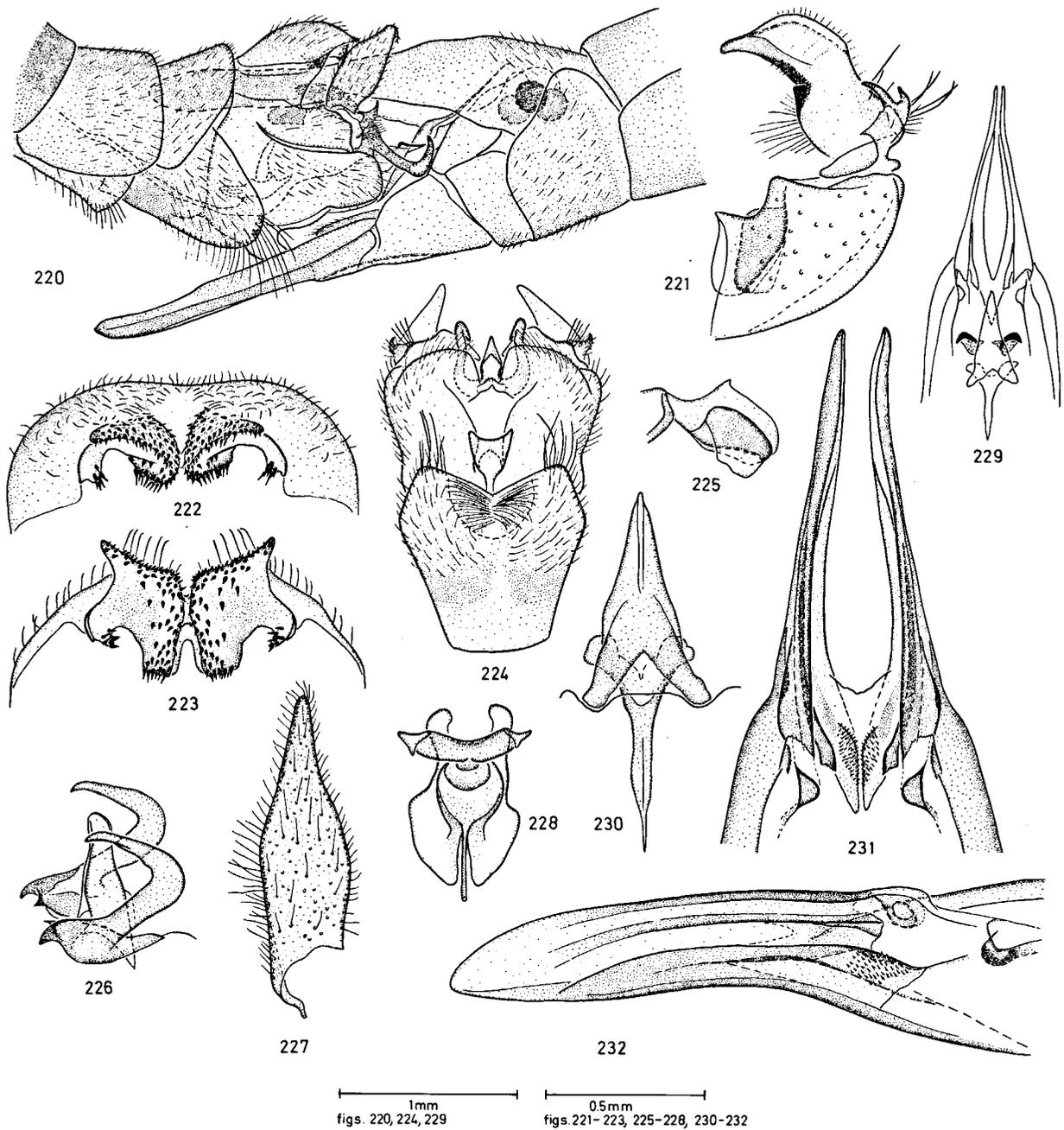
Thorax: Pronotum yellow; median parts of pronotum, prescutum and scutum 1 more or less subshining, remainder of thorax more distinctly polished. Stripes dark yellow to reddish-yellow. Transverse suture not to weakly tinted in the middle; antero-lateral corners of scutum 2 yellowish. Scutellum as well as markings on mediotergite transparently (dark) yellow; antero-median stripe on mediotergite more or less as broad as scutellum. Pleura completely yellow with slightly dark yellowish markings. Legs yellow, slightly darkened in apical direction. Metatarsi of middle and hind legs distinctly longer than corresponding tibiae. Tarsal claws untoothed. Wings hyaline-yellow, costal region (dark)yellow; pterostigma yellow to brown-yellow, usually without but sometimes with up to 15 macrotrichia; cell m1 varying from subsessile to long-petiolate.

Abdomen: Dorsal markings on tergites (1)2-7 ranging from rather distinct brown to largely obliterated; separate tergites usually with a more dark and narrow spot anteriorly and a broader and paler one posteriorly, some specimens with weakly indicated transverse banding along posterior margins. Tergites 2-6(7) on each side marked with one black-brown oblong dash and a more narrow and

pale, sometimes obliterated one anteriorly. Abdomen ventrally marked with oval to oblong black-brown spots on anterior parts of sternites 2-7, spots sometimes very small, sometimes tailed. No significant darkening of (sub)terminal segments.

Hypopygium: Hind margin of tergite 9 with rather shallow U-shaped median incision; posterior extension with slenderly pointed and abundantly black-spined caudo-lateral projections, on ventral side with broad and flat median and narrow lateral protrusions (figs. 222, 223). Outer dististyle fig. 227; inner dististyle with a narrowly extended crest, some long black hairs at basal bulge of the posterior margin, an angularly extended anterior part of the lateral shell and a bi-tipped lateral projection (fig. 221). Sp2 fig. 225. Hind margin of sternite 8 with indication of a moderately deep and rounded incision, passing into a thick membrane; this area abundantly set with medially directed yellow hairs (fig. 224). Membranous area on ventro-caudal surface of sternite 9 with small pubescent bulge at caudal end and a membranous, bi-tipped medisternal appendage (fig. 224); midventral extension of antecosta narrow and filmy. Adminiculum with slender, strongly upcurved gonapophyses, at base sclerotized and bulbous, anteriorly ending in two spines; median part cone-like (fig. 226). Semen pump fig. 228. Intromittent organ reaching into the fifth abdominal segment, hardly winding; length about 9.0 to 10.5 mm. Hypopygium about as broad as scutum 1 or slightly less or more.

Ovipositor: Cerci long, slender and slightly narrowed apically; hypovalvae parallel-sided, ending in a blunt point (fig. 232). Rostral extensions of hypovalvae each with a semicircular, disconnected sclerotized structure, sometimes very small; base of major ridge slightly thickened, internal shell only weakly and narrowly prolonged, no sclerotized internal arch (figs. 231, 232). Fused valvulae and furca slightly sclerotized, fig. 230. On level with and ventrally of fused valvulae are situated two, small and hollow sclerotized structures (fig. 229).



Figs. 220-232. *N. tenuis*; 221-228, ♂; 229-232, ♀. 220. copula, lateral view; 221. id, outside; 222. tergite nine, caudal view; 223. tergite nine, ventral view; 224. hypopygium, caudo-ventral view; 225. sp2, from inside; 226. adminiculum, lateral view; 227. od, outside; 228. semen pump, dorsal view; 229. hypovalvae, fused valvulae and furca, inside view; 230. fused valvulae and furca, dorsal view; 231. hypovalvae, dorsal view; 232. left hypovalva, inside.

