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THE TABANIDAE OF NEW YORK
By L. L. Pechuman, Ph.D.

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WARREN ARCHER MATTHEWS

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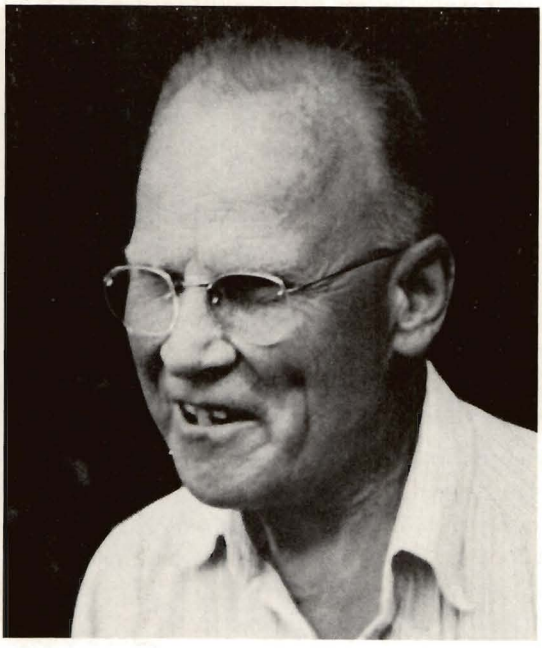
MAY 9, 1887—JANUARY 9, 1956



WARREN ARCHER MATTHEWS—1887–1956

Forty years a member of the Rochester Academy of Science, Warren Matthews was active in both our old and the new Botany Sections. With an engrossing interest in plant life and a highschool education in his birthplace, Pittsford, New York, as a background, he taught himself many facets of the science of botany. He achieved a proficiency seldom reached by a layman and maintained an enthusiasm seldom surpassed by the professional scientist. The fact that his major interest lay in the finding and identification of those most difficult and exacting groups, the grasses and sedges, bears out the relish with which he met the taxonomic challenge he set for himself. The Academy is fortunate in having been able to publish his fine paper: The Cyperacae of Monroe and Adjacent Counties, New York (Volume 10, Numbers 1-2, 1953).

A man's most fitting monument is the one he himself builds during his lifetime. And this paper can certainly be looked upon as the base. But the botanical storehouse he made of the top floor in his house must

be considered too. Here, in systematically arranged, homemade drawers, he collected and identified thousands of herbarium specimens which he had gathered and also obtained by exchange from all part of the world. He had the finest personal collection in this part of the country. Mrs. Matthews has graciously presented it to the Academy.

Warren Matthews loved plants. Moreover, he sought the company of botanical associates. He alone of the older group of Rochester botanists joined the younger Section formed in the 1940's. To it he brought a rich, unassuming knowledge, generous counsel, unruffled calm and unfailing good humor. His advice on field trips was constantly sought. He had an uncanny memory for the stations where rare orchids and ferns, the Twinleaf, *Trollius,* and the Stemmed White Violet could be found and, for such was his enjoyment of Nature's largesse, the spots for the best blueberries.

He was undaunted by rigorous ecological studies. Although somewhat handicapped physically, he was ever present when there was work to be done in the Washington Grove project of the Botany Section. In the Academy's herbarium, housed at the University of Rochester, he spent long hours revising the checklist of the plants of Monroe County (still incomplete). He culled many old collections for valuable specimens and painstakingly saw to their preservation.

So, to the scientific columns of his monument must be added his status as a friend and true gentleman. And it goes without saying that he was a beloved family man. His wife and children shared his trips, picnics and home-laboratory work with enthusiasm. He had many gardening ventures and during the war the family participated in an extensive vegetable-growing project on the old family farm.

A monument evokes memories. Many people will remember Warren Matthews crouching over a clump of sedge as he quietly points out characteristics for a companion to whom he has lent his magnifier. Or they will recall lively Section discussions as he displays herbarium sheets garnered from the Gaspé. Many will see his quizzical face while he decides that some herbarium specimen must be discarded for lack of data. Others will relive work in the Washington Grove and watch him again measuring cover under a huge black oak. Some will hear once more his accurate directions for locating a rare plant. Or they will smile when they see him crawling under a tangle of blueberry bushes with the same alacrity and anticipation at 60 as at 20. A few will remember his undefeated spirit as his excited face and lively head of rusty hair bobbed over bright blue pajamas in the bed from which he directed his new plumbing supply business (founded after "retirement") to the end of his life. His thirst for knowledge, his calm disposition, and his gentle love of living and people will never be erased from the memories of his family, friends and associates.

B. B. C., H. L. G.

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THE TABANIDAE OF NEW YORK

A DISTRIBUTIONAL STUDY

by

L. L. PECHUMAN, PH.D.

INTRODUCTION

This paper is based on records and notes accumulated during the past 25 years and which have been brought together when other duties permitted.

No account of New York State Tabanidae has been published although there have been some regional lists and papers dealing with the biologies and economic importance of a relatively few species. The present publication is primarily intended to make available in brief form our present knowledge of the distribution and habits of the various species of Tabanidae in New York with keys for their determination. No attempt is made to give detailed taxonomic descriptions of species. The reader will find most of these in the excellent papers of Brennan (1935) and Stone (1938). For a list of the nearctic species he is referred to Philip (1947 and 1950).

The first paper of importance on New York Tabanidae is that of Bequaert and Davis, "Tabanidae of Staten Island and Long Island, N. Y." (1923). Most of the records in that paper were incorporated in Leonard's "A list of the insects of New York" (1928), which for convenience is referred to throughout this paper as "State List". The writer has been able to study many of the specimens on which these 2 lists were based and has been able to make certain corrections. With few exceptions, when the writer has been unable to study questionable records, he has accepted the records of these 2 lists as valid. Pechuman's "Additions to the New York State list of Tabanidae" (1938) added some new records and species to the State List.

In the preparation of this paper it was decided to omit the list of localities where each species was collected by the Author or others. The distribution is shown by marking each collection locality on a separate map for most of the individual species. This shows, more graphically than a list, the distribution of each species found in the State. It should be remembered, however, that some sections of New York have been more heavily collected than others. Probably such species as *Chrysops vittata* and *Tabanus quinquevittatus* are found in every county in the State although a few show no records for these species. Probably the fewest records have been secured from the St. Lawrence Valley, east central New York and the counties east of the Hudson River north of Putnam County.

ECONOMIC IMPORTANCE

Because of their medical and veterinary importance, both by direct injury and the transmission of disease organisms, the economic importance of Tabanidae has received wide attention and much has been published concerning it. Webb and Wells (1924) and Philip (1931) give a large amount of this information.

In New York State as a whole the Tabanidae rank second only to mosquitoes as annoying pests of domestic and wild animals. In western New York they probably are a more important pest during their flight season than mosquitoes. As direct pests of man they are of secondary importance, certainly being exceeded by mosquitoes and black flies; nevertheless, under certain conditions they can be extremely annoying.

Dairy herds are severely attacked by Tabanidae and milk production drops considerably during periods of heavy attack. Not only is a considerable quantity of blood taken from the animals but the irritation and annoyance caused by the ravages of the flies in numbers results in interruption of feeding. The writer has seen herds of dairy cattle in Genesee County in a state bordering on panic due to the presence of hundreds of *Tabanus sulcifrons*. In the same county he has seen individual cattle streaming with blood due to the attacks of *T. lasiophthalmus* and *T. lineola scutellaris*. Since the blood does not immediately coagulate when the fly ceases to feed, there is a loss in addition to that taken by the fly.

Horses seem to be the particular object of attack by *Tabanus quinquevittatus* and fly nets appear to be of little value. Some farmers almost completely cover their horses with burlap as protection from fly attack and sometimes it is possible to work a team only during the cooler morning and evening hours at the height of the flight season of this species.

There have been several accounts of deer taking refuge in ponds and lakes as protection from the persistent attacks of various species of *Tabanus* and *Chrysops*.

Deerflies of the genus *Chrysops* are most annoying to man although *Tabanus nigrovittatus* is a pest on Long Island beaches, and other species such as *T. illotus, T. pumilus* and *T. nivosus* are bothersome under some conditions.

Deerflies cause considerable irritation to fishermen, lumbermen, road workers, horseback riders and others who spend any time in wooded or swampy areas. The writer has seen *Chrysops vittata* attacking so fiercely and in such numbers in swampy areas in Putnam County that it was necessary to find shelter for protection. Under such conditions, swinging an insect net around one's head for a few minutes would result in half a pint of flies being packed into the bottom of the net. *C. univittata* on Long Island, *C. lateralis* in the Adirondacks and *C. moecha* in Niagara County sometimes become nearly as abundant.

It is not likely that Tabanidae carry disease organisms under New York State conditions.

IMMATURE STAGES

Although extensive work has been done on the biology of a number of species of Tabanidae, a great deal is yet to be learned.

Eggs are laid in masses on vegetation above water (Fig. 1) or moist ground, although logs, rocks and bridge abutments are also used for this purpose. The egg mass is whitish when freshly laid but soon darkens to various shades of brown or jet black depending on the species.

The larval stages of most species are spent under moist conditions which vary from a completely aquatic habitat to moist soils and from rapidly flowing streams to stagnant ponds. The larvae of a few species are found in relatively dry soil and others have been found in rotten wood. Some species show great tolerance of variation in larval habitat. The larvae of many species, especially *Tabanus,* are predacious.

The larvae of the various species look much alike to the casual observer. They are usually white in color, tapering at each end. The larva of *Goniops chrysocoma* is bottle shaped. The larvae of many of the larger species of *Tabanus* have dark bands.

The pupae are brown or straw colored with a row of stiff spines encircling the apical third of each abdominal segment. At the apex of the abdomen are 6 stout, sharply pointed projections forming the pupal aster.

Under New York conditions, most species have one generation a year. There is some evidence, however, that *Tabanus lineola* and its subspecies *scutellaris* may occasionally develop from egg to adult in one season. Also, some individuals of *T. atratus* and other *Tabanus* species take 2 or 3 years to complete their development. The emergence of the males of a given species normally is slightly in advance of the main emergence of the females.

HABITS OF THE ADULTS

Most female Tabanidae suck blood and are easily collected when attacking humans or animals. The males do not suck blood and are generally collected from flowers or foliage. Tabanidae of both sexes frequently are encountered resting on paths and roads, especially where they run through wooded areas (Figs. 2 and 3). They are often quite wary under such conditions but considerable numbers may be collected. The writer has noted that *Tabanus sulcifrons* and *T. difficilis* have a decided proclivity for such situations. The females often enter buildings in considerable numbers, although they never seem to bite when indoors; large numbers may be found at the windows since they are attracted by light. The males of species of the *T. affinis* group often are found hovering in open glades in wooded areas and on the tops of hills and mountains. Both sexes of a

number of species are taken at lights at night and almost all the males of *T. sackeni* and *T. pumilus* studied by the writer were taken in this manner.

Tabanidae are most active on warm sunny days when there is no wind. A slight drop in temperature or the springing up of a breeze will cut down the number of attacking females to a great extent. There are exceptions to this and the writer has been attacked by numbers of *Chrysops moecha* after dark and by *C. shermani* during a heavy rain. It appears that *Tabanus sackeni* is normally of crepuscular habits.

Moving objects and dark objects seem to be more subject to attack. The writer has noted that predominantly dark cattle in a herd usually have the most Tabanidae feeding on them.

Although the immature stages of most Tabanidae are passed under wet or moist conditions, adults are frequently present in numbers some distance from breeding areas.

Figure 4 presents topographical features for correlation with the individual maps shown further on.

TAXONOMIC CHARACTERS AND CLASSIFICATION

Distinctive structural characters are few in the Tabanidae and most of them are confined to the head and its appendages. Chaetotaxy, which is so useful in many groups of Diptera, cannot be used since macrochaetae are not present. Since distinguishing structural characters are so few, much dependence must be placed on color pattern and this must be used with caution on partly denuded specimens.

Since some of the characters of the head are restricted to the females, it is necessary to use separate keys to the males of *Chrysops* and *Tabanus*. Since males do not attack man or animals, they are much less common in collections than females and the male is still unknown for a number of North American species. Males are readily recognized by the contiguous eyes.

With the use of Figure 5, most of the characters used in the keys may be readily understood.

New York Tabanidae may be divided into three subfamilies. The Pangoniinae includes *Stonemyia* and *Goniops*. The Chrysopinae includes *Merycomyia* and *Chrysops*. The Tabaninae includes *Diachlorus, Chrysozona, Microtabanus, Atylotus* and *Tabanus*. A detailed discussion of the classification of nearctic Tabanidae may be found in Philip (1941) and of the Tabaninae in Stone (1938). The most modern classification, based on a study of the World fauna, is by Mackerras (1954).

In the Pangoniinae, *Stonemyia* is represented in New York by 3 species and *Goniops* by one species. The Chrysopinae is represented by one species of *Merycomyia* and by *Chrysops* with 39 species or subspecies. In the Tabaninae, neither *Diachlorus* nor *Chrysozona* has been collected

in New York but may be represented by a single species each; there is one species of *Microtabanus,* 4 species of *Atylotus* and 54 species or subspecies of *Tabanus.*

ACKNOWLEDGMENTS

During the past 25 years, the writer estimates that he has examined well over 100,000 specimens of Tabanidae from New York State. No record was kept of the collectors of much of this material so at this time it is impossible to give other than a general acknowledgment to the several dozen private collectors and institutions, who without exception, have been extremely cooperative in providing him with material for study.

The extensive collecting of Prof. Henry Dietrich of Cornell University, especially in the Adirondacks, supplied many new records and the same can be said of Mr. Roy Latham of Orient, L. I. for eastern Long Island. The rearing and field collection studies of Dr. Clearhos Logothetis and Dr. Haruo Tashiro under the direction of Prof. H. H. Schwardt of Cornell University supplied a number of new localities for many species. Recent collections at lights by Prof. J. G. Franclemont of Cornell and his associates have resulted in the capture of the males of all New York species of *Chrysops* where this sex was previously unknown.