Biology (diagram 12)

N. tenuis is a rather uncommon species, inhabiting partly shaded to more open situations such as flood-plain forests, mesophytic

woodlands, wet meadows or grasslands and thickets and low vegetation along swamp- and stream-margins (Alexander, 1919b; Dietz, 1921; Rogers, 1930, 1942; Byers, 1979). In the southern parts of the range the species can be

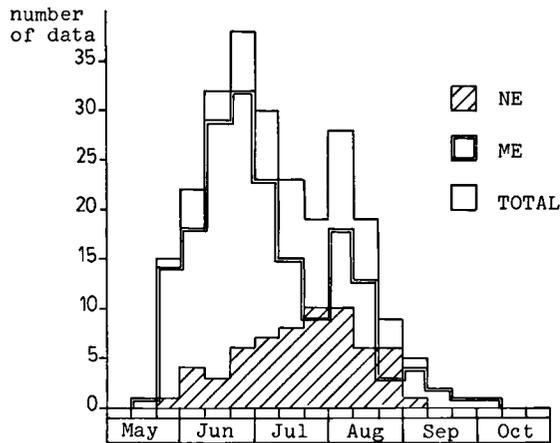
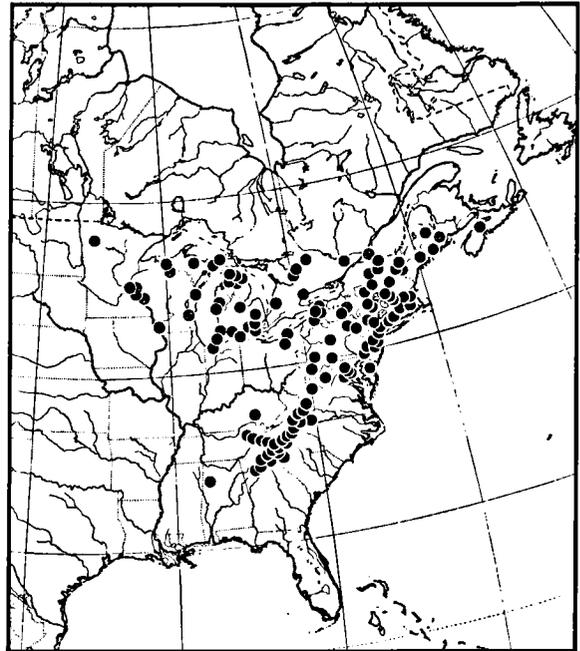


Diagram 12. Period of flight of *N. tenuis*.

found at altitudes up to 4500 feet (1370 m); there is one record of 6200 feet (1890 m) in the northern region (1♂, Mt. Washington, New Hampshire, VIII-7). The immature stages are unknown. The flight-period of *tenuis* ranges from mid-May to the first week of October (one record of X-3). In the northern part of the distribution-range there is one broad peak in July/August; in the other parts of the range two peaks are distinguishable, the largest one in the second half of June and a much smaller peak in the first week of August; this clearly points to two generations a year in this region (Rogers, 1942).

Distribution (map 18)

The range of *tenuis* covers largely the area mentioned in the literature (Alexander, 1942, 1965; Byers, 1979). From its northeastern limits, New Brunswick (mentioned by Alexander, 1919b, without further specification, omitted from the map), Nova Scotia (Kentville) and Maine (Hancock, Kennebec, Penobscot co's., supplemented by Washington Co. in Alexander, 1962), the range stretches westward to Wisconsin (Door Co., supplemented by Buffalo, St. Croix, Grant, Pierce, Vilas, Washington co's. in Dickinson, 1932) and Minnesota (Washington and Clearwater co's.). To the south *tenuis* is especially found in the mountainous areas of Virginia, Tennessee, North



Map 18. Distribution of *N. tenuis*, based on material examined (black dots) and literature (stippled dots).

and South Carolina and Georgia; the most southern locality is Fayette Co. in Alabama. Other specimens originated from the following localities and counties: Connecticut: Fairfield, New Haven, Tolland co's.; Delaware: not further specified; Georgia: Dawson, Lumpkin, Rabun, Union co's.; Indiana: La Porte Co.; Kentucky: Rockcastle Co.; Maryland: Montgomery, Pr. Georges co's.; Massachusetts: Franklin, Hampshire, Middlesex, Worcester co's.; Michigan: 20 counties; New Hampshire: Carroll, Coos, Grafton co's.; New Jersey: 7 counties; New York: 12 counties; North Carolina: 10 counties; Ohio: Lake Co., Summit Co.; Ontario: Huron Co. and Algonquin Park, Gull Lake (Muskoka Distr.), Kearney, Ottawa, Toronto; Pennsylvania: Centre, Fulton, Luzerne, Montgomery, Philadelphia, Sullivan, Westmoreland co's.; Quebec: East Baller (not located), supplemented by Chambly Co. (Alexander, 1929a); Rhode Island: Providence Co.; South Carolina: Greenville Co.; Tennessee: Great Smoky Mts. N.P. and Fentress, Knox, Morgan, Sevier co's.; Vermont: Bennington, Chittenden, Franklin, Windsor

co's.; Virginia: Arlington, Fairfax Co. and Bland, Giles, Grayson, Patrick, Smyth co's.; West Virginia: Hardy, Monroe, Pocahontas, Preston co's.

Nephrotoma penumbra Alexander, 1915

Figs. 233-245, map 19

Alexander, 1915b: 467-68, descr, 468, comp, pl. XVI fig 1, wing; Dietz, 1918: 109, key (as *Pachyrhina*); Alexander, 1919b: 826, distr, 829, biol, 935, key, pl. XLIV fig 205, wing; Alexander, 1919c: 11c, comp; Johnson, 1925: 34, loc; Alexander, 1934a: 117, biol, loc; Alexander, 1940a: 119, biol, note; Alexander, 1942: 223, key, 231, sh descr, distr; Alexander, 1962: 8, locs; Alexander, 1965: 22, distr; Byers, 1968: 402, comp.

As *Nephrotoma vittula*, presumably: Slosson, 1895: 320, loc (according to Alexander, 1940) (as *Pachyrhina*); Aldrich, 1905: 99, locs (partim; White Mts., N.H. = *penumbra*) (as *Pachyrhina*); Alexander, 1919b (partim): 782, 785, 826, locs.

Material examined

Type material: *Nephrotoma penumbra* Alexander, 1915, was described from 6 males: "Holotype, ♂, Halfway House, Mt. Washington, N.H.; July 6, 1914 (Johnson). Paratypes, 2♂'s, topotypic; 3♂'s, Mt. Washington, N.H. (Osten Sacken)." (Alexander, 1915b, p. 468). The holotype, condition fair, labelled: "Halfway H Mt W N H VII-6, 14" "HOLOTYPE *Nephrotoma penumbra* Alex." and two topotypic paratypes are preserved in the C.P. Alexander-collection, USNM. The three others paratypes were found neither here nor in the MCZ. There is one slide of a ♂-paratype in the Alexander-collection from "Halfway House, Mt Washington, N.H., July 6 1917", but the type-status of this specimen is dubious because the three above mentioned dated type-specimens are undamaged ("1917" probably erroneous). The statement in the original description that the type could be found in the collection of the Boston Society of Natural History and some paratypes in the MCZ, has caused the following confusion: All types from the B.S.N.H. were supposed to have been moved to the MCZ, but Byers (1961, in literis) only found a ♀ of *penumbra* here. In the

B.S.N.H.-collection 2 ♂♂ and 2 ♀♀ of *penumbra* were located and brought to the MCZ; the two ♂♂ with data exactly as the holotype but without type-labels were consequently but erroneously labelled 'Holotype' and 'Paratype' by Byers, MCZ type no. 30365, who did not know that C. P. Alexander had kept the real types in his own collection.

Other material: 55 ♂, 21 ♀, from the following states and provinces: British Columbia (3♂, 1♀), Maine (8♂), New Brunswick (4♂), Newfoundland (7♂, 8♀), New Hampshire (32♂, 12♀), Quebec (1♂).

Diagnostic features

In general appearance *N. penumbra* distinctly resembles *occipitalis*, *excelsior*, *oosterbroeki* and *vittula*, all species with more or less uniformly (dark) brown antennal flagella, a distinct occipital marking, a completely shining thorax and ventral abdominal markings. *N. penumbra* can be separated from *excelsior*, *oosterbroeki* and *vittula* by the number of antennal segments: 15 in ♂ and 14 (sometimes 15) in ♀ and the yellow-brown pterostigma, whereas *excelsior*, *oosterbroeki* and *vittula* all have 13-segmented antennae in both sexes and a dark brown pterostigma. Some differences between *penumbra* and *occipitalis* are the shape of the occipital marking (base not narrowed in *penumbra*, base distinctly narrowed in *occipitalis*), the narrow black dash on the anterior part of the paratergite, the blackened longitudinal band on the median thoracic stripe and the dark-bordered posterior margin of the mediotergite in *penumbra* (all usually indistinct or absent in *occipitalis*), the distinct hypopygial differences of the ♂ and the longer antennal verticils in ♀ of *penumbra* (up to 1.5 times length of segments; in *occipitalis* at most slightly exceeding length of segments).

Description

Body length: ♂ 12-13.5 mm, ♀ 14-18 mm.

Wing length: ♂ 11.5-13.5 mm, ♀ 12-15 mm.

Antennal length: ♂ 4.1- 5.0 mm, ♀ 2.6-3.1 mm.

Body colour dark yellow to orange-yellow.