Special acknowledgment is due Dr. Alan Stone of the United States National Museum, Washington, D. C. and Dr. Cornelius B. Philip of the Rocky Mountain Laboratory, Hamilton, Montana who supplied or confirmed records of several species rare in New York. The cooperation of Dr. Donald L. Collins, State Entomologist of New York, is also appreciated.

KEY TO THE GENERA OF NEW YORK TABANIDAE

1. Hind tibiae with 2 apical spurs 2
   Hind tibiae without apical spurs 5
2. Flagellum of antenna with 8 distinct annuli 3
   Flagellum of antenna with 5 or less distinct annuli 4
3. Eyes of female with upper inner angles acute; frons broader than width of eye; wings with a dark pattern ..... **Goniops** Aldrich
   Eyes of female normal; frons narrower than width of eye; wings hyaline **Stonemyia** Brennan
4. Flagellum of antenna with 5 annuli; smaller species with dark markings on wing ..... **Chrysops** Meigen
   Flagellum with 2 or 3 annuli; larger *Tabanus*-like species with hyaline wings; hind tibial spurs very small ..... **Merycomyia** Hine
5. First antennal segment longer than thick; frons of female widened below, broader than high; wing gray with white maculations ..... **Chrysozona** Meigen
   First antennal segment usually scarcely longer than thick; frons of female higher than broad; wing pattern not as above or hyaline 6
6. Third antennal segment with no dorsal angle; frons of female narrow; median callus a narrow line; wings with a dark pattern; eyes bare; no ocellar tubercle; fore tibiae swollen; subepaulets bare ..... **Diachlorus** O.S.
   Not with this combination of characters 7
7. Flagellum of antenna with 2 or 3 annuli and with articulations indistinct; small flies usually under 10 mm.; basal callus of females small or absent **Microtabanus** Fairch.

Flagellum with 4 distinct annuli; size variable, usually more than 10 mm.; frontal callus present or absent 8

8. Basal callus absent or vestigial; eyes pilose; no ocellar tubercle; eyes of male yellow-brown in dried specimens ..... **Atylotus** O.S.
Basal callus well developed, nearly as wide as frons; at least lower eye facets of male blackish in dried specimens ..... **Tabanus** Linn.

STONEMYIA Brennan

The species of this genus are not known to suck blood but are found on flowers and resting on the ground in openings in wooded areas. None of the species seem to be common. Nothing is known of the biology of this group.

Until this genus was erected the species under consideration were placed in various genera, most commonly in *Pangonia* and *Buplex*.

KEY TO THE SPECIES OF NEW YORK *STONEMYIA*

1. Yellowish species including antennae and legs ..... **isabellinus** (Wied.)
Antennae at least partly dark; legs reddish to black 2

2. Legs reddish brown; posterior margins of abdominal segments with grayish hairs ..... **rasa** (Lw.)
Legs black; posterior margins of segments with yellow hairs .... **tranquilla** (O.S.)

Stonemyia isabellinus (Wiedemann)

Moderate in size (12 mm.)*; yellow; wing membrane very faintly tinted, costal cell yellow.

This species was originally described in the genus *Silvius* and for many years was unrecognized, the specific name *pigra* being used. Osten Sacken's original series of *pigra* included a specimen from New York and the writer knows of no other specimens from the State. It seems to be uncommon throughout its range.

Stonemyia rasa (Loew) (New York localities shown in Fig. 6.)

Moderate in size (12.5 mm.); dark brown; abdominal tergites with grayish hind margins; legs reddish brown; wing membrane faintly tinted, costal cell yellow.

The writer has examined the specimens on which the various Adirondack records in the State List were based and found them to be *S. tranquilla*. Like other members of this genus, *S. rasa* flies fairly late in the season, most records being in late August. However, it has also been collected in July and September.

Stonemyia tranquilla (Osten Sacken) (Fig. 7)

Moderate in size (12.5 mm.); blackish brown; abdominal tergites

* In the brief description for each species a more or less arbitrary measurement of length is given in parenthesis. Most species would not vary more than 2 mm. longer or shorter than this figure; in small species the variation would be somewhat less and in the largest species of *Tabanus* variation of 3 or 4 mm. could occur. In general, measurements of a long series of any species would cluster close to the figure given.

with yellowish hind margins and considerable yellowishness or chestnut laterally; legs mostly black; wing membrance faintly tinted, costal cell yellow.

This species is more northern in distribution than *S. rasa* and most records are from the mountainous areas of the State. Closely related to *S. tranquilla* is *S. fera* (Will.), but it is separated by the longer proboscis and entirely black palpi. Some New York specimens might be considered *fera* but for the present the writer prefers to consider this form entirely western in distribution. In series, *fera* is more brightly colored than *tranquilla.*

There are 3 August records for *S. tranquilla,* all others being in July.

GONIOPS Aldrich

Goniops chrysocoma (Osten Sacken) (Fig. 8)

Stout species (12 mm.); yellowish; wings with a dark pattern. Male brownish; abdominal tergites with pale bands on the hind margins.

This is the only species known in the genus and neither sex is likely to be confused with any other Tabanidae. They are stout-bodied insects 10 to 15 mm. long with the fore part of the wings infuscated.

This species is not common in New York and the female is not known to attack man or animals. All collection records for New York are in July and August.

The eggs are laid on the underside of tree leaves above damp ground in wooded areas. The female normally remains with the eggs until they hatch and when disturbed often makes a loud buzzing sound. The larvae are found in the lower layers of deep leaf mould and in damp soil.

MERYCOMYIA Hine

Merycomyia whitneyi (Johnson)

Large (21 mm.); brownish; abdomen with a large white patch indented above on the fourth tergite and 2 white spots on the fifth tergite; wing membrane tinted with brown which is deeper toward the front margin and base and along the veins; costal cell yellowish brown.

Only 3 other species, all of which appear to be very rare, have been placed in this genus.

M. whitneyi is reported in the Bequaert and Davis list (1923) from Clove Valley, Staten Island. The writer has seen no New York specimens but specimens from northern New Jersey, western Connecticut and southern Ontario indicate that its range does include New York. This species, which resembles a rather large brown *Tabanus,* is very rare throughout its range and nothing is known of its habits or early stages. A synonym of this species is *M. geminata* Hine.

CHRYSOPS Meigen

This genus includes the common deerflies with dark wing markings. The eyes are bright green and gold with dark markings. The bright eye colors and dark markings disappear shortly after death. The deerflies are annoying pests of man but probably are of less importance as pests of livestock than the larger *Tabanus* species.

They are most abundant in wooded areas but may also be found in many other surroundings. Some species are very abundant in the vicinity of salt marshes on Long Island.

Deerflies first appear in mid May in New York and are rarely found after September first although on eastern Long Island occasional specimens may be found into October. The main flight season of each species is short, rarely over 2 weeks; nevertheless, individual specimens may be found throughout the season.

The males of all the species of *Chrysops* found or likely to be found in New York are now known. In the case of several species, however, the male is known from only a single specimen. Not enough male material of *C. beameri* and *C. hinei* has been collected to find a line of demarcation between them, if indeed, it exists.

In the brief descriptions of *Chrysops* which precede the discussion of each species, forms averaging 7 mm. or less in length are considered small, larger than 7 mm. and less than 9 mm. as moderate and 9 mm. or more as large. Characters given for the male include only those showing obvious differences from the female.

KEY TO THE SPECIES OF NEW YORK *CHRYSOPS*

I. Females

1. Apex of wing beyond the crossband hyaline 2
   Apex of wing beyond the crossband infuscated so that an apical spot is present .. 9
2. Second basal cell hyaline; frontoclypeus without median pollinose stripe 3
   Second basal cell at least half infuscated; frontoclypeus with a median pollinose stripe 4
3. Crossband saturate, black ..... **nigra** Macq.
   Crossband dilute, faint, pale brown ..... **nigribimbo** Whitn.
4. Abdomen entirely dark; sometimes an indefinite pattern of grayish pollinose areas 5
   Abdomen with pale areas on at least first 2 abdominal segments 7
5. Fifth posterior cell with hyaline area at base ..... **carbonaria** Wlk.
   Fifth posterior cell infuscated at base 6
6. Pleura with yellow to orange-red pile; crossband broadly reaches hind margin of wing ..... **celer** O.S.
   Pleura with grayish or pale yellowish pile; crossband narrowly or not at all reaches hind margin of wing ..... **mitis** O.S.
7. Tergites with gray posterior borders; infuscation of second basal cell much less than first; apical portion of wing sometimes faintly infuscated **sordida** O.S.
   Tergites without gray posterior borders; infuscation of basal cells about equal .. 8
8. Wing picture pale; pleura with gray pile; no median abdominal triangles **cuclux** Whitn.
   (Occasional specimens of *C. mitis* have small reddish spots laterally at base of abdomen, but the wing picture is dark).
   Wing picture dark; pleura with yellow or orange pile; median abdominal triangles usually present ..... **excitans** Wlk.

9. (1) Frontoclypeus black with a median pollinose stripe 10
Frontoclypeus shining yellow at least in center; no median pollinose stripe 12

10. Apical spot paler than crossband with indefinite outline; dark species with pale borders and small triangles on abdominal segments; first 2 abdominal segments with small reddish lateral markings ..... **sordida** O.S.
Not with above combination of characters 11

11. Abdomen completely black; hyaline triangle reaches costal margin of wing; pleura with bright orange pile ..... **amazon** Daecke
Abdomen usually with contrasting black and yellow pattern; hyaline triangle rarely reaches beyond bifurcation of third longitudinal vein; pleura with yellowish pile ..... **frigida** O.S.

12. Crossband and apical spot broken by dilute areas along veins; abdomen striate **shermani** Hine
Dark markings of wing not broken by dilute areas 13

13. Wing markings rather pale; a conspicuous spot which is often connected to strongly bowed crossband covers the bifurcation of the third longitudinal vein; apical spot fills second submarginal cell; dull blackish species .. **fuliginosa** Wied.
Not with above combination of characters; if a spot is present at bifurcation, apical spot is narrow 14

14. Apical spot dilutely extended around wing reducing hyaline triangle to a subhyaline area not reaching hind margin of wing; large brown species with swollen first antennal segment and little or no trace of abdominal markings **brunnea** Hine
Not with above combination of characters 15

15. Wing pattern pale and not distinctly outlined; usual hyaline areas dilutely infuscated; antennae short and somewhat swollen ..... **atlantica** Pech.
Markings of wing clear cut; no infuscation of usual hyaline portions of wing except occasionally in anal area; antennae slender 16

16. First basal cell completely infuscated, rarely with a subhyaline spot at apex ... 17
First basal cell always at least half hyaline, sometimes almost entirely so 31

17. Hyaline triangle small but clear and distinct, restricted to apices of second and third posterior cells ..... **moecha** O.S.
Hyaline triangle extending toward costal margin of wing beyond second posterior cell 18

18. Apical spot very narrow, entering only extreme upper corner of second submarginal cell; an isolated spot is present at bifurcation of third longitudinal vein; a small gray-black species ..... **brimleyi** Hine
Apical spot broad, usually covering at least half of second submarginal cell; no isolated spot at bifurcation 19

19. Predominantly black or fuscous species with paler abdominal markings, if any, not conspicuous; hyaline triangle usually narrow and crescent shaped, reaching the second longitudinal vein but sometimes upper portion of hyaline triangle tinted so that it is indistinct 20
Abdomen conspicuously marked in yellow and black 23

20. A yellow or grayish stripe laterally on thorax above wing base 21
No thoracic stripe above wing base 22

21. Abdomen usually with three dull yellow stripes which are often much reduced, especially the lateral ones ..... **obsoleta** Wied.
Abdomen dark without pattern or only traces of a pale median stripe **obsoleta** subsp. **lugens** Wied.

22. Hind legs predominantly dark; rarely with any trace of an abdominal pattern; apical spot normally not extending beyond second submarginal cell **parvula** Daecke
Hind legs predominantly yellow or brownish; abdomen usually with distinct traces of a pale median line and occasionally with traces of lateral lines; apical spot usually extends into the first posterior cell ..... **dacne** Philip

23. Apex of hyaline triangle reaches second longitudinal vein 24
Apex of hyaline triangle does not reach second longitudinal vein 27

24. Frontal callus yellow 25
Frontal callus black or deep brown 26

25. Apical spot reaches into first and sometimes second posterior cell; fifth posterior cell usually with some infuscation; two central stripes of abdomen heavier and darker than lateral stripes ..... **hinei** Daecke

Apical spot rarely reaches into first posterior cell except as a pale shadow; fifth posterior cell usually entirely hyaline; 4 stripes of abdomen of about equal intensity or central stripes only slightly accentuated .... **beameri** Brennan

26. Lateral abdominal stripes usually not present on first two segments; hyaline triangle blunt and rounded at apex ..... **pikei** Whitn.
Lateral abdominal stripes normally complete; hyaline triangle crescent shaped and nearly pointed at apex ..... **sequax** Will.

27. Abdomen with 4 more or less complete dark longitudinal stripes 28
Abdomen not striped or with less than 4 stripes 30

28. Most of fifth posterior cell infuscated; scutellum yellow ..... **vittata** Wied.
Fifth posterior cell almost entirely hyaline; scutellum dark, with or without paler apex 29

29. Apical spot nearly fills second submarginal cell; 2 central stripes of abdomen rarely joined on second segment; frontal callus yellow ..... **aberrans** Philip
Apical spot only about half fills second submarginal cell; 2 central abdominal stripes usually join on second segment; frontal callus usually black, sometimes brownish, rarely yellowish ..... **striata** O.S.

30. Apical spot fills out most of second submarginal cell and extends into first and sometimes second posterior cell, usually connecting with crossband by an infuscated streak in the first posterior cell; abdomen with 2 stripes which are sometimes reduced to faint lines or enlarged to cover much of abdomen on each side of a yellow central stripe; scutellum usually with considerable yellow **univittata** Macq.
Apical spot fills only about half of second submarginal cell and does not extend further; abdomen not striped; scutellum dark ..... **inda** O.S.