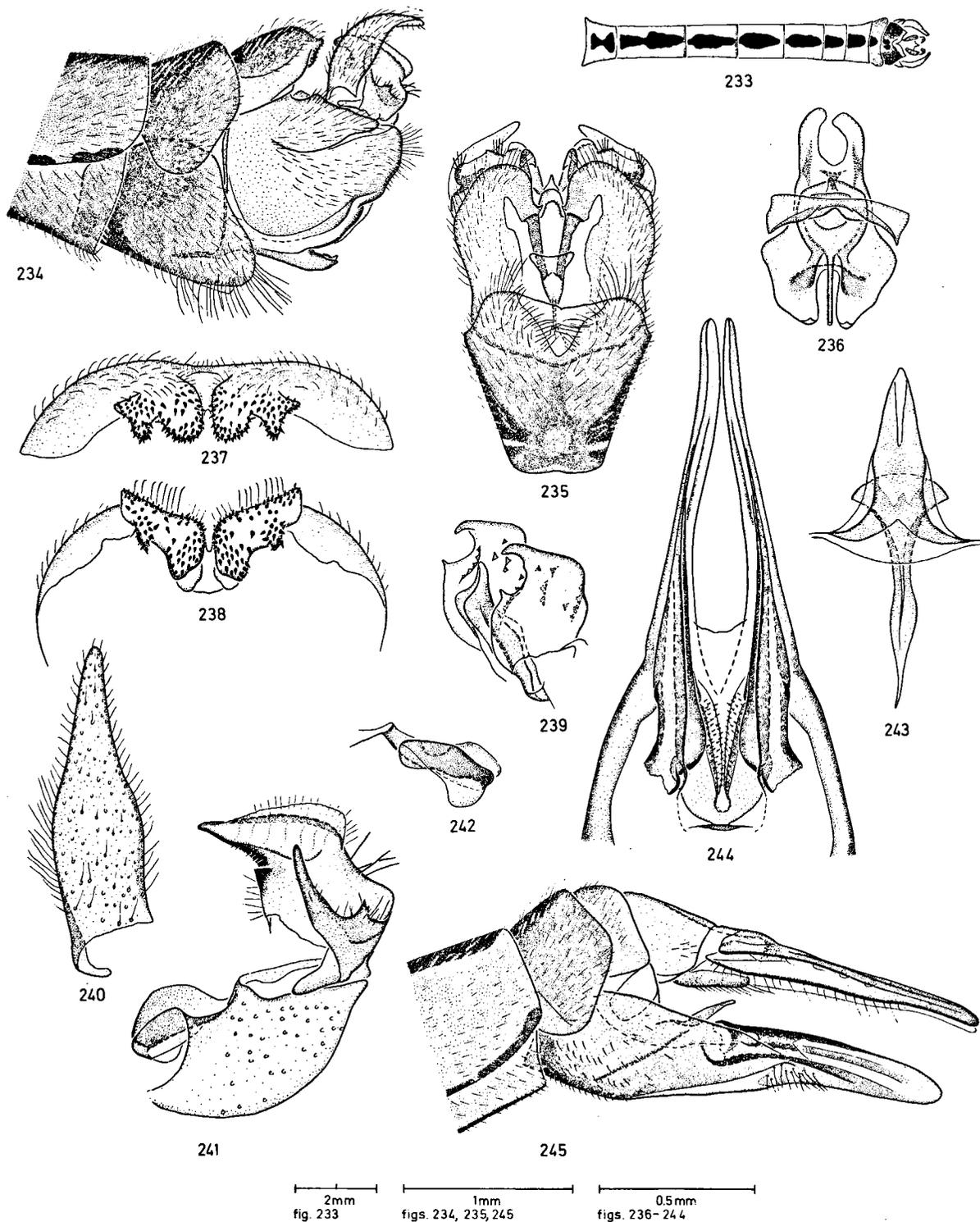
Head: Antennae of ♂ 15-segmented, flagellar segments 2 to 8/9 reniform; verticillar hairs reaching to about length of segments. Antennae of ♀ 14 to 15-segmented, flagellar segments two and following weakly thickened at base; longest verticillar hairs slightly to 1.5 times longer than segments. Scape yellowish, pedicel sordid yellow to brown, flagellum more or less uniformly brown to dark brown, sometimes basal nodes slightly darker. Sides of rostrum with light to dark brown ventral part; yellowish dorsal side frequently with two (dark) brown longitudinal spots. Palps with three dark brown basal segments and more yellowish-brown apical ones. Frons and tubercle opaque dark yellow with sometimes brownish spot between the antennal bases, remainder of head shining brownish-yellow; vertex with a triangular to bottle-shaped (dark) brown occipital marking, usually reaching to frontal tubercle; sometimes more faint brownish spots on antero-lateral parts of vertex and brown orbital spots along eye-margin. Postgenae frequently with a brown spot on both sides of neck-attachment.

Thorax: Median part of pronotum more or less opaque and vaguely tinted, remainder of thorax distinctly polished. Dark to brownish-yellow lateral parts of pronotum with dark brown posterior sides. Stripes brown to dark brown, median one usually with a blackened longitudinal stripe in the middle. Transverse suture distinctly (dark) brown tinted, antero-lateral corners of scutum 2 (dark) brown. Scutellum transparently light brown, usually with a narrow dark brown longitudinal line; mediotergite with a brown antero-median stripe and broad caudal spot, posterior margin distinctly dark brown bordered. Pleura dark yellow with brown to dark brown markings; anterior and posterior parts of paratergites marked with black-brown dashes; lateral parts of prescutum usually with a faint to distinct, oblique, brown line. Legs dark to brownish yellow, coxae with brown spots, femora and tibiae narrowly darkened apically, tarsi darkened. Tibiae of middle and hind legs of equal length or slightly longer than metatarsi. Tarsal

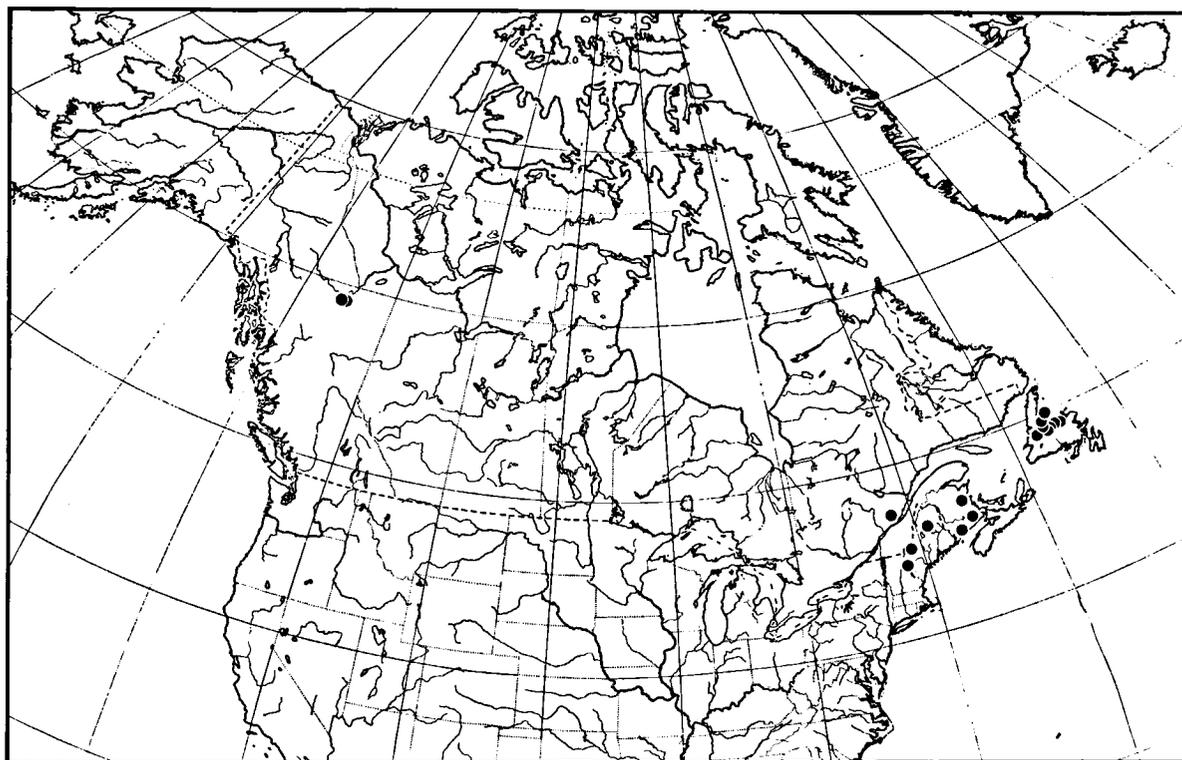
claws untoothed. Wings weakly infused with brown; costal region hyaline yellowish; pterostigma yellow-brown to brown, occasionally with some macrotrichia; cell m1 sessile to short-petiolate.