31. (16) Apical spot narrow including at most only extreme apex of second submarginal cell 32
Apical spot broad, entering second submarginal cell over at least one third of upper branch of third longitudinal vein 36

32. Apical spot just beyond where it leaves the crossband slightly wider than marginal cell; frontal callus usually yellow, often bordered with black or brown, occasionally black 33
Apical spot at base narrower or just as wide as marginal cell; frontal callosity black 34

33. Black spot on second abdominal segment practically joins with that on the first segment; second and third sternites with black sublateral spots; robust species **sackeni** Hine
Black spot on second segment usually does not attain the anterior margin of the segment; no sublateral spots on sternities; more slender species .. **pudica** O.S.

34. Crossband dilute and leaving about half of the discal cell hyaline; cheeks black; frontoclypeus with a large black spot on each side ..... **delicatula** O.S.
Crossband saturate and covering discal cell; frontoclypeus and cheeks yellow or orange 35

35. Apical spot very narrow and more dilute than crossband; front little convergent at vertex; pale markings of abdomen usually grayish or dull yellow; on the second abdominal segment are black triangles, one on each side of the median dark marking, and they may or may not be connected with the latter by a dark band along the posterior margin of the segment ..... **aestuans** Wulp
Apical spot varies from one half to full width of marginal cell and is same density as crossband; front somewhat convergent at vertex; pale markings of abdomen yellow which sometimes is quite bright; dark median marking of second abdominal segment may have projections along posterior margin of segment but they do not form lateral triangles ..... **callida** O.S.
(Some specimens of *C. sackeni* may key here but may be separated by the shape of the frontal callus which is almost as high as it is wide).

36. (31) Blackish species with a mid-dorsal yellow (rarely grayish) abdominal stripe and sometimes with shorter stripes on each side of the center stripe **wiedemanni** Krb.
Abdomen with a different pattern and showing more yellow 37

37. Hyaline triangle distinctly crosses second longitudinal vein, nearly separating apical spot from the crossband 38
Hyaline triangle at most reaches second longitudinal vein 39

38. Apical spot occupies almost all of second submarginal cell; crossband reaches hind margin of wing ..... **geminata** Wied.
Apical spot occupies only about half of second submarginal cell; crossband usually does not reach hind margin of wing ..... **lateralis** Wied.

39. Abdomen with 4 rows of spots, but lateral spots on second segment may be reduced or absent; median figure on second segment an inverted "V"; scutellum and frontal callus normally dark, but the latter sometimes brownish .. **montana** O.S.
Abdomen normally not with 4 rows of spots 40

40. Hyaline triangle reaches second longitudinal vein 41
Hyaline triangle does not reach second longitudinal vein 42

41. Crossband dilute and basal portion of discal cell pale or hyaline; frontal callus and hind femora yellow; usually no dark spot under scutellum .. **cursim** Whitn.
Crossband not very dilute and basal portion of discal cell usually concolorous with rest of crossband; frontal callus yellow or fuscous and hind femora usually dark at base; there is a dark spot under scutellum ..... **pudica** O.S.

42. Abdominal markings black and median marking of second segment usually reaches anterior margin; frontal callus normally black but sometimes yellow; at least basal portion of hind femora black ..... **dimmocki** Hine
Abdominal markings brown, often quite pale; median marking of second abdominal segment rarely attains anterior margin; frontal callus and hind femora yellow the latter sometimes brownish at base 43

43. Thorax greenish-gray with fuscous stripes; outer margin of crossband usually sinuous ..... **flavida** subsp. **celata** Pech.
Thorax yellow-brown with dark brown stripes; outer margin of crossband straight or sinuous 44

44. Dark median marking of second abdominal segment reaching only about half way across segment leaving an anterior greenish-yellow area; outer margin of crossband sinuous ..... **flavida** subsp. **reicherti** Fairch.
Dark median marking of second abdominal segment reaching about two thirds of way across segment and pale anterior area usually without greenish tinge; outer margin of crossband usually straight ..... **flavida** Wied.

KEY TO THE SPECIES OF NEW YORK *CHRYSOPS*

II. Males

1. Apex of wing beyond the crossband hyaline, sometimes a vague cloud present in this area 2
Apex of wing infuscated beyond crossband so that an apical spot is present ... 8

2. Frontoclypeus black with a midfacial pollinose stripe which begins below antennae and runs at least half way to the oral margin 3
Frontoclypeus black or yellow without a midfacial pollinose stripe 7

3. Abdomen completely black 4
First 2 abdominal segments with small reddish or yellowish spots laterally 6

4. Fifth posterior cell with a hyaline area at base ..... **carbonaria** Wlk.
Fifth posterior cell infuscated at base 5

5. Crossband broadly and distinctly reaches hind margin of wing; outer margin of crossband usually very straight ..... **celer** O.S.
Crossband narrowly, indistinctly or not at all reaching hind margin of wing; outer margin of crossband usually irregular ..... **mitis** O.S.

6. Wing pattern dilute; pleural pile grayish ..... **cuclux** Whitn.
Wing pattern saturate; pleural pile yellowish ..... **excitans** Wlk.

7. Wing pattern saturate; frontoclypeus yellow with a large black spot on each side; fairly robust species ..... **nigra** Macq.
Wing pattern very dilute; frontoclypeus fuscous; small species **nigribimbo** Whitn.

8. (1) Frontoclypeus with a midfacial pollinose stripe which begins below antennae and runs at least half way to oral margin; integument of frontoclypeus usually entirely black 9
Frontoclypeus without a midfacial pollinose stripe; integument of face at least partly yellow 11

9. Species usually with considerable yellow on abdomen; legs usually with much yellow ..... **frigida** O.S.
Black species with pale abdominal markings, if any, restricted to sides of first 2

segments and traces of small median and posterior markings; legs almost entirely dark 10

10. Abdominal tergites and sternites from second segment with pale posterior margins which on tergites expand to small median triangles; a small reddish spot laterally on second segment; apical spot extensive but paler than crossband, filling all of first submarginal cell and fading out in lower portion of second submarginal cell; first basal cell with small subhyaline area near apex; second basal cell completely infuscated ..... **sordida** O.S.
Abdominal tergites and sternites black without paler markings; both basal cells with a distinct hyaline area near apex ..... **amazon** Daecke
(If body completely black and apical spot paler than crossband and vague in outline, refer back to Couplet 3).

11. Abdomen black with no yellow markings; hind femora black 12
Abdomen with yellow markings; hind femora variable 15

12. Apical spot narrow, including only part of second submarginal cell .. **brimleyi** Hine
Apical spot including all of second submarginal cell 13

13. Hyaline triangle clear, restricted to apices of second and third posterior cells; thorax usually with at least a trace of a pale stripe above wing base; facial area with considerable yellow ..... **moecha** O.S.
Hyaline triangle dilutely infuscated; no trace of a pale stripe above wing base; yellow of facial area restricted to a narrow stripe in center of frontoclypeus .. 14

14. Pleurae with some pale markings; first 2 antennal segments and fore coxae and femora with considerable yellow ..... **parvula** Daecke
Pleurae, antennae and all coxae and femora black ..... **fuliginosa** Wied.

15. Crossband and apical spot broken by dilute areas along veins .... **shermani** Hine
Crossband and apical spot not broken by dilute areas although entire wing pattern may be pale 16

16. Wing pattern dilute and indefinite or hyaline triangle represented by a narrow subhyaline or hyaline area not reaching hind margin of wing; first antennal segment somewhat swollen 17
Wing pattern clear-cut and hyaline triangle open at hind margin of wing; first antennal segment not especially swollen, often very slender 18

17. Dull yellowish species with pattern of dark spots on each abdominal segment except first; wing pattern dilute and indefinite; first antennal segment moderately swollen ..... **atlantica** Pech.
Brown species with no definite abdominal pattern, although dark markings may be indicated by dark shadows; hyaline triangle indicated by clear area along edge of crossband and not usually extended beyond center of third posterior cell; first antennal segment considerably swollen ..... **brunnea** Hine

18. Black species; abdomen with a yellowish median longitudinal stripe, occasionally with a similar abbreviated stripe on each side; hyaline triangle crosses second longitudinal vein; apical spot rarely occupies more than half of second submarginal cell, often less ..... **wiedemanni** Krb.
Not with above combination of characters 19

19. Apical spot very little broader at its apex than at its origin, crossing upper branch of third longitudinal vein at its apex and occupying very little of the second submarginal cell 20
Apical spot considerably broadened towards its apex, crossing at least half of upper branch of third longitudinal vein 23

20. Hyaline triangle not reaching second longitudinal vein ..... **sackeni** Hine
Hyaline triangle reaching or crossing second longitudinal vein 21

21. Frontoclypeus with a large black spot on each side ..... **delicatula** O.S.
Frontoclypeus entirely yellow or, at most, with some dark shading around frontoclypeal pits 22

22. Second abdominal segment with sublateral black triangles which join the median figure along the posterior border of the segment; fourth posterior cell usually hyaline at apex and fifth posterior cell with considerable infuscation especially basally; pale markings grayish yellow; apical spot very narrow .. **aestuans** Wulp
Second abdominal segment without sublateral black triangles; fourth posterior cell usually entirely infuscated and fifth posterior cell often mostly hyaline; pale markings yellow ..... **callida** O.S.

23. Abdomen bright yellow and black; large black figure of second abdominal segment broadly joined to black figure of first segment; median yellow triangles do not

reach the anterior border of the segments; apical spot occupying one half to two thirds of second submarginal cell 24
Not with above combination of characters 25

24. Abdomen with a sublateral row of black spots; median yellow triangles moderate in size; hyaline triangle extending beyond bifurcation of third longitudinal vein, sometimes reaching second longitudinal vein ..... **montana** O.S.
Abdomen without a sublateral row of black spots; median triangles very small, sometimes obsolete; hyaline triangle ends at bifurcation of third longitudinal vein ..... **inda** O.S.

25. Apical spot filling about half or less of second submarginal cell 26
Apical spot filling all or nearly all of second submarginal cell, sometimes extending into first posterior cell 32

26. Frontoclypeus with a black spot on each side; hyaline triangle crosses second longitudinal vein ..... **lateralis** Wied.
Frontoclypeus entirely yellow; hyaline triangle does not cross second longitudinal vein 27

27. First basal cell infuscated, except for subhyaline area near apex; second basal cell at least half infuscated; hind femora usually partly black .. **dimmocki** Hine
First basal cell usually not more than half and second basal cell one third infuscated; hind femora often entirely yellow; dark markings on second abdominal segment not reaching the anterior margin 28

28. Thorax yellow or brownish in ground color with brown stripes 29
Thorax greenish gray with fuscous stripes 30

29. Outer margin of crossband nearly straight; ground color of abdomen rather uniformly yellow ..... **flavida** Wied.
Outer margin of crossband sinuous; base of second abdominal segment often with a greenish cast ..... **flavida** subsp. **reicherti** Fairch.

30. Crossband dilute, base of discal cell nearly hyaline; ground color of abdomen bright yellow; hind femora entirely yellow ..... **cursim** Whitn.
Crossband saturate or nearly so, discal cell not paler at base; ground color of abdomen dull yellow; hind femora variable 31

31. Hind femora usually dark at base; a black spot beneath scutellum; dark abdominal markings usually saturate ..... **pudica** O.S.
Hind femora usually entirely yellow; black spot beneath scutellum very pale or absent; dark abdominal markings often faded ..... **flavida** subsp. **celata** Pech.

32. Hyaline triangle crosses second longitudinal vein; yellow species with black median abdominal spots which are usually joined on the second segment; apical spot does not extend beyond second submarginal cell .... **geminata** Wied.
Not with above combination of characters 33

33. Hyaline triangle reaches or nearly reaches second longitudinal vein (if subhyaline beyond bifurcation of third longitudinal vein, predominantly black species with pale abdominal markings reduced) 34
Hyaline triangle scarcely extends beyond bifurcation of third longitudinal vein; predominantly yellowish species with dark abdominal markings 39

34. Blackish species, with reduced pale abdominal markings 35
Yellow species with black abdominal markings 37

35. Thorax with a yellow stripe on each side above wing base; lower border of second basal cell infuscated 36
Thorax without a yellow stripe above wing base; lower border of second basal cell not more heavily infuscated than adjoining portion of cell .... **dacne** Philip

36. Abdomen with a dull yellowish median stripe, frequently with a shorter stripe on each side ..... **obsoleta** Wied.
Abdomen with only traces of longitudinal stripes .. **obsoleta** subsp. **lugens** Wied.

37. Frontoclypeus and cheeks mostly yellow ..... **beameri** Brennan **hinei** Daecke
Frontoclypeus with a large dark spot on each side and cheeks with considerable black 38

38. Lateral abdominal stripes incomplete; second basal and fifth posterior cells with reduced infuscation; hyaline triangle broadly open at base ..... **pikei** Whitn.
Lateral abdominal stripes complete; second basal and fifth posterior cells mostly infuscated; hyaline triangle narrow at base and crescent shaped .. **sequax** Will.

39. Abdomen with a median yellow stripe with a longitudinal black band on each side; lateral margins of segments narrowly yellow ..... **univittata** Macq.
Abdomen yellow with 4 more or less complete rows of black spots 40

40. Ground color of thorax and scutellum yellow ..... **vittata** Wied.
Ground color of thorax plumbeus; scutellum sometimes with some yellow 41
41. Apical spot completely fills second submarginal cell; the sublateral rows of abdominal spots are about as dark as the median rows ..... **aberrans** Philip
Apical spot not completely filling second submarginal cell; sublateral rows of abdominal spots paler than median rows ..... **striata** O.S.

Chrysops aberrans Philip (Fig. 9)

Moderate in size (8 mm.); yellow and black; thorax greenish in ground color; black stripes on abdomen, the median pair rarely joining on the second tergite; first basal cell wholly infuscated; fifth posterior cell mostly hyaline; apical spot broad, usually nearly filling second submarginal cell; frontal callus yellow. Male with yellow areas reduced; second basal cell largely infuscated.

Many of the records in the State List for *C. striata* refer to *C. aberrans*. The two species are much alike and often fly together, but may be distinguished by the characters given in the key.

Although *C. aberrans* is found in various parts of the State, it is most common in and near the cat-tail swamps along the south shore of Lake Ontario. In such situations it is often an annoying pest. This species appears in late June and on Long Island has been collected into September. Its peak abundance is from mid July to mid August.

The larvae have been collected from mud on the edges of ponds and streams.

Chrysops aestuans van der Wulp (Fig. 10)

Moderate in size (8.5 mm.); black; abdomen with gray or yellowish gray markings not in form of stripes; both basal cells hyaline; apical spot very narrow; crossband often not reaching hind margin of wing. Male generally darker; both basal cells partly infuscated.

Normally this is not a common species in New York although from Ohio west it is a species of considerable economic importance. The only place in New York where the writer has encountered it in numbers is on Grand Island in the Niagara River. It is most commonly collected near Lake Ontario. It flies from June until August. In the older literature this species is sometimes called "*moerens* Walker."

The larvae have been reported from mud on the edge of temporary and permanent ponds and from marshes along Lake Erie. The eggs are laid on emergent vegetation, often over rather deep water.

Chrysops amazon Daecke

Large (10 mm.); black; pleurae with dense reddish or orange pile; frontoclypeus with a median pollinose stripe; both basal cells partly infuscated; apical spot broad, separated from crossband. Male with black pile only on pleurae; entire anal area of wing infuscated.

This species has not been reported from New York. Since it is found in New Jersey and southern New Hampshire, it is entirely possible that it occurs on Long Island.

Chrysops atlantica Pechuman (Fig. 11)

Rather large (9 mm.); dull yellow and brown; dark pattern of abdomen not clear cut but never in form of stripes; wing membrane dilutely infuscated with pattern showing as darker area; both basal cells partly infuscated; apical spot broad. Male usually darker than female with abdominal pattern more distinct.

This species has long been confused with *C. flavida* but the smoky wing and dark thorax serve to distinguish it. It is more common than *C. flavida* in New York and is often a pest in the vicinity of salt marshes.

The larvae are found in very wet situations, often under water, in salt marshes and brackish pools and since the species is never found inland, they probably are restricted to this habitat.

Chrysops beameri Brennan

Moderate in size (8 mm.); yellow and black; thorax greenish yellow in ground color; abdomen with black stripes; first basal cell infuscated; fifth posterior cell hyaline; apical spot broad but usually only barely reaching first posterior cell; frontal callus yellow. Male not surely distinguishable from *C. hinei.*

Specimens close to this form are occasionally collected on Long Island. The writer has seen such specimens from Peconic (July 30), Orient (August 5), Fishers Island (August 21) and Belmont Lake State Park (August 22), the specimen from the last locality being reported by the writer (1938) as *C. pikei.* These specimens do not exactly match specimens of *C. beameri* from near the type locality and it is quite possible they are a light form of *C. hinei* and these collection localities are shown in Fig. 27 as *hinei.* Additional material, especially males, will be necessary to determine the status of this species.

Chrysops brimleyi Hine (Fig. 12)

Small (6.5 mm.); dark grayish black; abdomen with traces of a grayish pattern; first basal cell infuscated, second hyaline; apical spot narrow. Male with both basal cells partly infuscated.

This small species is rare in New York where it apparently reaches the northern extent of its range on Long Island. It is found in June and July.

Chrysops brunnea Hine (Fig. 13)

Rather large (9 mm.); brown; abdominal pattern obsolete, sometimes with dark shadows and with faint pale median triangles; the broad apical spot continues around the wing and joins the cross-band by a lightly infuscated area along the hind margin isolating the hyaline triangle; both basal cells partly infuscated; first antennal segment swollen. Male differs from female only in sex characters.

This large brown species is almost entirely restricted to the vicinity of marshes along the south shore of Lake Ontario and probably will be found

in similar situations along Lake Erie. It has not been found on Long Island but may be present since it is recorded from New Jersey.

C. brunnea attacks with a loud buzzing noise and is quite aggressive. It is sometimes annoying to fishermen in the bays along Lake Ontario. It is found in July and August.

Chrysops callida Osten Sacken (Fig. 14)

> Moderate in size (8 mm.); black and yellow; abdominal markings not in form of stripes; both basal cells hyaline; apical spot narrow; crossband reaching hind margin of wing. Male with pale markings less extensive; both basal cells partly infuscated.

This common species seems to have been collected in all portions of the State except the Adirondack area. It is active and aggressive and causes considerable annoyance to man and livestock. It is most abundant in June and early July but occasional specimens are found from May until August in upstate New York and on Long Island it has been collected as late as October.

C. callida belongs in a difficult taxonomic group which includes *C. dimmocki, C. pudica, C. sackeni* and some rarer forms. However, the majority of the specimens may be separated by the characters given in the key.

The larvae have been found in a variety of situations including stagnant mud on the edge of ponds, wet organic material and the edges of brackish pools. The writer has never found the egg masses over anything but water. These masses, which shortly after oviposition become dark and shining, are laid along the edges of creeks and ponds on emergent vegetation but none are found on similar adjacent growth over mud (Fig. 1). Since these egg masses are often quite abundant and noticeable, this selectivity is most striking to observe.

Chrysops carbonaria Walker (Fig. 15)

> Moderate in size (8 mm.); black; fifth posterior cell hyaline at base; no apical spot; both basal cells more than half infuscated. Male with both basal cells at least three quarters infuscated; considerable dilute infuscation in anal area of wing.

In New York, *C. carbonaria* usually is the first species to appear. It is found throughout the State and often is abundant. It appears from early to mid May and reaches a peak abundance in early June. Occasional specimens are found into July.

C. carbonaria belongs to a species group which sometimes show intergrading characters. It is especially close to *C. mitis* but most specimens may be separated by the characters given in the key. Certain specimens differ in that the crossband is very dark with a straight outer margin which runs to the posterior margin of the wing, and with grayish-yellow to bright yellow hairs on the pleurae. This form of *C. carbonaria* is especially common on Long Island where it has been confused with *C. celer*.

It is separated from this species by the presence of a hyaline area at the base of the fifth posterior cell. Although *C. carbonaria* belongs to the group without an apical spot, occasional males of this group show a tinting in the apical area which is often quite distinct. A form of *carbonaria* with apical tinting of the wing has recently been described by Philip (1955) as *"carbonaria nubiapex"* with the holotype male from Little Valley, N. Y. and paratype males from Ithaca, Oswego and Albany. The writer regards its status as uncertain and has not separated its distribution from that of the other forms.

The larvae are found in mud and plant debris on the edges of ponds and streams, often under several inches of water.

Chrysops celer Osten Sacken (Fig. 16)

Rather large (9 mm.); black; pleurae with dense yellow to orange-red pile; fifth posterior cell infuscated at base; both basal cells more than half infuscated; no apical spot. Male lacks the orange pleural pile of the female; anal area of wing dilutely infuscated.

This species is widely distributed over New York but seems to be most abundant in the warmer portions of the State. It is annoying to man and livestock early in the season. *C. celer* flies from May until July and on Long Island it has been collected in August; it is most common in June.

The egg mass of this species is unique for a *Chrysops* since it is brown in color and in several layers much like a *Tabanus* egg mass. The writer has seen oviposition take place on emergent vegetation along Tonawanda Creek in Niagara County over about eight inches of water. The larvae are found in the muddy banks of ponds and streams.

Chrysops cuclux Whitney (Fig. 17)

Moderate in size (8 mm.); black; abdomen with a grayish yellow area laterally near base; wing pattern pale; both basal cells more than half infuscated; no apical spot. Male with pale area of abdomen smaller than in female.

This species is related to the two preceding but is less common. Although it is widely distributed over New York, it rarely is abundant enough to be considered a pest. It flies in late May and early June with an occasional specimen being found in July.

The larvae have been found in very wet mud of streams and ponds.

Chrysops cursim Whitney

Moderate in size (7.5 mm.); yellow and black with yellow predominating; abdominal markings not in form of stripes; crossband dilute and part of discal cell subhyaline; both basal cells hyaline; apical spot moderately broad. Male with both basal cells partly infuscated; crossband less dilute than in female.

This is a rare form in New York. It is related to *C. pudica* and some

variations of that species approach *cursim* closely. The only undoubted *cursim* the writer has seen from New York are from extreme eastern Long Island, all collected by Mr. Roy Latham. Collection dates are from June 10 to July 20 at Riverhead, August 2 at Greenport and July 2 at Orient.

Chrysops dacne Philip (Fig. 18)

Moderate in size (7.5 mm.); dark brown; no pale stripe above wing base; abdomen often with a narrow pale median line and rarely with obsolete sublateral lines; first basal cell infuscated; apical spot very broad; hyaline triangle narrow; legs with considerable yellow. Male with hyaline areas of wing somewhat tinted.

For many years this species was called *C. lugens* but the name *lugens* should be used for another form. *C. dacne* is rare in New York and of no apparent economic importance. All specimens on record were collected in July.

Chrysops delicatula Osten Sacken (Fig. 19)

Moderate in size (7:5 mm.); black and pale yellow; abdominal markings not in form of stripes; both basal cells hyaline, discal cell partly hyaline; frontoclypeus with a black spot on each side; apical spot narrow. Male with both basal cells partly infuscated.

Although this has been considered a rare species in New York, it is occasionally abundant enough on Long Island to be considered a pest. It is essentially a coastal form in New York and is rarely found inland. On Long Island it has been collected from May until October with most records in late June and July. The few upstate collections were made in June and July.

Chrysops dimmocki Hine (Fig. 20)

Moderate in size (8 mm.); black and yellow; abdominal markings not in form of stripes; both basal cells hyaline; apical spot quite broad. Male with both basal cells partly infuscated.

Members considered by the writer as belonging to this species seem to be restricted to Long Island and Staten Island in New York. He has been unable to locate the specimen on which the Grand Island, Erie County record in the State List is based and has been unable to collect other specimens at that locality. *C. dimmocki* is close to *C. pudica* and by some workers it is considered a synonym of that species. It seems best to retain the name until further work can be done on the group to which it belongs.

This species flies from April until September but most of the records are in June and early July.

Chrysops excitans Walker (Fig. 21)

Large (10 mm.); black; abdomen with a yellow area laterally near

base and usually with median triangles on the second, third and sometimes fourth tergites; pleurae with dense yellowish pile; fifth posterior cell infuscated at base; both basal cells more than half infuscated; no apical spot. Male much darker than female with pale abdominal markings reduced or obsolete.

This northern species is largely restricted to the Adirondack area in New York. It has not been collected in the Catskills nor in the Allegheny area of western New York but may possibly be found there. *C. excitans* is the largest *Chrysops* found in New York. It is sometimes abundant enough in the higher Adirondacks to be a pest of humans. It is most common in late June and July with an occasional specimen being found into August.

The larvae have been found in the mud along the edges of ponds and lakes.

Chrysops flavida Wiedemann (Fig. 22)

Moderate in size (8.5 mm.); yellow and brown; brown markings of abdomen not in form of stripes; thorax yellow with brown stripes; both basal cells somewhat infuscated at base; apical spot broad. Male differs from female only in sex characters.

The typical form of *C. flavida* is not especially common in New York. Many of the earlier published records of this species refer to *C. atlantica* or to *C. flavida celata.* Where the writer has been unable to confirm the earlier records, they are omitted from Fig. 22. This species flies from June until October on Long Island but is most abundant in July. There are no inland records of *C. flavida* or its subspecies in New York.

The larvae are found in very wet situations, often in mud under a foot of water.

Chrysops flavida subspecies **celata** Pechuman (Fig. 23)

Moderate in size (8.5 mm.); much like typical form but both sexes have thorax greenish gray with dark stripes and outer margin of crossband usually sinuate.

This form appears to be more common in New York than typical *flavida* but rarely is abundant enough to be considered a pest. It flies from June to September with most records being in June.

Occasional specimens of *C. flavida* from Long Island are very close to subspecies *reicherti* but do not exactly match type material of this form studied by the writer.

Chrysops frigida Osten Sacken (Fig. 24)

Moderate in size (7.5 mm.); black and orange; extent of color pattern of abdomen variable, sometimes almost completely black or almost completely orange yellow but pattern never in form of longitudinal stripes; frontoclypeus with a median pollinose stripe;

both basal cells partly infuscated; apical spot broad and broadly united with crossband. Male with infuscation in both basal cells greater than in female.

As will be seen on the map, this little species is widely distributed in New York. It probably is even more common than indicated on the map since it is of retiring habits and not at all aggressive. It prefers swampy woods and the writer has never found it abundant enough to be annoying. The body coloration is very variable and some specimens are nearly black. In spite of this variation, it is easily distinguished from other New York *Chrysops* by the combination of a large apical spot and a black face with a pollinose stripe. Occasional specimens have a considerable amount of yellow on the face and legs and an extreme of this form with almost completely yellow legs and face has recently been described as subspecies *xanthas* Philip. Some New York specimens studied by the writer probably could be considered this form.

In upstate New York it is an early season species appearing in May and being most abundant in June and early July. There are some August and September records from Long Island. The male is often found on flowers.

Chrysops fuliginosa Wiedemann (Fig. 25)

Rather small (7 mm.); dark grayish black; sometimes with traces of paler pattern on abdomen; entire wing dilutely infuscated with usual dark pattern indicated by heavier infuscation; first basal cell infuscated; apical spot broad and nearly separated from crossband. Male darker than female; both basal cells almost completely infuscated.

This small dark species is found only in the immediate vicinity of salt marshes along the coast. It is sometimes abundant enough to be of considerable annoyance to man and animals. Although it has been collected in New York from May to September, it is present in numbers only in June.

C. fuliginosa breeds in salt marshes including areas which are daily swept by tides.

Chrysops geminata Wiedemann (Fig. 26)

Small to moderate in size (7 mm.); black and yellow; abdominal markings usually not in form of stripes but black markings occasionally reduced and appear as broken rows of spots; both basal cells hyaline; apical spot broad and nearly separated from crossband. Male with some dilute infuscation in both basal cells.