Abdomen: Dark brown dorsal stripe on tergites 1-8 in ♂ usually interrupted at posterior margins of tergites and about as broad as scutellum (fig. 233); in ♀ continuous and somewhat broader, spots frequently passing into narrow, transverse brown bands along posterior margins of tergites. Lateral markings on tergites (1) 2-7 dark brown, two dashes on each side of segment, anterior one usually smaller. Dark brown ventral stripe on sternites 2-7 in ♂ discontinuous with elongate, caudally fading spots, in ♀ nearly continuous. Tergites 8, 9 and basal part of sternite 8 in ♂ distinctly dark brown fuscous, in ♀ usually more weakly fuscous; remainder of (sub)terminal segments dark yellow to brown-yellow.

Hypopygium: Hind margin of tergite 9 with widely U-shaped incision; posterior extension with strongly pronounced lateral corners; caudal margin and ventral surface with distinct median and lateral protrusions set with black spines (figs. 237, 238). Outer dististyle fig. 240; crest of inner dististyle rather broad and basally bulbous, anterior part of lateral shell acutely tipped; lateral projection with a long, solid extension anteriorly and a much smaller one behind (fig. 241). Sp2 fig. 242. Hind margin of sternite 8 with rather shallow V-shaped incision (rarely deeper and reaching half length of sternite), closed by a thin membrane; some long yellowish hairs on caudo-lateral corners and along incision-margin (figs. 234, 235). Membranous area on ventro-caudal surface of sternite 9 with pubescent bulge caudally, narrow sclerotized lateral plates, small finger-like caudo-lateral offshoots; medisternal appendage distinctly extended and two-tipped (fig. 235); midventral extension of antecosta narrow and membranous. Adminiculum with strongly broadened gonapophyses, apically acutely curved and internally prickled; median part cone-like with slight thickenings on anterior side (fig. 239). Semen pump with distinctly bulging



Figs. 233-245. *N. penumbra*; 233-242, ♂; 243-245, ♀. 233. abdomen, dorsal view; 234. hypopygium, lateral view; 235. hypopygium, caudo-ventral view; 236. semen pump, dorsal view; 237. tergite nine, caudal view; 238. tergite nine, ventral view; 239. adminiculum, lateral view; 240. od, outside; 241. id, outside; 242. sp2, from inside; 243. fused valvulae and furca, dorsal view; 244. hypovalvae, dorsal view; 245. ovipositor, lateral view.



Map 19. Distribution of *N. penumbra*, based on material examined.

lateral appendages and long posterior ones (fig. 236). Intromittent organ weakly winding, reaching into fourth abdominal segment, length about 13 to 14.5 mm. Hypopygium nearly as broad as scutum 1.

Ovipositor: Cerci slightly narrowed in apical one-third; hypovalvae with slightly converging sides and rounded tips (fig. 245). Rostral extensions of hypovalvae shortly cut off; internal shell narrowly prolonged and upcurved; base of major ridge bulbous; spined area rather large (fig. 244). Details of fused valvulae and furca fig. 243.

Biology

N. penumbra is a boreal species known from northern British Columbia, the Atlantic Canadian provinces and the high mountains in the north-eastern USA, where specimens were found at altitudes from 3000 to 6000 feet (900-1830 m). Here the species can be very abundant, accord-

ing to Alexander (1934a) "the most common and characteristic crane-fly of the alpine summits of the Presidential Range" in New Hampshire. In Newfoundland *penumbra* was taken near small streams and in boggy areas. The larvae and pupae were found in cushions of *Diapensia lapponica* (a dwarf evergreen plant) on Mount Washington (Alexander, 1934a, 1940). The short flight-period ranges from the last week of June till the end of July.

Distribution (map 19)

The distribution-range of *penumbra* covers the northern Atlantic states and provinces from Newfoundland to New Hampshire, while the species is also known from two localities in northern British Columbia: 3♂ from Muncho Lake, 26, 27 and 28 June 1952 collected by C. P. Alexander and 1♀ from Toad River on Alaska Hwy, 30 July 1949 collected by E. K. Miller. The large gap in the distribution pattern

apparently is not due to insufficient exploration because from the intermediate region many other species are known from numerous localities. Furthermore a similar gap is found in some other species, such as *alterna* and *pedunculata*. The origin of the disjunction might well go back to the last (Wisconsin) continental glaciation. The other specimens originated from the following localities: Maine: Mt. Katahdin in Piscataquis Co., Oquossoc in Franklin Co.; New Brunswick: Chatham in Northumberland Co., Lepreau in St. Charlotte Co., Petitcodiac in Westmoreland Co.; Newfoundland: 2 mi N of Baie Verte Jct., Blue Pond picnic Area (not located), Notre Dame Camping Park (Notre Dame Bay), Buchans Road 14 mi from Badger, idem 3 mi from Badger, Trans Canada Hwy nr Indian River, 11 mi W of Indian R Camp, near Birchy Bay (NE shore), Hampden Jct., King's Point (NW of Springdale), Southbrook at Pasadena; 1♂ from Labrador, not further specified and not included on the map; New Hampshire: White Mountains and especially Mt. Washington in Coos Co., Quebec: Laurentides Park.

***Nephrotoma ramulifera* Tjeder, 1955**
Figs. 246-258, map 20

Introduction

N. ramulifera is a rare species, hitherto known only from six localities in the Palaearctic region; during this study some specimens from Alaska were discovered. Literature, description and attendant information for *ramulifera* were presented in Oosterbroek (1979c). Here only the nearctic material is considered.

Material examined

Type material: Tjeder (1955) described *Nephrotoma ramulifera* after a male holotype from Torne Lappmark, Jebrenjokk, 22.VII.1926 (O. Ringdahl leg.) and a female paratype from Torne Lappmark, Abisko, 9.VII.1920 (O. Ringdahl leg.), both preserved in the Zoologiska Institutionen, Avdelningen för Systematik, Lund, Sweden. The types were not

examined by me, but are known from detailed drawings by Tjeder (1978). The interpretation of *ramulifera* is further based on palaeartic material identified by Savchenko and Oosterbroek.

Other material: 4♂, 6♀ from Alaska.

Diagnostic features

In general appearance *ramulifera* mostly resembles *excelsior*, and to a lesser extent also *oosterbroeki* and *vittula*. The males of *ramulifera* are easily recognized by the hypopygial characters (especially the posterior extension of tergite 9 and the medisternal appendage of sternite 9) and the toothed tarsal claws; females are distinguished by the blackened tergite 10. Other diagnostic characters of *ramulifera* are: the yellow sides of the rostrum, the large opaque rostral part of the vertex, the usually infuscated spot below the anterior end of the lateral stripes on scutum 1, the broad anterior marking on the mediotergite, the (dark) brownish tinted anatergite and the extremely strong (sub)terminal darkening of the abdomen in both sexes.

Description

Body length: ♂ 12-13.5 mm, ♀ 17-18.5 mm.

Wing length: ♂ 12-13 mm, ♀ 14-15.5 mm.

Antennal length: ♂ 5.6-5.8 mm, ♀ 3.1-3.4 mm.

Body colour light yellow to yellow.

Head: Antennae of both sexes 13-segmented; in ♂ flagellar segments two and following slightly incised, verticillar hairs to 0.7 times length of segments; in ♀ flagellar segments slightly thickened basally, longest verticillar hairs to 1.5 times length of segments. Scape yellowish with brown spots, pedicel brown to dark brown, flagellum uniformly dark to black-brown. Rostrum shining yellow, dorsal surface with a large dark brown spot, nasus dark brown. Palps with basal and apical segments brownish-yellow, segments in between brown. Frons pale yellow, tubercle and largest rostral part of vertex opaque yellow, remainder of head shining yellow to pale yellow; vertex with a

large more or less triangular to bottle-shaped dark to black-brown occipital marking, reaching over frontal tubercle, about as broad as median part of pronotum; distinct dark brown orbital spots between eyes and tubercle, usually somewhat extended along eye-margins. Postgenae with a dark brown spot on each side of neck-attachment.