This little species is widely distributed throughout New York. It is partial to wooded areas and the writer has found it most abundant along country roads running through woods. Although fairly common at times, it can not be considered a serious pest. *C. geminata* is related to *C. lateralis* but may be separated by the characters given in the key;

it is also smaller than that species. *C. geminata* shows considerable variation in the markings of the second abdominal segment. It flies from late June into August but is most abundant in mid July.

The larvae have been found in wet soil and plant debris along streams and in wet soil and mud under trees.

Chrysops hinei Daecke (Fig. 27)

Moderate in size (8 mm.); yellow and black; thorax greenish in ground color; abdomen with black stripes; first basal cell infuscated; fifth posterior cell usually partly infuscated; apical spot broad reaching first posterior and sometimes second posterior cell; frontal callus yellow. Male with black abdominal stripes wider and sublateral ones more distinct than in female.

This species is not common in New York and to date has been found only on Long Island. It is a late flying species and most specimens are found in late August and early September. However, the writer has seen specimens collected in May, July and October as well as the two months mentioned above. Some of the paler specimens are close to *C. beameri.*

Chrysops inda Osten Sacken (Fig. 28)

Moderate in size (8 mm.); yellow and black; abdomen with a row of rather large yellow median triangles; hind margins of tergites narrowly and lateral margins broadly yellow; first basal cell infuscated; apical spot broad; frontal callus black. Male with black areas much more extensive than in female; both basal cells and fifth posterior cell almost completely infuscated.

As will be seen on the map, this species is found throughout the State. It seems to be most common in the western portion of New York although the writer on one occasion found it extremely abundant in Bear Mountain State Park. It is aggressive and sometimes is quite annoying.

C. inda is an early season form appearing in May and reaching its peak abundance in June and is rarely taken after early July although an occasional specimen is collected in August.

The eggs resemble those of *C. callida* and are laid on vegetation over water. The larvae have been found in mud and plant debris along creeks and the edges of ponds.

Chrysops lateralis Wiedemann (Fig. 29)

Moderate in size (8 mm.); yellow and black; abdomen with a yellow median stripe, usually black laterally but sometimes black reduced to form rows of spots; both basal cells hyaline; apical spot broad and nearly separated from crossband. Male with some dilute infuscation in both basal cells.

As indicated on the map, this species is found only in the mountainous and hilly areas of the State. The writer has never found it abundant except in the Adirondacks where it is probably the most common species

of *Chrysops* during most of the season. At the peak of its flight in this area it is a very annoying pest of humans and animals. The males are often collected on flowers.

It flies from June into August but is most abundant from late June until mid July.

Chrysops mitis Osten Sacken (Fig. 30)

Large (9.5 mm.); black; fifth posterior cell infuscated at base; no apical spot; both basal cells more than half infuscated. Male with considerable dilute infuscation in anal area of wing.

This species is close to *C. carbonaria* and some specimens can scarcely be differentiated. In general it is more northern than *C. carbonaria* and in the Adirondacks it is an early season pest. It is found from May until July and is most common in June. The larvae have been found on the edges of ponds and in swampy areas.

Chrysops moecha Osten Sacken (Fig. 31)

Moderate in size (7.5 mm.); yellow and black; thorax greenish in ground color; black markings of abdomen usually in form of stripes; first basal cell infuscated; fifth posterior cell mostly hyaline; apical spot very broad; hyaline triangle extremely small but regular in outline; frontal callus usually black. Male black; wings almost entirely infuscated except for small hyaline triangle.

C. moecha is most common in the warmer portions of New York and has not been collected in the Adirondacks or Catskills. Although it is not often common enough to be a pest, the writer has seen it in hugh swarms along Tonawanda Creek in Niagara and Erie Counties in late June. Under these conditions it was a serious pest of humans and domestic animals in the area, attacking in maximum abundance late in the afternoon and still being present in small numbers after dark. It is aggressive in its habits.

The body pattern of this species is very variable, the abdominal stripes of some specimens being reduced to a series of dashes and in others the stripes are very extensive, the entire insect appearing quite dark.

C. moecha flies from mid June until early August but only an occasional specimen is encountered after mid July. The male is black and is rather frequently collected from leaves of trees overhanging streams.

Eggs are laid on the underside of leaves of trees overhanging streams, sometimes many feet above the water. The egg mass is unusual in that the individual eggs are deposited almost at right angles to the leaf and do not overlap each other as is usual in *Chrysops*. The larvae have been collected in wet mud, often under water, along ponds and streams.

Chrysops montana Osten Sacken (Fig. 32)

Moderate in size (8 mm.); black and yellow; abdomen with a

geminate black spot and often with a sublateral black spot on the second tergite, and 4 rows of spots on the third, fourth and fifth tergites; first basal cell partly infuscated, second nearly hyaline; apical spot variable but usually broad. Male with yellow areas usually much reduced; both basal cells partly infuscated.

This species is found throughout New York but rarely is common anywhere. However, the writer once found it abundant and aggressive near Childwold in the Adirondacks. It is most commonly found in the vicinity of ponds and lakes.

Occasional specimens lack the small black lateral spots on the second abdominal segment or have them much reduced; such specimens are especially common on Long Island. The size and shape of the apical spot is also subject to considerable variation.

C. montana flies from late June until August but is most commonly collected in mid July.

The larvae have been collected in sand on the edges of ponds.

Chrysops nigra Macquart (Fig. 33)

Moderate in size (7.5 mm.); black; first basal cell infuscated, second hyaline; no apical spot. Male wing with both basal cells largely infuscated.

This widely distributed species is found throughout New York. It is an early season form and sometimes is extremely abundant. It is especially a pest of livestock but is also annoying to man.

The hyaline second basal cell will distinguish this species from related forms. It is, however, very variable and a trace of an apical spot can sometimes be seen in both sexes. Occasional specimens have a small spot at the bifurcation of the third longitudinal vein, in this respect resembling *C. brimleyi*. The anal area of the wing is sometimes dilutely infuscated.

C. nigra flies from May until September although it is rarely seen after mid July.

The larvae seem tolerant of many conditions and they have been collected from such varied situations as stagnant mud and plant debris on the edge of a pool, from mud on the banks of a small brook, from wet soil under trees, from the margin of a brackish pool and in sandy areas swept daily by tides.

Chrysops nigribimbo Whitney (Fig. 34)

Small (6 mm.); very dark brown to black; wing pattern very pale; first basal cell infuscated, second hyaline; apical spot absent or very faint. Male wing with lower basal portion of second basal cell and anal area dilutely infuscated.

This small species is rare in New York and seems to be restricted to Long Island. Its small size and very faint wing pattern serve to distinguish it. It has been collected in June and July.

Chrysops obsoleta Wiedemann (Fig. 35)

Moderate in size (8 mm.); dark brown to black; abdomen with 3 yellowish stripes which are often indistinct, especially the sublateral ones; a pale stripe above wing base; first basal cell infuscated; apical spot very broad; legs with considerable yellow. Male with part of second basal cell and anal area of wing dilutely infuscated.

This coastal form is rare in New York although it is quite common along the coast of New Jersey and Delaware. The writer has been unable to confirm a record from White plains in the State List and all specimens he has seen have been from Long Island. All specimens studied by the writer were collected in July except for single specimens, one each in May, August and September.

The extent of pale markings on the abdomen in this species is very variable. *Chrysops obsoleta lugens* Wied. seems to be an extreme form in which the abdomen is practically all dark; specimens approaching this form, which is the same as *C. ultima* Whitney, have been collected on Long Island. This subspecies should not be confused with *C. lugens* of authors which is now known as *C. dacne* Philip. It should also be noted that for many years the name *obsoleta* was applied to the species we now know as *C. wiedemanni* Kröber and during this time the name *C. morosus* was used for the species under discussion. *C. morosus* is a synonym of the typical form of *C. obsoleta* Wied.

The larvae of *C. obsoleta* have been found in very wet situations in salt marshes.

Chrysops parvula Daecke

Small (6.5 mm.); very dark brown or black; no pale stripe above wing base; first basal cell infuscated; apical spot very broad; legs mostly dark. Male wing completely infuscated with pattern showing as a darker area; both basal cells completely infuscated.

This species is reported from Callicoon in the State List but the writer has been unable to find the specimen on which the record is based. Since *C. parvula* is found in the New Jersey pine barrens it may be found in similar situations on Long Island.

Chrysops pikei Whitney (Fig. 36)

Rather small (7 mm.); yellow and black; thorax greenish yellow in ground color; abdomen with black stripes, the sublateral ones quite short; first basal cell infuscated; fifth posterior cell mostly hyaline; apical spot broad; hyaline triangle rounded above; frontal callus black. Male with second basal cell partly infuscated.

As indicated on the map, this species has been collected only in the northwestern portion of the State. It probably is a recent addition to the New York fauna since no specimens have been found in any of

the early collections made in the area. Since it is not found in numbers in New York, it is of little economic importance but in the midwest and south it is reported as a persistent biter, usually attacking the ears of domestic animals.

In New York it flies from June through August but most records are for July.

The larvae are found in the banks of ponds and streams.

Chrysops pudica Osten Sacken (Fig. 37)

Moderate in size (7.5 mm.); black and yellow; abdominal markings not in the form of stripes; both basal cells hyaline; apical spot narrow. Male with both basal cells partly infuscated.

Although occasionally collected at inland localities, this species is most common along the coast. In New York, all records but one are from Long Island and Staten Island. Although occasionally found in some numbers, it is not often abundant enough to be considered a pest.

New York records extend from April to September but most specimens were collected in June and July.

Chrysops sackeni Hine (Fig. 38)

Moderate in size (8.5 mm.); black and yellow; abdominal markings not in form of stripes; both basal cells hyaline; apical spot narrow but at its origin slightly wider than marginal cell. Male usually with pale markings less extensive; both basal cells partly infuscated.

This species is most abundant in the western and southeastern portions of the State. Although not usually as abundant as the related *C. callida* it sometimes is found in sufficient numbers to be classified as a pest.

C. sackeni often flies with *C. callida* and occasional specimens are difficult to separate from that species. In cases of doubt, the shape of the frontal callus is usually the best character; the callus of *C. callida* is very narrow and is always black whereas in *C. sackeni* it is higher in proportion to its width and often yellow or brown. In coastal areas some specimens are close to *C. dimmocki, pudica* and other species of this group; in addition to the characters given in the key, *C. sackeni* has a row of sublateral spots on the venter of the abdomen which are rarely found in related species except in *C. callida* where it is a variable character. *C. sackeni* shows considerable variation in body and leg coloration and in the width of the apical spot.

This species is most abundant in late June and early July and specimens are rarely seen after August first.

The larvae have been collected in mud on the edges of permanent and temporary ponds and in organic material on the edge of salt marshes.

Chrysops sequax Williston

Moderate in size (8.5 mm.); yellow and black; thorax greenish in

ground color; 4 black stripes run the length of the abdomen; first basal cell infuscated; fifth posterior cell often partly infuscated; apical spot broad; hyaline triangle narrowed above; frontal callus black. Male darker than female; second basal cell about half infuscated.

Although this species has been recorded from neighboring States, the accuracy of these records is questionable and it is doubtful if it is found in New York. Specimens from New York determined as *C. sequax* all seem to be *C. beameri* or *C. hinei.*

Chrysops shermani Hine (Fig. 39)

Rather large (9 mm.); yellow and black; abdominal pattern usually in form of stripes on a yellow background but there is a tendency for stripes to unite reducing yellow to a narrow median stripe and sublateral patches; wing pattern interrupted by hyaline areas along veins. Male differs from female only in sex characters.

This species with its fenestrate wings is not likely to be confused with any other species found in New York. This species is not represented in any of the early collections studied by the writer and it is possible that it has extended its range into the State in relatively recent years. Although considered a rare species it is now found in most of the mountainous areas of the State and in Allegheny State Park (New York) it is the most abundant and annoying deerfly in late June and July. The writer has seen it in numbers attempting to bite during a heavy rain. It is an aggressive species and attacks with a loud buzzing sound.

C. shermani is most abundant in late June and July and is found into August. The writer has seen a single specimen which was collected at Marcy Dam, Essex County on September 3rd.

Chrysops sordida Osten Sacken (Fig. 40)

Moderate in size (8.5 mm.); black; abdomen with small pale median triangles; tergites with narrow pale hind margins and a pale area laterally on the second or first and second; first basal cell about one half and second about one sixth infuscated; apical spot absent or present as an indefinite dark area. Male much darker; both basal cells almost entirely infuscated; apical spot more distinct than in female.

This northern form is confined to the higher Adirondacks and probably reaches its southern limit of distribution in this area. A record in the State List for western New York probably is an error. The coloration of the apical portion of the wings of this species is variable since sometimes this area is clear and in other specimens there is an indication of an apical spot.

Nothing is known of the biology of *C. sordida* and since most records are based on single specimens or short series, it probably is of slight economic importance. It has been collected in June, July and August, most of the records being in June.

Chrysops striata Osten Sacken (Fig. 41)

Moderate in size (8 mm.); yellow and black; thorax greenish in ground color; black stripes on abdomen, the median pair usually united on second tergite; first basal cell infuscated; fifth posterior cell mostly hyaline; apical spot broad but usually only about half filling second submarginal cell; frontal callus usually black or brown. Male with yellow areas reduced; second basal cell largely infuscated.

An examination of many of the specimens on which records in the State List are based show them to be *C. aberrans* and all records which the writer has been unable to confirm are omitted from the map. *C. striata* often flies with *C. aberrans* and resembles this species but the two forms may be separated by the characters given in the key. It seems to be somewhat less common than *C. aberrans* and like that species is most common in the cat-tail swamps along the shore of Lake Ontario.

It flies from June until late August and is most abundant in July.

Larvae have been collected in mud on the edge of ponds and in sandy soil swept by tides. It probably also breeds in the swamps where the adults are common.