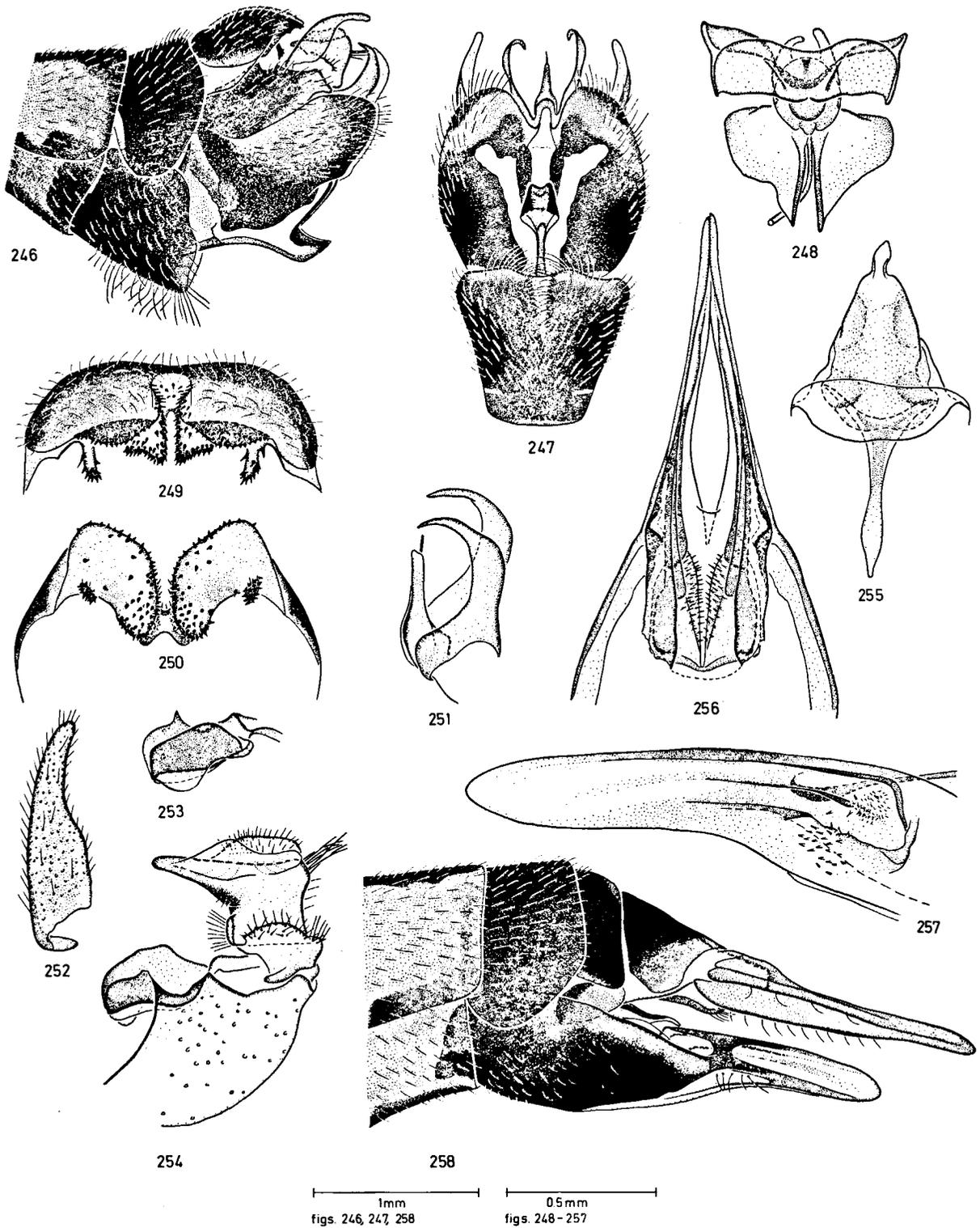
Thorax: Median part of pronotum subopaque yellow with usually a narrow brown band in the middle; lateral parts shining and completely dark brown. Remainder of thorax distinctly polished. Stripes black, rostral part of median one with slightly concave lateral margins and caudal part with converging sides; the lateral stripes on scutum 1 straight, usually shiningly infuscated below anterior ends, frequently giving stripes a downcurved appearance. Transverse suture (dark) brown tinted; anterolateral corners of scutum 2 subshining brown to dark brown. Scutellum transparently brownish with a dark brown stripe medially; dorsal side of mediotergite with a broad, caudally narrowing dark brown stripe, passing into the broad black-brown marking on posterior part. Pleura yellow to pale yellow with black-brown markings; posterior part of paratergite with a broad black-brown dash, katatergite blackened posteriorly, anatergite transparently (dark) brownish, caudally darker. Coxae with dark brown spots, trochanters dark yellowish, femora basally dark yellow, (dark) brown in apical half, tibiae and tarsi brown to dark brown, tips of segments more infuscated. Metatarsi of middle and hind legs usually slightly longer than corresponding tibiae. Tarsal claws of ♂ toothed. Wings hyaline-brownish with dark brown veins; pterostigma dark brown, usually with some macrotrichia, up to about 12; base of cells r3 and r4 + 5 (dark) brown shaded, apical part of cell r4 + 5 sometimes with some macrotrichia; wingtip with slightly brownish tinge; cell m1 sessile to short-petiolate.

Abdomen: Dorsal stripe on tergites 1-7 dark brown, about as broad as scutellum, continuous except where interrupted by yellow hind margin of tergite 1; hind margins of tergites

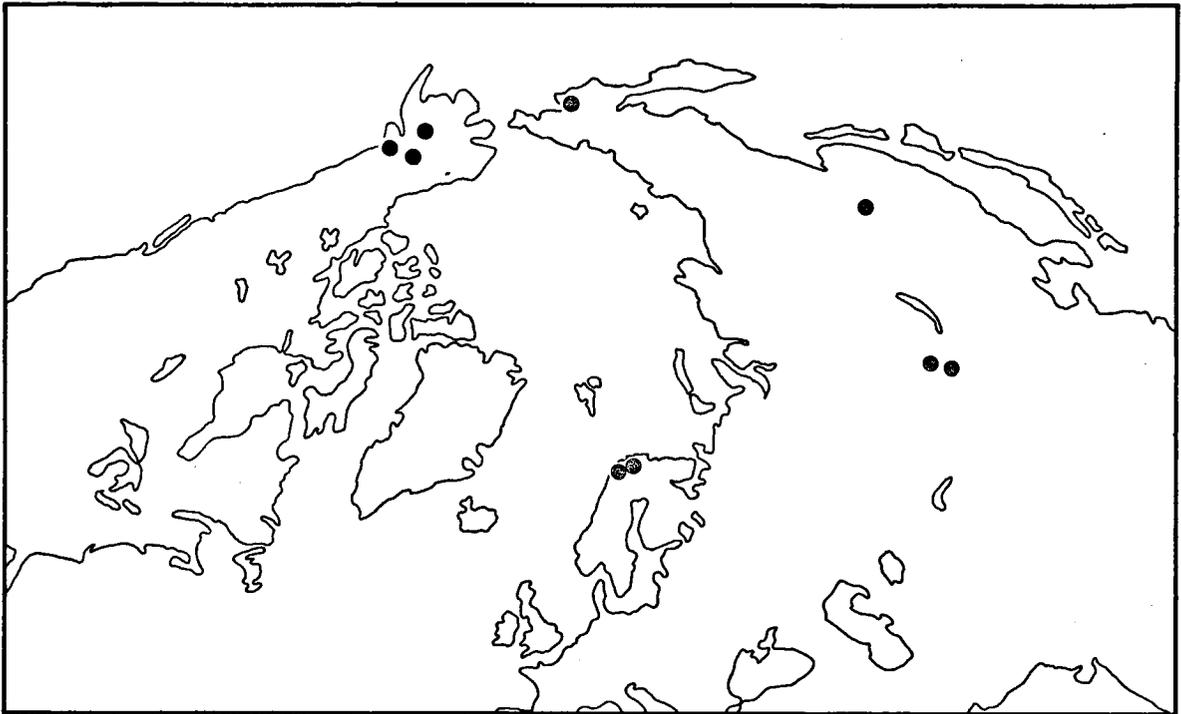
3-6(7) usually narrowly lined with dark brown; spot on tergite 1 about as broad as long. Lateral stripes on tergites 1-7 dark brown and more or less continuous. Dark brown ventral stripe on sternites 1-7 continuous, at most half as broad as dorsal stripe; hind margins of sternites usually lighter tinted. Both sexes with strong black-brown (sub)terminal colouring, in ♂ at segments 7 (largely), 8 and 9 (fig. 246), in ♀ at segment 8 and tergites 9 and 10 (fig. 258).