Chrysops univittata Macquart (Fig. 42)

Moderate in size (7.5 mm.); yellow and black; thorax greenish gray in ground color; abdomen with yellow median stripe between 2 black stripes of varying width, laterally yellow; first basal cell infuscated; fifth posterior cell mostly hyaline; apical spot very broad; hyaline triangle small and irregular in outline; frontal callus black or dark brown. Male with broader black abdominal stripes; second basal cell half or more infuscated.

This is a common species in many parts of the State but has not been collected on the flat Ontario Plain west of the Genesee River and in general is rarely seen within twenty miles of Lake Ontario. In western New York it is largely restricted to hilly areas but in southeastern New York and Long Island it is generally distributed. On Long Island it is sometimes extremely abundant and during its flight season is a pest of humans and animals.

C. univittata flies from June until early September but is most abundant from late June through July.

The larvae have been collected in mud and plant debris from the edges of ponds and streams.

Chrysops vittata Wiedemann (Fig. 43)

Moderate in size (8 mm.); yellow and black; thorax yellow in ground color; black stripes on abdomen; first basal cell infuscated; fifth posterior cell largely infuscated; apical spot broad; frontal callus yellow. Male with yellow areas reduced; second basal cell largely infuscated.

This is the commonest deerfly in New York and there probably is no portion of the State where it is not seen. Although found in almost any habitat, the adults are most abundant in low lying wooded areas. It is a severe pest of livestock throughout the State but seems to show a definite preference for humans.

In upstate New York it flies from mid June until early September but is most numerous during July and early August. On Long Island is has been collected into October.

The larvae have been collected in wet soil and plant debris from the edges of streams, ponds and lakes as well as from saturated soil under trees.

Chrysops wiedemanni Krober (Fig. 44)

> Rather small (7 mm.); black or dark brown; abdomen with a median yellowish stripe and sometimes similar shorter sublateral stripes; both basal cells hyaline; apical spot broad and nearly separated from crossband. Male with first basal cell infuscated.

As indicated on the map this species is found throughout New York. It is often common enough to be considered a pest but never seems to reach the abundance found in *C. univittata* and *C. vittata.* Unlike most deerflies it is quiet in its attack and it has been the writer's experience that humans are more likely to be bitten by this species than by any other. Often the first indication of its presence is a sharp pain back of the ear or on the cheek; these two spots seem to be favorite points of attack. It is partial to wooded areas.

The body coloration of *C. wiedemanni* is very variable. The abdominal pattern varies from three distinct yellow stripes to only a trace of a median stripe. For many years this species was called *C. obsoleta,* a name properly belonging to a quite unrelated species.

This species is found from late May until early September but it is most abundant in July and early August.

The larvae have been found in wet soil and plant debris on the edge of both sluggish and swift streams, in mud at the edge of ponds and lakes and in marshes.

CHRYSOZONA Meigen

The name *Haematopota* Meigen is often used in the literature for this genus. No representatives of the genus have been reported from New York. *Chrysozona rara* (Johnson) has been collected in New Jersey and Pennsylvania but appears to be quite rare. It is probable that it will be collected eventually in southeastern New York and on Long Island.

C. rara is about the size of a small *Chrysops* and is distinguished from all other northeastern Tabanidae by the gray and white lace-like wing pattern.

DIACHLORUS Osten Sacken

Diachlorus ferrugatus (Fabricius) is found as far north as New Jersey and may eventually be collected on Staten Island or Long Island. Although it is in a different subfamily, it looks much like a *Chrysops* in general appearance. It is an annoying pest of man and animals in some of the southern states.

MICROTABANUS Fairchild

This genus contains a single species *M. pygmaeus* (Williston) which is rare throughout its range. A male of this species labeled "Erie Co., N.Y." is in the collection of Dr. C. B. Philip and has been studied by the writer. It matches quite well males of this species in the writer's collection from Florida and North Carolina. Unless an error in labeling is involved, it appears that this species is found in New York although previously it has not been recorded north of Delaware.

ATYLOTUS Osten Sacken

Four species of this genus are found in New York. All of them are rather small hairy insects of little economic importance. Although most specimens are easily placed to species, apparent intergrades are not uncommon and make definite determinations difficult.

KEY TO THE SPECIES OF NEW YORK *ATYLOTUS*

1. Pleural hairs bright yellow; basal portion of third antennal segment about as broad as long ..... **bicolor** (Wied.)
   Pleural hairs gray; basal portion of third antennal segment variable, slender to broad 2
2. Hair of abdomen white; basal portion of third antennal segment stout with dorsal angle usually near middle of length; frons of female moderate in width ..... **ohioensis** (Hine)
   Hair of abdomen yellow; basal portion of third antennal segment with dorsal angle basad of middle, shape variable, often somewhat slender; frons of female rather narrow 3
3. Abundant black hair on palpi and prescutal lobe; abdomen in female dark brown, narrowly yellowish on sides of first two tergites; hair of venter often white on first two segments; genae yellowish at least on upper portions ..... **pemeticus** (Johns.)
   Only scattered black hairs on palpi and prescutal lobe; abdomen in female usually fuscous in center, broadly yellowish on sides; hair of venter mostly yellow; genae gray with gray hairs ..... **thoracicus** (Hine)

Atylotus bicolor (Wiedemann) (Fig. 45)

Small to moderate in size (11 mm.); yellow or light orange: abdomen with a median indefinitely outlined dark area; wings hyaline, costal cell hyaline or pale yellow; eyes hairy. Male eye facets differentiated; eyes hairy.

This species does not seem to be common although it is widely distributed. *A. bicolor* has been collected flying around livestock in New York but the writer has never observed it actually sucking blood. If it does occa-

sionally attack animals, it is of minor importance. The adult is found in June, July and August with most collections being in July.

The larvae of *A. bicolor* have been collected from such diverse habitats as the muddy banks of ponds and streams, wet sod and from sod in salt marshes. Adults are often collected in sphagnum bogs so it is likely that the larvae are also found in sphagnum.

Atylotus ohioensis (Hine) (Fig. 46)

> Small in size (9 mm.); grayish black; abdomen often grayish laterally on first 2 tergites; wings hyaline, costal cell sometimes faintly tinged with yellow; eyes hairy. Male eye facets differentiated; abdomen laterally with a more extensive pale area than in female; eyes hairy.

A. ohioensis is the only *Atylotus* which on several occasions has been observed attacking man and animals in New York. It has been collected while feeding on cows and attacks man much like *Chrysops*. A few specimens have been collected in June but the majority of records are in July.

Larvae of this species have been collected in saturated pasture sod but since it, like other members of the genus, are commonly found in sphagnum bogs it is likely that the larvae will also be found in sphagnum.

Atylotus pemeticus (Johnson) (Fig. 47)

> Small to moderate in size (11 mm.); dark yellowish brown; abdomen usually paler laterally; wings hyaline, costal cell pale yellow; eyes hairy. Male eye facets differentiated; abdomen laterally often more extensively pale than in female; eyes hairy.

This species seems to be the rarest *Atylotus* found in New York. Except for one Long Island record in late June and another in early August, all collection records are in July. Occasional specimens are collected in sphagnum areas in association with *A. thoracicus* and others have been found in non-sphagnum marshes.

Nothing seems to be known of the early stages of *A. pemeticus*.

Atylotus thoracicus (Hine) (Fig. 48)

> Small in size (10 mm.); dull yellowish; abdomen with a median indefinitely outlined dark area which is broader posteriorly; wings hyaline, costal cell pale yellow; eyes hairy. Male eye facets differentiated; eyes hairy.

This species is closely related to *A. pemeticus* but most specimens may be separated by the characters given in the key. However, the line of demarcation between the two forms is not distinct and further study will be necessary to clarify it.

Although not a common species, *A. thoracicus* is sometimes found in relatively large numbers in sphagnum bogs and in such situations the

males are as common as females. The flight of this species is weak and when disturbed it rarely flies more than a few yards. The species may be abundant in local areas but there are no reports of this species attempting to bite.

Almost all collection records are in July with a very few August records. Nothing is known of the biology of this species but the larvae probably are found in sphagnum.

TABANUS Linnaeus

The major pests of livestock belong to this genus, which includes some of the largest flies found in New York. Some species are irritating to humans under certain conditions. They are commonly called Horseflies and some species for obvious reasons Greenheads.

For the purposes of this paper it was considered best to retain in *Tabanus* most of the species placed there by earlier workers. Many attempts have been made to split *Tabanus* into a number of genera but the intergradation of characters has led to confusion when the World fauna is taken into consideration. *Tabanus,* in spite of its somewhat unwieldy size as a genus, is rather homogeneous and the writer prefers to adopt a conservative attitude toward splitting it.

There is considerable justification for considering those species with hairy eyes and an ocellar tubercle as distinct. Of late years the most commonly used name for this group is *Hybomitra* Enderlein used either in the generic or subgeneric sense. However, these two characters do not always go together. In the New York fauna *T. cinctus* and *T. difficilis* have practically bare eyes but both possess an ocellar tubercle: *T. reinwardtii* has bare eyes in the female and hairy eyes in the male and lacks an ocellar tubercle. Some nearctic species have hairy eyes in both sexes but lack an ocellar tubercle.

New York species which would fall in *Hybomitra* are *affinis* and its subspecies *aurilimbus, astutus, cinctus, daeckei, difficilis, epistates, frontalis* and its subspecies *septentrionalis, hinei, illotus, lasiophthalmus, metabolus, microcephalus, minusculus, nudus, trepidus, trispilus, typhus* and *zonalis.*

One species, *T. cymatophorus* O.S., recorded in the State List, is omitted. The writer has studied the specimens on which this record was based and they are all *T. reinwardtii.* Two other species, *T. rhombicus* and *T. longus,* are of doubtful occurrence but since the writer has been unable to locate the specimens used for these records, they are included in the key. The writer strongly suspects that the specimen of *T. fulvicallus* from Saranac Lake, now in the collection of The Ohio State University, is the one on which the *T. longus* record is based.

In the brief descriptions of *Tabanus* which precede the discussion of each species, forms averaging under 10 mm. in length are considered small, those from 13 to 17 mm. moderate in size and those 19 mm. or more

as large. Characters given for the male include primarily those which are not present in the female or differ from the female. The identity of the male is unknown or doubtful for the following species: *atratus* subsp. *fulvopilosus, fulvicallus* and *longus.*

KEY TO THE SPECIES OF NEW YORK *TABANUS*

I. Females

1. Vertex without an ocellar tubercle; eyes bare or indistinctly hairy 23
   Vertex with an ocellar tubercle; eyes usually distinctly hairy .... (**Hybomitra**) 2
2. Black species with first 3 abdominal segments mostly bright orange .. **cinctus** Fab.
   Abdomen otherwise marked 3
3. Abdomen without median stripe or triangles but with posterior margins of all segments with yellowish or whitish bands ..... **zonalis** Kirby
   Abdomen with median markings 4
4. Subcallus denuded and shining 5
   Subcallus pollinose 11
5. Subcallus swollen; whole face below eyes denuded and shining; small species with dark wing markings 6
   Subcallus normal; face below eyes not shining 7
6. Basal portion of third antennal segment orange; wing markings faint **hinei** John.
   Basal portion of third antennal segment mostly black; wing markings distinct **hinei** subsp. **wrighti** Whitn.
7. Abdomen broadly orange-brown laterally, the median black area usually constricted on the third segment 8
   Abdomen not broadly orange-brown laterally, if paler laterally the median dark area on the third segment is broad and not constricted 9
8. Basal callus shiny and protuberant; all cross veins strongly spotted with brown **lasiophthalmus** Macq.
   Basal callus flat and wrinkled; spots on cross veins if present not clear cut and distinct ..... **nudus** McD.
9. Eyes apparently bare; basal portion of third antennal segment narrow; abdomen brownish, faintly reddish-brown laterally and with a median row of indistinct whitish triangles ..... **difficilis** Wied.
   Eyes hairy and not with above combination of characters 10
10. Bifurcation of third longitudinal vein with a distinct brown spot; third antennal segment stout with distinct dorsal excision; prescutal lobe orange-brown **metabolus** McD.
    Bifurcation without a distinct spot; third antennal segment rather slender; prescutal lobe black ..... **rhombicus** O.S.
11. (4) Abdomen broadly orange-brown laterally, the median black area usually constricted on the third segment 12
    Abdomen not as above, if paler laterally median dark area of third segment is broad and not constricted 16
12. Second palpal segment stout, especially at base 13
    Second palpal segment slender 14
13. Frons about 5 times as high as width at base, widened above; basal portion of third antennal segment mostly orange and about two thirds as wide as long **epistates** O.S.
    Frons about three and one half times as high as width at base, almost parallel sided; basal portion of third antennal segment usually at least half black and about as wide as long (coastal form) ..... **daeckei** Hine
14. Second palpal segment unusually slender, at least 5 times as long as greatest width; basal portion of third antennal segment about four fifths as wide as long and annulate portion rather short; hind tibial fringe black ..... **trepidus** McD.
    Second palpal segment moderately slender, not more than 4 times as long as greatest width; basal portion of third antennal segment not more than three fifths as wide as long and annulate portion relatively long; hind tibial fringe usually black but sometimes extensively yellow 15
15. Basal callus quadrangular, rarely joined to median callus; basal portion of third antennal segment rather deeply excised; palpi yellowish white, about 3 times as long as greatest width ..... **affinis** Kirby

Basal callus rounded above and often joined to median callus; basal portion of third antennal segment rather slender and not deeply excised; palpi yellow, three and a half to 4 times as long as greatest width
affinis subsp. **aurilimbus** Stone

16. Abdomen black with a median row of distinct white triangles and no sublateral spots ..... **trispilus** Wied.
Abdomen otherwise marked 17

17. Second palpal segment slender, scarcely thickened at base 18
Second palpal segment stout, especially so at base 20

18. Femora, except base of hind femora, brown; sides of abdomen reddish brown
minusculus Hine
Femora black 19

19. Prescutal lobe reddish; third antennal segment not especially slender; hair of palpi short and even ..... **typhus** Whitn.
Prescutal lobe black; third antennal segment slender; hair of palpi long and uneven ..... **astutus** O.S.