Hypopygium: Hind margin of tergite 9 with deep U-shaped incision; posterior extension deeply incised medially and with caudally extended lateral corners; caudal region set with black spines; ventral surface with slightly hollowed and black spined medial protrusions and pendent spiny rods laterally (figs. 249, 250). Outer dististyle fig. 252; crest of inner dististyle with a densely hairy inner lobe and a membranous outer lobe, posterior margin just beyond the crest with some long dark hairs, lateral projection ridge-like and densely set with brown bristles (fig. 254). Sp2 with a narrow and a flap-like transparent extension at base (fig. 253). Hind margin of sternite 8 with rather indistinct and narrow, but deep median incision, completely membrane-closed and lined with yellow hairs curved in medial direction (fig. 247). On ventro-caudal surface of sternite 9: two distinctly sclerotized lateral plates, a small sclerotized area inbetween, a stout and sclerotized bifid medisternal appendage, a distinct ventral stem and a membranous area with two broad and obtuse caudo-lateral offshoots (fig. 247); antecosta of sternite 9 with small narrow lateral extensions and midventrally a membranous tapering one. Adminiculum with flat dorsally curved and apically slender gonapophyses; median part cone-like with slender apical prolongation (fig. 251). Semen pump with a large bifid and broadly expanded compressor apodeme, lateral appendages wide and anteriorly pointed (fig. 248). Intromittent organ weakly winding, reaching into third abdominal segment, length about 12.2 to 13.1 mm. Hypopygium usually not as broad as scutum 1.

Ovipositor: Cerci slightly narrowed in apical



Figs. 246-258. *N. ramulifera*; 246-254, ♂; 255-258, ♀. 246. hypopygium, lateral view; 247. hypopygium, caudo-ventral view; 248. semen pump, dorsal view; 249. tergite nine, caudal view; 250. tergite nine, ventral view; 251. admiculum, lateral view; 252. od, outside; 253. sp2, from inside; 254. id, outside; 255. fused valvulae and furca, dorsal view; 256. hypovalvae, dorsal view; 257. left hypovalva, inside; 258. ovipositor, lateral view.



Map 20. Distribution of *N. ramulifera*, based on material examined (black dots) and Oosterbroek, 1979c (stippled dots).

one-third; hypovalvae parallel-sided with rounded tips and with a deep notch at lateral bases (fig. 258). Dorsal rim of hypovalvae broadened and extended at base, basal end of major ridge passing into a fine-spined thickening, just above this a rugose area, internal shell basally closed by an internal arch (figs. 256, 257). Fused valvulae and furca fig. 255. Spermathecae oval-shaped.

Biology

Some palaeartic specimens of *ramulifera* were collected on alpine tundra and mountain steppe, at altitudes up to 6900 feet (2100 m). Some nearctic specimens were collected on tundra-vegetation at altitudes up to 3400 feet (1040 m). The records of the nearctic *ramulifera* are from June 10 till July 15.

Distribution (map 20)

The known localities, though few and widely scattered, do warrant the conclusion that the

area of *ramulifera* presumably includes the whole northern part of the Holarctic region. The nearctic specimens originated from the following localities in Alaska: 1♂ Keystone Canyon (5 mi W of Valdez); 1♂ Alaska Hwy mile 1395 Little Gerstle River (near Dot Lake); 2♂, 6♀ from McKinley Nat. Park (1♂ MP 68 Muldrow Glacier, 1♀ Polychrome Pass, 1♀ Teklanika River, 2♀ Teklanika Camp, 1♂ 2♀ not further specified).

ACKNOWLEDGEMENTS

First of all I want to express my thanks to George W. Byers (University of Kansas, Lawrence) and Pjotr Oosterbroek (Zoölogisch Museum, Amsterdam) for the help received in many ways, especially in providing facilities, valuable advice, critical discussion and encouragement. For the opportunity to study material and for the loan of specimens I wish to thank the curators of the Institutions mentioned under 'Material' (p. 112), especially D. Otte

(ANSP), P. H. Arnaud (CAS), R. J. McGinley (MCZ) and W. N. Mathis and his staff, among others for the kind permission to study the C. P. Alexander-collection (USNM). Furthermore I am much indebted to J. P. Duffels and Th. van Leeuwen (Amsterdam) for their stimulating interest in my work and their comments on the manuscript.

The investigations were supported by the Foundation for Fundamental Biological Research (BION), which is subsidized by the Netherlands Organization for the Advancement of Pure Research (ZWO).

A grant, which enabled the publication of this revision was thankfully received from the Uyttenboogaart-Eliassen Foundation (Amsterdam).

REFERENCES

- The following list of references refers to both part I and part II of this revision.
- ALDRICH, J. M., 1905. A catalogue of North American Diptera. *Smithson. misc. Collns*, **46**: 1-680.
- ALEXANDER, C. P., 1910. Fulton County (New York) Tipulidae, 1. *Ent. News*, **21**: 247-254.
- , 1915a. A biological reconnaissance of the Okefenokee Swamp in Georgia. *The Tipulidae (Diptera)*. *Wash. Univ. Stud. scient. Ser.*, **2**: 97-98.
- , 1915b. New or little-known Crane-flies from the United States and Canada: Tipulidae, Diptera, Part 2. *Proc. Acad. nat. Sci. Philad.*, **67**: 458-514.
- , 1919a. New nearctic Crane-flies (Rhyphidae and Tipulidae, Diptera) Part 7. *Can. Ent.*, **51**: 162-172, 191-199.
- , 1919b. The Crane-flies of New York. Part 1, Distribution and taxonomy of the adult flies. *Mem. Cornell Univ. agric. Exp. Stn*, **25**: 763-993.
- , 1919c. The Crane-flies collected by the Canadian Arctic Expedition, 1913-1918. In: Anderson, R. M. (Ed.), *Report of the Canadian Arctic Expedition 1913-18, Vol. 3: Insects, Part C: Diptera*: 3-30.
- , 1920a. The Crane-flies of New York. Part 2, Biology and phylogeny. *Mem. Cornell Univ. agric. Exp. Stn*, **38**: 699-1133.
- , 1920b. New nearctic Crane-flies (Tipulidae, Diptera). Part 9. *Can. Ent.*, **52**: 109-112.
- , 1922. The Crane-flies of New York: first supplementary list. *Bull. Brooklyn ent. Soc.*, **17**: 58-62.
- , 1924. The Crane-flies of New York: second supplementary list. *Bull. Brooklyn ent. Soc.*, **19**: 57-64.
- , 1925a. Studies on the Crane-flies of Mexico. Part 1. (Order Diptera, Superfamily Tipuloidea). *Ann. ent. Soc. Am.*, **18**: 341-362.
- , 1925b. The Crane-flies (Tipulidae) of New England: first supplementary list. *Occ. Pap. Boston Soc. nat. Hist.*, **5**: 169-174.
- , 1926. Records of Crane-flies (Tipulidae) from Ontario (Diptera). *Can. Ent.*, **58**: 236-240.
- , 1927a. The Crane-flies (Tipulidae) of New England: second supplementary list. *Occ. Pap. Boston Soc. nat. Hist.*, **5**: 223-231.
- , 1927b. Records and descriptions of Crane-flies from Alberta (Tipulidae, Diptera). 1. *Can. Ent.*, **59**: 214-225.
- , 1928. Records of Crane-flies (Tipulidae) from Ontario (Diptera). Part 2. *Can. Ent.*, **60**: 54-60.
- , 1929a. A list of the Crane-flies of Quebec (Diptera). 1. *Can. Ent.*, **61**: 231-236, 247-251.
- , 1929b. The Crane-flies of New York: third supplementary list. *Bull. Brooklyn ent. Soc.*, **24**: 22-29.
- , 1929c. The Crane-flies of New York: fourth supplementary list. *Bull. Brooklyn ent. Soc.*, **24**: 295-302.
- , 1930. The Crane-flies (Tipulidae) of New England: third supplementary list. *Occ. Pap. Boston Soc. nat. Hist.*, **5**: 267-278.
- , 1931a. A list of the Crane-flies of Quebec. 2. *Can. Ent.*, **63**: 135-147.
- , 1931b. Deutsche Limnologische Sunda-Expedition. The Crane-flies (Tipulidae, Diptera). *Arch. Hydrobiol., suppl.* **9**(2): 135-191.
- , 1934a. Notes on some uncommon Crane-flies from the White Mountains, New Hampshire. *Can. Ent.*, **66**: 116-118.
- , 1934b. The exploration of Southampton Island, Hudson Bay by George Miksch Sutton, sponsored by Mr. John Bonner Semple 1929-1930. Part II. *Zoology. Sect. 4. Spiders and insects (in part) of Southampton Island. II. Diptera collected on Southampton Island by George Miksch Sutton. Trichoceridae and Tipulidae. Mem. Carneg. Mus.*, **12**(2, 4): 3-10.
- , 1936. The Crane-flies (Tipulidae) of New England: fourth supplementary list. *Occ. Pap. Boston Soc. nat. Hist.*, **8**: 273-292.
- , 1940a. The Presidential Range of New Hampshire as a biological environment, with particular references to the insects. *Am. Midl. Nat.*, **24**: 104-132.
- , 1940b. Records and descriptions of North American Crane-flies (Diptera), 1, Tipuloidea of the Great Smoky Mountains National Park, Tennessee. *Am. Midl. Nat.*, **24**: 602-644.
- , 1941. Records and descriptions of North American Crane-flies (Diptera), 2, Tipuloidea of Mountainous Western North Carolina. *Am. Midl. Nat.*, **26**: 281-319.
- , 1942. Guide to the insects of Connecticut, 6, The Diptera or true flies of Connecticut, First fascicle,

- Family Tipulidae. Bull. Conn. St. geol. nat. Hist. Surv., 64: 196-486.
- , 1943a. Records and descriptions of North American Crane-flies (Diptera), 3, Tipuloidea of the Upper Gunnison Valley, Colorado. Am. Midl. Nat., 29: 147-179.
- , 1943b. Records and descriptions of North American Crane-flies (Diptera), 4, Tipuloidea of the Yellowstone National Park. Am. Midl. Nat., 30: 718-764.
- , 1945. Records and descriptions of North American Crane-flies (Diptera), 5, Tipuloidea of the Grand Teton National Park and Teton National Forest, Wyoming. Am. Midl. Nat., 33: 391-439.
- , 1946. Records and descriptions of North American Crane-flies (Diptera), 6, Tipuloidea of Arizona, New Mexico and Trans-Pecos Texas, 1. Am. Midl. Nat., 35: 484-531.
- , 1947. New or little-known Crane-flies from California (Tipulidae, Diptera), 3. Bull. Sth. Calif. Acad. Sci., 46: 35-50.
- , 1948. Records and descriptions of North American Crane-flies (Diptera), 7, The Tipuloidea of Utah, 1. Am. Midl. Nat., 39: 1-82.
- , 1949a. Records and descriptions of North American Crane-flies (Diptera), 8, The Tipuloidea of Washington, 1. Am. Midl. Nat., 42: 257-333.
- , 1949b. New or insufficiently-known Crane-flies from the Nearctic region (Diptera, Tipulidae), Part 10. Bull. Brooklyn ent. Soc., 44: 98-104.
- , 1953. Records and descriptions of Neotropical Crane-flies (Diptera, Tipulidae), 27. J. N.Y. ent. Soc., 61: 147-157.
- , 1954. Records and descriptions of North American Crane-flies (Diptera), 9, The Tipuloidea of Oregon, 1. Am. Midl. Nat., 51: 1-86.
- , 1962. The Crane-flies of Maine. Bull. Me agric. Exp. Stn, T4: 1-24.
- , 1965. Tipulidae. In: Stone, A. et al. (Eds), A catalogue of the Diptera of America north of Mexico. U.S. Dept. Agric. Handb., 276: 15-90.
- , 1967. The Crane-flies of California. Bull. Calif. Ins. Surv., 8: 1-269.
- ALEXANDER, C. P. & M. M. ALEXANDER, 1970. A catalogue of the Diptera of the Americas south of the United States, 4, Tipulidae: 1-259 (Museu de Zoologia, Universidade de Sao Paolo).
- ALEXANDER, C. P. & G. W. BYERS, 1981. Tipuloidea. In: McAlpine, J. F. et al. (Eds), Manual of Nearctic Diptera, Vol. 1: 153-190 (Biosyst. Res. Inst. Monograph 27, Ottawa).
- ALEXANDER, C. P. & W. L. McATEE, 1920. Diptera of the Superfamily Tipuloidea found in the District of Columbia. Proc. U.S. nat. Mus., 58: 385-435.
- BELLARDI, L., 1859. Saggio di ditterologia messicana, Part 1: 1-80 (Torino).
- BERGROTH, E., 1888a. Ueber einige nordamerikanische Tipuliden, I. Wien. ent. Ztg., 7: 193-201.
- , 1888b. Ueber einige nordamerikanische Tipuliden, II. Wien. ent. Ztg., 7: 239-240.
- BRIMLEY, C. S., 1938. The insects of North Carolina: 1-560 (N.C. Dept. Agric., Raleigh).
- BYERS, G. W., 1963. Type specimens of North American Tipulidae (Diptera) described by Francis Walker. J. Kans. ent. Soc., 36: 146-161.
- , 1968. Two new species of Nearctic Nephrotoma (Diptera: Tipulidae). J. Kans. ent. Soc., 41: 395-403.
- , 1976. Type specimens of Tipulidae described by R. W. Doane in the collection of the California Academy of Sciences. Occ. Pap. Calif. Acad. Sci., 124: 1-51.
- , 1979. Summer Crane-flies of Lake Itasca vicinity, Minnesota. Univ. Kans. Sci. Bull., 51: 603-613.
- COLE, F. R., 1969. The flies of Western North America: 1-693 (Univ. Calif., Berkeley).
- DICKINSON, W. E., 1932. The Crane-flies of Wisconsin. Bull. publ. Mus. Milwaukee, 8: 139-266.
- DIETZ, W. G., 1918. A revision of the North American species of the tipulid genus Pachyrhina Macquart, with descriptions of new species (Diptera). Trans. Am. ent. Soc., 44: 105-140.
- , 1921. A list of the Crane-flies taken in the vicinity of Hazleton, Pennsylvania (Diptera). Trans. Am. ent. Soc., 47: 233-268.
- DOANE, R. W., 1908. New North American Pachyrhina, with a table for determining the species. Ent. News, 19: 173-179.
- DUZEE, M. C. VAN, 1911. A list of Diptera taken at Kearney, Ontario, in July, 1909. Can. Ent., 43: 237-244.
- ERIKSON, G. E., 1940. The tipulid prey of a crabronid. Bull. Brooklyn ent. Soc., 35: 172.
- FABRICIUS, J. C., 1781. Species insectorum exhibentes eorum differentias specificas, synonyma, auctorum, loca natalia, metamorphosin, 2: 1-517 (C. N. Bohn, Hamburgi & Kilonii).
- , 1805. Systema antliatorum secundum ordines, genera, species: 1-373 + 30 (C. Reichard, Brunsvigae).
- FOOTE, B. A., 1956. A preliminary survey of the Crane-flies of Delaware County, Ohio (Diptera, Tipuloidea). Ohio J. Sci., 56: 217-229.
- FROMMER, S. I., 1963. Gross morphological studies of the reproductive system in representative North American Crane-flies (Diptera: Tipulidae). Univ. Kans. Sci. Bull., 44: 535-626.
- GELHAUS, J. K., 1982. New records and distributional notes for Kansas Crane-flies, excluding Limonia (Diptera: Tipulidae). Techn. Pap. St. Biol. Surv. Kansas, 12: 70-88.
- HART, C. A., 1895. On the entomology of the Illinois river and adjacent waters. Bull. Ill. St. Lab. nat. Hist., 4: 149-273.
- HENDEL, F., 1908. Nouvelle classification des Mouches à