20. Bifurcation of third longitudinal vein with a distinct spot; third antennal segment stout ..... **illotus** O.S.
Bifurcation without a distinct spot; third antennal segment more slender 21

21. Legs nearly uniformly brownish, rarely femora somewhat darker; third antennal segment very slender ..... **microcephalus** O.S.
Femora black or grayish 22

22. Sublateral abdominal spots yellow, large and contiguous ..... **frontalis** Wlk.
Sublateral spots if present grayish, small and not contiguous
frontalis subsp. **septentrionalis** Lw.

23. (1) Abdomen unicolorous or with narrow indistinct posterior bands 24
Abdomen with one or more median triangles or a median stripe 31

24. Subcallus denuded; body and wings entirely or almost entirely black; abdomen often with a whitish bloom 25
Subcallus not denuded; wings at least partly hyaline 27

25. Mesoscutum with orange hair laterally ..... **atratus** subsp. **fulvopilosus** John.
Mesoscutum entirely black 26

26. Wing uniformly dark brown to black ..... **atratus** Fab.
Wing brown with a yellowish tinge along posterior border
atratus subsp. **nantuckensis** Hine

27. Palpi dark brown to black 28
Palpi pale to reddish brown 30

28. Mesonotum dark brown ..... **nigrescens** Palisot
Mesonotum white pollinose 29

29. Frons orange brown, moderate in width; wing veins not margined with brown although darker clouds may be present ..... **stygius** Say
Frons gray, broad; wing veins margined with brown ..... **subniger** Coqu.

30. Wing hyaline with dark brown costal cell; abdomen usually with narrow gray posterior bands ..... **americanus** Forster
Wing uniformly dilutely infuscated; costal cell yellow; abdomen sometimes with traces of small median triangles ..... **calens** L.

31. (23) Abdomen with a longitudinal median stripe which may or may not be somewhat widened at posterior margins of segments 32
Abdomen with median markings not forming an uninterrupted stripe 41

32. Lateral markings forming a stripe on each side of median stripe and parallel to it but often shorter than median stripe; spots forming median stripe nearly parallel sided 33
Lateral markings broken into separate, often roundish spots; spots forming median stripe usually widened at posterior margins of abdominal segments 37

33. Prescutal lobe usually paler than mesonotum; frons widened above; annulate portion of third antennal segment usually shorter than basal portion; costal cell usually hyaline; eye in life with 2 purple bands 34
Prescutal lobe concolorous with rest of mesonotum; frons nearly parallel sided; annulate portion of third antennal segment usually longer than basal portion; costal cell infuscated; eye in life with a single purple band 36

34. Scutellum and thorax concolorous ..... **lineola** Fab.
Scutellum reddish, sometimes faintly, on posterior margin 35

35. Legs predominantly reddish ..... **lineola** subsp. **scutellaris** Wlk.
Femora of at least fore and hind legs darkened .. **vittiger** subsp. **schwardti** Philip

36. Costal cell deep yellow; thorax bright yellow pollinose; palpi yellow **quinquevittatus** Wied.
Costal cell usually weakly colored; thorax grayish; palpi whitish **nigrovittatus** Macq.

37. Frons narrow, widened above 38
Frons broader, parallel sided 39

38. Gray-brown species; costal cell hyaline; basal portion of third antennal segment very narrow, dark yellow-brown; palpi white ..... **sackeni** Fairch.
Yellowish species; costal cell colored; basal portion of third antennal segment broader, bright orange; palpi yellow ..... **fulvulus** Wied.

39. Second palpal segment much swollen basally; median abdominal stripe broad **sagax** O.S.
Second palpal segment not very swollen basally; median abdominal stripe narrow 40

40. Pale markings of abdomen yellowish brown, the sublateral spots touching the hind margins of the segments ..... **sublongus** Stone
Pale markings grayish, the sublateral spots small and separated from the hind margins ..... **longus** O.S.

41. (31) Thorax white pollinose; abdomen dark with white triangles 42
Thorax not white or contrasting strongly with the abdomen 43

42. Large white triangles on third, fourth and fifth abdominal segments; fore tibiae bicolored ..... **trimaculatus** Palisot
Small white triangles on the second to sixth abdominal segments; fore tibiae essentially unicolorous ..... **superjumentarius** Whitn.

43. Abdomen with both median and sublateral spots 44
Abdomen without sublateral spots although abdomen may be paler laterally 52

44. Bifurcation of third longitudinal vein with a dark spot; grayish species 45
Bifurcation without a dark spot; color variable 46

45. Median and sublateral spots broadly joined along base of abdominal segments; frons narrow, basal callus higher than wide ..... **cymatophorus** O.S.
Median and sublateral spots narrowly or not at all joined along base of abdominal segments; frons broad, basal callus almost square ..... **reinwardtii** Wied.

46. Small species, usually 12 mm. or less; frons widened above; costal cell hyaline .. 47
Larger species, usually 13 mm. or more and differing in at least one other character from above 49

47. Median callus large; palpi not swollen basally or sharply pointed; eye in life with 2 purple bands ..... **pumilus** Macq.
Median callus slender; palpi swollen basally but with apex acute; eye in life unicolorous or with a single purple band 48

48. Eye unicolorous ..... **sparus** Whitn.
Eye with a single purple band ..... **sparus** subsp.**milleri** Whitn.

49. First antennal segment swollen above; sides of subcallus with a few hairs laterally **fairchildi** Stone
First antennal segment not swollen above; sides of subcallus without hairs 50

50. The sublateral white abdominal spots considerably larger than the small median triangles and usually reaching anterior border of second and third segments **nivosus** O.S.
The median triangles are relatively larger and sublateral spots smaller rarely extending to anterior border of segments 51

51. Vertex depressed with a swollen adjacent area; frons about 4 times as high as wide; last antennal annulus yellow; median triangle of third abdominal segment narrowly reaching anterior margin ..... **fulvicallus** Philip
Vertex slightly depressed or flat; frons about three and one half times as high as wide; last antennal annulus black; median triangle of third abdominal segment not reaching anterior margin ..... **vivax** O.S.

52. (43) Bifurcation of third longitudinal vein with a brown spot 53
Bifurcation without a brown spot although veins may have indistinct brown margins 55

53. Fore tibiae unicolorous; median abdominal spots long and narrow .. **recedens** Wlk.
Fore tibiae bicolored, the basal portion pale 54

54. Frons narrow, 5 times or more as high as wide; first posterior cell normally closed; all femora black ..... **abdominalis** Fab.
Frons moderately wide, about 4 times as high as wide; first posterior cell normally open although often much narrowed at margin; at least middle femora brownish ..... **sulcifrons** Macq.

55. Wings with a smoky tinge; costal cell heavily colored; large species with median triangles small or obsolete 56
Wings hyaline; costal cell hyaline or slightly tinted; smaller species with conspicuous median triangles 58

56. Fore tibiae bicolored ..... **novae-scotiae** Macq.
Fore tibiae unicolorous 57

57. Third antennal segment reddish yellow; median abdominal triangles faint and arising from faint posterior bands; first posterior cell narrowed toward margin ..... **calens** L.
Third antennal segment partly black; median triangles small but distinct and not arising from bands; first posterior cell not narrowed ..... **catenatus** Wlk.

58. At least fore tibiae bicolored; first posterior cell much narrowed and sometimes closed at wing margin; subcallus pollinose; usually over 15 mm. ..... **melanocerus** Wied.
Tibiae unicolorous although fore tibiae may be slightly paler at base; first posterior cell slightly or not at all narrowed at margin; subcallus thinly pollinose or denuded; usually under 15 mm. ..... **nigripes** Wied.

KEY TO THE SPECIES OF NEW YORK *TABANUS*

II. Males

1. Stiff hairs along mid line between eyes ..... **difficilis** Wied.
No stiff hairs along mid line between eyes 2

2. Eyes hairy 3
Eyes bare 27

3. Black species with first 3 abdominal segments mostly bright orange ..... **cinctus** Fab.
Abdomen otherwise marked 4

4. Abdomen without median stripe or triangles but posterior margins of segments with yellowish or whitish bands ..... **zonalis** Kirby
Abdomen with median markings 5

5. Small dark species with gray, protuberant frontal triangle; genae black, somewhat shining; a dark cloud on wing near stigma 6
Differing in one or more characters from the above 7

6. Basal portion of third antennal segment mostly orange; wing markings faint ..... **hinei** John.
Basal portion of third antennal segment mostly black; wing markings distinct ..... **hinei** subsp. **wrighti** Whitn.

7. Cross veins and bifurcation of third longitudinal vein with distinct dark spots 8
Wings hyaline, tinted or with bifurcation only having a dark spot 9

8. Rather large grayish species with 3 rows of gray triangles on abdomen ..... **reinwardtii** Weid.
Blackish species; sides of first 3 abdominal segments broadly orange ..... **lasiophthalmus** Macq.

9. Abdomen with a conspicuous parallel sided median longitudinal white stripe and a similar stripe on each side of it ..... **vittiger** subsp. **schwardti** Philip
Abdomen without a conspicuous parallel sided median stripe 10

10. First antennal segment strongly swollen above; hair on eyes sparse ..... **fairchildi** Stone
First antennal segment not swollen above; hair on eyes usually heavy 11

11. Abdomen black, obscurely reddish laterally but no distinct sublateral spots; a conspicuous row of white median triangles ..... **trispilus** Wied.
Abdomen otherwise marked 12

12. Small species not over 12 mm. with very small slender second palpal segment; sides of abdomen broadly dark orange but first segment usually completely black; third antennal segment with a very shallow dorsal excision ..... **minusculus** Hine
Species usually over 12 mm. or if smaller, second palpal segment stout and dorsal excision distinct 13

13. Prescutal lobe black 14
Prescutal lobe reddish at least on disc 16
14. Femora brown ..... **microcephalus** O.S.
Femora black 15
15. Second palpal segment stout, blunt; thorax black, somewhat shining **rhombicus** O.S.
Second palpal segment small, not much larger than first segment; thorax dull **astutus** O.S.
16. Abdomen broadly orange-brown laterally, median black area constricted on third abdominal segment 17
Abdomen not broadly orange laterally; orange sublateral spots may be present but black area on the third segment is not constricted 25
17. Median black area of abdomen vary narrow and usually finely divided by a narrow, pale longitudinal line; a large square dark area reaches completely across second abdominal sternite ..... **daeckei** Hine
Median black area variable, not divided by a pale line 18
18. First abdominal sternite almost entirely black or with a small orange area sublaterally 19
First sternite orange, occasionally with a small dark area in the center 22
19. Frontal triangle protuberant; base of third antennal segment rather stout; palpi very stout, grayish brown; anterior portion of wing often infuscated along veins, in basal cells and at bifurcation of third longitudinal vein; costal cell tinted .. 20
Frontal triangle rather flat; base of third antennal segment slender; palpi moderately stout, yellowish brown; wing often dilutely infuscated but without intensification in anterior portion; costal cell dilutely tinted or clear 21
20. Claws of fore tarsi subequal; median black area of abdomen rather broad **metabolus** McD.
Outer claw of fore tarsi longer than inner claw; median black area of abdomen rather narrow ..... **nudus** McD.
21. Hairs of venter of abdomen black with many golden yellow hairs on second, third and fourth sternites ..... **frontalis** Wlk.
Hairs of venter mostly black with some pale hairs intermixed; paler on incisures; median black area of abdomen somewhat wider than in typical form **frontalis** subsp. **septentrionalis** Lw.
22. Third antennal segment including annuli reddish; second palpal segment very stout, only slightly longer than thick ..... **epistates** O.S.
Third antennal segment with at least annuli black; second palpal segment moderately stout to slender 23
23. Large and small eye facets differentiated; second palpal segment at least twice as long as thick; usually under 15 mm. ..... **trepidus** McD.
Almost no differentiation in size of eye facets; usually 16 mm. or more; second palpal segment variable 24
24. Second palpal segment yellowish white, about one and a half times as long as thick; base of third antennal segment distinctly excised ..... **affinis** Kirby
Second palpal segment yellow, about twice as long as thick; base of third antennal segment slender and shallowly incised; median black area of abdomen usually much reduced ..... **affinis** subsp. **aurilimbus** Stone
25. Second palpal segment slender, twice as long as thick; areas of large and small eye facets sharply differentiated ..... **typhus** Whitn.
Second palpal segment robust, less than twice as long as thick; eye facets nearly uniform in size 26
26. Costal cell deeply tinted; claws of fore tarsi subequal; entire insect rather shining **metabolus** McD.
Costal cell moderately tinted; outer claw of fore tarsi about one third longer than inner claw ..... **illotus** O.S.
27. (2) Abdomen unicolorous or with narrow indistinct pollinose bands 28
Abdomen with median markings 34
28. Palpi orange brown to yellow 29
Palpi dark brown to black 30
29. Wing dilutely infuscated, costal cell darker; hind tibial fringe black .... **calens** L.
Wing hyaline, costal cell deep yellow; hind tibial fringe orange **americanus** Forster

30. Wing heavily infuscated 31
Wing dilutely infuscated or clear, a black spot at bifurcation of third longitudinal vein 32

31. Wing completely black ..... **atratus** Fab.
Wing brownish to black with a yellowish tinge along posterior border **atratus** subsp. **nantuckensis** Hine

32. Lower margin of area of large facets of eye somewhat sinuate and at lowest point about on level with top of antennal pits ..... **subniger** Coqu.
Lower margin of large facets more nearly straight and somewhat higher than antennal pits 33

33. Integument of thoracic dorsum brown, contrasting strongly with black abdomen; wing membrane, except for spots, rather uniformly dilutely infuscated **stygius** Say
Integument of thoracic dorsum dark brown to black, usually contrasting but slightly with black abdomen; apex of wing, except for spots, almost hyaline **nigrescens** Palisot

34. Abdomen with a longitudinal stripe which may or may not be somewhat widened at posterior margins of segments 35
Abdomen with median markings not forming an uninterrupted stripe 42

35. Lateral markings of abdomen forming a stripe on each side of median stripe and parallel to it but usually shorter than median stripe; spots forming median stripe nearly parallel sided 36
Lateral markings broken into separate often roundish spots; spots forming median stripe usually wider at posterior margin of each segment 39

36. Prescutal lobe usually paler than mesonotum; annulate portion of third antennal segment usually shorter than basal portion; costal cell usually hyaline 37
Prescutal lobe usually concolorous with mesonotum; annulate portion of third antennal segment as long or longer than basal portion; costal cell infuscated .. 38

37. Scutellum and thorax concolorous ..... **lineola** Fab.
Scutellum reddish, sometimes faintly, on posterior margin **lineola** subsp. **scutellaris** Wlk.
(If upper eye facets enlarged and femora dark see **vittiger** subsp. **schwardti**—Couplet 9)

38. Palpi and pleura deep yellow; costal cell heavily infuscated .. **quinquevittatus** Wied.
Palpi white, pleura grayish; costal cell lightly infuscated .... **nigrovittatus** Macq.