- deux ailes (Diptera L.). D'après un plan tout nouveau par J. G. Meigen, Paris, an VIII (1800 v.s.). Verh. zool.-bot. Ges. Wien, **58**: 43-69.
- HENNIG, W., 1973. Diptera (Zweiflüger). In: W. Kükenthal, Handbuch der Zoologie, **4**: (2)/31, Lief. 20: 1-337.
- JOHANNSEN, O. A., 1903. Notes on some Adirondack Diptera collected by Messrs. MacGillivray and Houghton. Ent. News, **14**: 14-17.
- JOHNSON, C. W., 1895. Diptera of Florida. Proc. Acad. nat. Sci. Philad., **1895**: 303-340.
- , 1903. Diptera of Beulah, New Mexico. Trans. Am. ent. Soc., **29**: 101-106.
- , 1913. Insects of Florida, 1, Diptera. Bull. Am. Mus. nat. Hist., **32**: 37-90.
- , 1925. Fauna of New England. 15. List of the Diptera or two-winged flies. Occ. Pap. Boston Soc. nat. Hist., **7** (15): 1-326.
- LEONARD, M. D., 1928. A list of insects of New York with a list of the spiders and certain other allied groups. Mem. Cornell Univ. agric. Exp. Stn, **101**: 1-1121. (Tipuloidea, pp. 688-701).
- LINNAEUS, C., 1758. Systema naturae per regna tria naturae. 10th ed., 1: 1-824 (L. Salv., Holmiae).
- LOEW, H., 1863. Diptera Americae septentrionalis indigena. Centuria quarta. Berl. ent. Z., **7**: 275-326.
- , 1864. Diptera Americae septentrionalis indigena. Centuria quinta. Berl. ent. Z., **8**: 49-104.
- , 1879. Analytische Tabelle zum Bestimmen der nord-amerikanischen Arten der Tipuliden-Gattung Pachyrhina. Verh. zool.-bot. Ges. Wien, **29**: 513-516.
- MACQUART, J., 1834. Histoire naturelle des Insectes. Diptères, Tome premier. Diptera. 1: 1-578, 12 pls (Collections des suites à Buffon, Roret, Paris).
- , 1838. Diptères exotiques nouveaux ou peu connus, Vol. 1, Part 1: 1-221 (Paris).
- , 1850. Diptères exotiques nouveaux ou peu connus, suppl. 4. Mém. Soc. Sci. Agric. Lille, **1849**: 309-465.
- MALLOCH, J. R., 1917. A preliminary classification of Diptera, exclusive of Pupipara, based upon larval and pupal characters, with keys to imagines in certain families. Part 1. Bull. Ill. St. Lab. nat. Hist., **12**(3): 161-409.
- MANNHEIMS, B., 1962. Zur Synonymie der Europäischen Tipuliden (Dipt.), **7**. Bonn. zool. Beitr., **13**: 193-195.
- MANNHEIMS, B. & E. PECHLANER, 1963. Die Tipuliden Nordtirols (Dipt.). Stuttg. Beitr. Naturk., **102**: 1-29.
- MCALPINE, J. F., 1981. Morphology and terminology. In: McAlpine, J. F. et al. (Eds), Manual of Nearctic Diptera, Vol. 1: 9-63 (Biosyst. Res. Inst. Monograph 27, Ottawa).
- McGILLIVRAY, A. D. & C. O. HOUGHTON, 1903. A list of Insects taken in the Adirondack Mountains, New York. II. Ent. News, **14**: 12-13.
- MEIGEN, J. W., 1800. Nouvelle classification des mouches à deux ailes (Diptera L.) d'après un plan tout nouveau: 1-40 (Paris). (See for fascimile reproduction Hemming, F., 1945, Internl. Comm. zool. Nomencl., Bull. zool. Nomencl., **1**: 119-160).
- , 1803. Versuch einer neuen Gattungseintheilung der europäischen zweiflügeligen Insecten. Magazin Insektenk. Illiger, **2**: 259-281.
- , 1818. Systematische Beschreibung der bekannten europäischen zweiflügeligen Insekten. 1: i-xxxvi, 1-333, pls 1-11 (F. W. Fostmann, Aachen).
- NEUMANN, H., 1958. Der Bau und die Funktion der männlichen Genitalapparate von *Trichocera annulata* Meig. und *Tipula paludosa* Meig. Dt. ent. Z., Neue Folge, Band **5**: 235-298.
- NIELSEN, J. C., 1907. The insects of East-Greenland. Medd. Grønland, **29**: 363-404.
- OOSTERBROEK, P., 1978. The western palaeartic species of *Nephrotoma* Meigen, 1803 (Diptera, Tipulidae) Part 1. Beaufortia, **27**: 1-137.
- , 1979a. idem, Part 2. Beaufortia, **28**: 57-111.
- , 1979b. idem, Part 3. Beaufortia, **28**: 157-203.
- , 1979c. idem, Part 4, including a key to the species. Beaufortia, **29**: 129-197.
- , 1980. idem, Part 5, Phylogeny and Biogeography. Beaufortia, **29**: 311-393.
- , in preparation. A revision of the Crane Fly Genus *Nephrotoma* Meigen, 1803, in North America (Diptera, Tipulidae). Part II: The non-dorsalis species-groups.
- OOSTERBROEK, P., R. SCHUCKARD & BR. THEOWALD, 1976. Die *Nephrotoma*-Verbreitung in der Welt (Diptera, Tipulidae). Bull. zool. Mus. Univ. Amsterdam, **5**: 111-123.
- OSTEN SACKEN, C. R., 1877. Western Diptera: Descriptions of new genera and species of Diptera from the region west of the Mississippi and especially from California. Bull. U.S. geol. geogr. Surv. Territ., **3**: 189-354.
- , 1878. Catalogue of the described Diptera of North America. Smithson. misc. Collns, **16**: 1-276.
- , 1886. Diptera, Vol. 1. In: Godman, F. D. & O. Salvin (Eds), Biologia Centrali-Americana. Insecta: I-VIII, 1-216 (London).
- PROCTER, W., 1938. Biological survey of the Mount Desert Region, 4, The insect fauna with references to methods of capture, food plants, the flora and other biological features: 1-496.
- REES, B. E. & G. F. FERRIS, 1939. The morphology of *Tipula reesi* Alexander (Diptera, Tipulidae). Microentomology, **4**: 143-178.
- ROGERS, J. S., 1918. A collection of Tipulidae from Schoolcraft County, Michigan. Occ. Pap. Mus. Zool. Univ. Mich., **55**: 1-4.
- , 1926. Some notes on the feeding habits of adult Crane-flies. Fla. Ent., **10**: 5-7.
- , 1930. The summer Crane-fly fauna of the Cumberland Plateau in Tennessee. Occ. Pap. Mus. Zool. Univ. Mich., **215**: 1-50.

- , 1933. The ecological distribution of the Crane-flies of Northern Florida. *Ecol. Monogr.*, **3**: 1-74.
- , 1942. The Crane-flies (Tipulidae) of the George Reserve, Michigan. *Misc. Publ. Mus. Zool. Univ. Mich.*, **53**: 1-128.
- SAVCHENKO, E. N., 1973. Tipulidae. *Fauna SSSR*, (n.s.), **105** (Diptera, 2) (5): 1-281 (Russian, date of manuscript: 1965).
- SAY, T., 1823. Descriptions of dipterous insects of the United States. *J. Acad. nat. Sci. Philad.*, **3**: 9-54, 73-104.
- SLOSSON, A. T., 1897. Additional list of insects taken in alpine region of Mt. Washington. *Ent. News*, **8**: 237-240.
- , 1898. Additional list of insects taken in alpine region of Mt. Washington. *Ent. News*, **9**: 251-253.
- , 1900. Additional list of insects taken in alpine region of Mt. Washington. *Ent. News*, **11**: 319-323.
- SNODGRASS, R. E., 1904. The hypopygium of the Tipulidae. *Trans. Am. ent. Soc.*, **30**: 179-235.
- STONE, A., 1980. History of Nearctic Dipterology. In: Griffiths, G. C. D. (Ed.): *Flies of the Nearctic Region*, **1**: i-xiii, 1-62.
- TJEDER, B., 1955. Five new Swedish Crane-flies (Diptera, Tipulidae). Preliminary descriptions. *Opusc. ent.*, **20**: 225-227.
- , 1978. Ptychopteridae and Tipulidae (Cylindrotominae and Tipulinae) from the Abisko Area, Torne Lappmark, Sweden (Ins.: Diptera). *Fauna Norrlandica*, **9**: 1-14.
- TUCKER, E. S., 1907. Contributions towards a catalogue of the insects of Kansas. *Trans. Kans. Acad. Sci.*, **20**: 190-201.
- , 1909a. Additional results of collecting insects in Kansas and Colorado. *Trans. Kans. Acad. Sci.*, **22**: 276-304.
- , 1909b. Supplementary additions to the list of Kansas Diptera. *Trans. Kans. Acad. Sci.*, **22**: 306-307.
- WALKER, F., 1848. List of specimens of dipterous insects in the collection of the British Museum, Vol. 1: 1-229 (London).
- WESTWOOD, J. O., 1840. An introduction to the modern classification of insects. Synopsis of genera of British insects. Order 13. Diptera: 125-158 (London).
- WIEDEMANN, C. R. W., 1821. *Diptera exotica* (Ed. 2): i-xix, 1-244 (Kiliae).
- , 1828. *Aussereuropäischen zweiflügelige Insekten*. 1: i-xxxii, 1-608 (Hamm).
- WILLISTON, S. W., 1893. New or little-known Diptera. *Kans. Univ. Quart.*, **2**: 59-78.
- , 1900. Supplement. In: Godman, F. D. & O. Salvin (Eds), *Biologia Centrali-Americana. Insecta*: 217-248 (London).
- WINN, A. F. & G. BEAULIEU, 1932. A preliminary list of the insects of the province of Quebec. Part 2, Diptera. Revised and supplemented by C. E. Petch & J. B. Maltais. 24th Rep. Quebec Soc. Prot. Plants, 1932, Supplement, 1-100.
- YOUNG, C. W., 1978. Comparison of the Crane-flies (Diptera: Tipulidae) of two woodlands in eastern Kansas, with a key to the adult Crane-flies of eastern Kansas. *Univ. Kans. Sci. Bull.*, **51**: 407-440.
- ZIMSEN, E., 1964. The type material of J. C. Fabricius: 1-656 (Munksgaard, Copenhagen).

Received: May 16, 1983.