39. Hair and pollen of pleura yellow; area of large and small eye facets scarcely differentiated ..... **fulvulus** Wied.
Hair and pollen of pleura gray; area of large and small facets distinctly differentiated 40

40. Hair of thoracic dorsum gray; sublateral abdominal spots grayish; costal cell hyaline ..... **sackeni** Fairch.
At least short hairs of thoracic dorsum yellow; sublateral abdominal spots yellow; costal cell tinted 41

41. Median abdominal stripe broad; face below eyes with many black hairs, beard yellowish white; second palpal segment stout, yellow brown with many black hairs ..... **sagax** O.S.
Median abdominal stripe narrow; face with almost no black hairs, beard pale gray; second palpal segment relatively slender, pale yellowish white with few black hairs ..... **sublongus** Stone

42. Abdomen with median spots or triangles and at least some tergites with sublateral spots 43
Abdomen with median spots or triangles; no distinct sublateral spots although some tergites may be paler laterally 49

43. First antennal segment swollen above; third antennal segment entirely black; eyes sometimes with sparse hairs ..... **fairchildi** Stone
First antennal segment not swollen; third antennal segment variable; eyes bare .. 44

44. Bifurcation of third longitudinal vein and cross veins with brown spots **cymatophorus** O.S.
Wings hyaline or with a faint spot at bifurcation 45

45. Fore tibiae entirely black; sublateral spots very large often crossing second and third tergites; third antennal segment black ..... **nivosus** O.S.
Fore tibiae paler at base; sublateral spots smaller rarely crossing any tergite; third antennal segment not entirely black 46

46. Moderate sized species, 14–15 mm.; second palpal segment yellow brown about twice as long as wide; median triangles fairly large, sometimes crossing tergite; sublateral spots reaching posterior margin of at least second tergite; costal cell somewhat tinted ..... **vivax** O.S.
Small species, usually under 11 mm. second palpal segment whitish, less than twice as long as thick; median triangles small, never crossing tergite; sublateral spots small, rarely reaching posterior margins of tergites; costal cell hyaline 47

47. Tibiae same color as reddish brown to brown femora or slightly paler basally; antennae yellowish often with annulate portion somewhat darker; basal portion of third antennal segment 2 and one half to 3 times as long as wide; occipital tubercle prominent and often projecting above level of eyes ..... **pumilus** Macq.
Tibiae distinctly paler than dark femora except apex of fore tibia which is dark; antennae uniformly dull brownish; basal portion of third antennal segment about twice as long as wide; occipital tubercle inconspicuous and compressed, usually not reaching level of eyes 48

48. Eyes in life without stripes ..... **sparus** Whitn.
Eyes in life with a single purple stripe ..... **sparus** subsp. **milleri** Whitn.

49. Pale thorax sharply contrasting with dark abdomen which has distinct white median triangles on the third to fifth tergites; fore tibiae bicolored **trimaculatus** Palisot
Not with the above combination of characters 50

50. Bifurcation of third longitudinal vein with a brown spot 51
Bifurcation without a brown spot 53

51. Legs including fore tibiae uniformly brown; abdomen mahogany brown with very narrow alongate median white triangles ..... **recedens** Wlk.
Fore tibiae bicolored or at least paler at base; at least fore femora black; abdominal triangles if present broad 52

52. Pale median abdominal triangles conspicuous; middle femora often brownish; wing membrane lightly tinted ..... **sulcifrons** Macq.
Pale median abdominal triangles obsolete but with heavy median black spots; all femora deep black; wing heavily tinted especially anteriorly .. **abdominalis** Fab.

53. Frontal triangle denuded and somewhat protuberant; abdominal triangles often indistinct; smaller species, usually under 13 mm. ..... **nigripes** Wied.
Frontal triangle not denuded; larger species rarely smaller than 15 mm. and as large as 25 mm. 54

54. Facets of eyes all about same size; median triangles very small ..... **calens** L.
Upper facets of eye larger than lower facets with line of demarcation distinct .. 55

55. Median triangle usually absent from tergite 2 or very small if present; large eye facets occupying about half total eye area ..... **superjumentarius** Whitn.
Median triangle present on tergite 2 and about same size as those on tergites 3 and 4; large eye facets occupying about two thirds of total eye area 56

56. Femora dark brown or black; excision of third antennal segment moderate **melanocerus** Wied.
Femora orange brown or chestnut brown; excision of third antennal segment deep 57

57. Legs almost uniformly brown, tarsi somewhat darker; genae brown; second palpal segment brown; abdomen uniformly dark brown with small median triangles **catenatus** Wlk.
Middle and hind tibiae and base of fore tibiae paler than femora; genae grayish; second palpal segment yellow brown; abdomen reddish brown laterally with median triangles on a narrow black stripe ..... **novae-scotiae** Macq.

Tabanus abdominalis Fabricius

Fairly large (20 mm.); orange to reddish brown; abdomen with a median row of black spots indented behind by indefinite pale or orange triangles; fore tibiae pale at base; all femora black; wing heavily tinted, with dark spots and dark yellow costal cell, discal cell paler than surrounding membrane; frons very narrow; eyes bare. Male with eye facets differentiated but line of demarcation not very distinct; eyes bare.

This species has not been recorded from New York but since it has been reported from Massachusetts, Connecticut, New Jersey and Pennsylvania, it may be found in the State. All New York specimens determined as *abdominalis* and seen by the writer are actually *T. sulcifrons* in his opinion and it is probable that at least some of the records from the States mentioned above are also *sulcifrons*.

Tabanus affinis Kirby (Fig. 49)

> Moderate in size (18 mm.); brownish; abdomen broadly orange brown laterally; wings usually with a faint tint which becomes heavier along longitudinal viens; costal cell yellow; eyes hairy. Male eye facets scarcely differentiated; eyes hairy.

What the writer considers to be the typical form of this species seems to be restricted to the Adirondack area in New York. In some parts of Canada this species is often abundant and of considerable economic importance but it has not been found in large numbers in New York. It is an early season species with most of the records in June and early July.

Tabanus affinis subspecies **aurilimbus** Stone (Fig. 49)

> Moderate in size (17 mm.); orange brown; abdomen broadly orange brown laterally, sometimes reducing dark median area on second and third tergites to a shadow; wing with a yellowish tint; costal cell dark yellow; eyes hairy. Male eye facets scarcely differentiated; black median area of abdomen more extensive than in most females; eyes hairy.

The writer has believed for some time that most specimens assigned to *affinis* from New York south of the Adirondacks represented a different form. The type of *T. aurilimbus* has a yellow hind tibial fringe but the writer has studied series of specimens showing complete intergradation to a black tibial fringe. It appears that the type of this species is an extreme variant and that specimens close to it in other respects probably belong here. For the present, the writer prefers to consider it a subspecies of *affinis*. In addition to the characters given in the key, *aurilimbus* in series is smaller than *affinis* and although its range is south of *affinis*, it flies later in the season.

Males are often collected hovering on hill tops and in openings in forested areas.

All New York specimens studied were collected in July.

Tabanus americanus Forster (Fig. 50)

> Large (27 mm.); reddish brown; abdomen with narrow pale bands on hind margins of tergites; wings hyaline with dark brown costal cell; eyes bare. Male eye facets distinctly differentiated; eyes bare.

T. americanus is the largest Tabanid found in North America, sometimes

reaching a length of 30 mm. Only an occasional specimen is taken in New York although it is a common species in the south. The writer has seen specimens from Southold (Suffolk County), Bronx Park (Bronx County) and Monroe (Orange County), the latter specimen collected in August.

Tabanus astutus Osten Sacken (Fig. 50)

> Moderate in size (14 mm.); brownish black; abdomen with 3 rows of grayish triangles; prescutal lobe dark; wings hyaline, costal cell pale yellow; eyes hairy. Male eye facets scarcely differentiated; pale abdominal markings with an orange cast; eyes hairy.

This species is close to *T. typhus* and the specimens on which the records for *astutus* in the State List are based actually are *typhus*. The only New York specimens of *astutus* which the writer has seen were collected in August at Woodhull Lake (Herkimer County). It is a northern form and probably will be found at other localities in the Adirondacks.

Tabanus atratus Fabricius (Fig. 51)

> Large (24 mm.); black; abdomen sometimes with a whitish or bluish bloom; eyes bare; wings dark brown to black. Male eye facets distinctly differentiated; eyes bare.

This large black horsefly is common over most of New York except in the mountainous areas. Although it rarely appears in sufficient numbers to become a serious pest, its large size and the loud buzzing noise it makes when attacking is very disturbing to horses and cattle. It flies from May to September (October on Long Island) with a maximum abundance in mid summer.

The biology of this species has been studied by a number of workers. The eggs are laid on grass or leaves over marshy areas or streams and the writer has seen oviposition take place on cement bridge abutments. The larvae, which can be found throughout the year, are found in moist earth or in water and appear to tolerate a wide range of moisture conditions. The life cycle normally is completed in one year but some individuals require two years and possibly more.

Tabanus atratus subspecies **fulvopilosus** Johnson (Fig. 52)

> Like typical *atratus* except for orange yellow hair on all or some of the following areas: upper half of prescutal lobe, postalar lobe and a streak above base of wing. Occasional specimens have wings similar to *nantuckensis*.

This and the following subspecies of *T. atratus* seem to be restricted to coastal areas. The male of *fulvopilosus* has not been recognized, but it is possible that males collected at the same time as females of this form

but indistinguishable from typical *atratus* males belong here. The amount of orange hairs is quite variable in the female.

Tabanus atratus subspecies **nantuckensis** Hine (Fig. 52)

Like typical *atratus* but averages a little smaller (21 mm.) and wing is yellowish or brown posteriorly.

Apparent intergrades between this form and typical *atratus* are not uncommon. Both forms fly from May until September.

Larvae of *nantuckensis* have been found in mats of plant debris in salt marshes.

Tabanus calens Linnaeus (Fig. 53)

Large (24 mm.); thorax brown with indistinct reddish lines; abdomen blackish, sometimes with faint pale median triangles; eyes bare; wings pale yellowish with costal cell darker. Male eye facets show little differentiation and line of demarcation not distinct; pale median triangles of abdomen when present usually larger than in female; eyes bare.

This large species is not common in New York. It is a late flying form and all collections except a single July record were made in August.

T. calens for many years was unrecognized and the species was called *T. giganteus* Degeer. However, Linnaeus' name seems to be correctly associated with this species (Philip, 1952, p. 311.).

Tabanus catenatus Walker (Fig. 54)

Large (23 mm.); dark reddish brown; abdomen with a median row of small pale triangles; fore tibiae entirely brown; wings pale yellowish, often darkened anteriorly along veins, costal cell deep yellow; eyes bare. Male eye facets distinctly differentiated; thorax and abdomen from reddish brown to very dark brown; median row of abdominal triangles often indistinct; eyes bare.

Although widely distributed, *T. catenatus* never seems to be very common. This species has sometimes been referred to under the name of *T. orion* O.S. *T. catenatus* flies in late July and August.

Tabanus cinctus Fabricius (Fig. 55)

Moderate to large in size (20 mm.); black with an orange band covering most of first three tergites; subcallus partly denuded; wing with dark yellow tint; eyes practically bare. Male eye facets little differentiated; eyes hairy.

It is not likely that this species with its brilliant yellow or orange band on the abdomen will be confused with any other species in New York. *T. criddlei* Brooks, which has been collected in Ontario, is similar but the subcallus is pollinose.

T. cinctus is not a common form. The males are sometimes found

hovering in the manner described for *T. affinis* subsp. *aurilimbus*. *T. cinctus* flies from June to August with the majority of the collection records being in July.

Tabanus daeckei Hine

Moderate in size (12 mm.); brownish; abdomen broadly orange brown laterally and with a faint pale stripe superimposed on a dark median stripe; second palpal segment somewhat swollen at base; wings including costal cell with a uniform yellow tint; eyes hairy. Male eye facets barely differentiated and without distinct line of demarcation; eyes hairy.

This species has previously been reported from Staten Island and the writer has seen a single male and a single female collected June 15 and June 24 respectively at Babylon (Suffolk County). It is a coastal form and probably breeds in salt marshes. In the coastal area of New Jersey and Delaware it is sometimes a serious pest of livestock.

Tabanus difficilis Wiedemann (Fig. 56)

Moderate in size (13 mm.); dark brown; abdomen rather broad with a median row of inconspicuous pale triangles, obscurely reddish laterally; subcallus denuded; wings hyaline with yellow costal cell; eyes practically bare. Male eye facets scarcely differentiated; a row of stiff black hairs stand erect between eyes; frontal triangle grayish; eyes practically bare.

For many years this species was known as *T. carolinensis* but Macquart's name belongs to another species. It is rarely abundant enough to be a pest but occasionally it appears in local areas in large numbers. Under such circumstances it attacks wild and domestic animals and humans indiscriminately. It is an early season form appearing in late May, most abundant in June and only occasionally found in July.

Tabanus epistates Osten Sacken (Fig. 57)

Moderate in size (14 mm.); brownish; abdomen broadly orange brown laterally; second palpal segment rather swollen; wings with a faint yellowish tinge which deepens anteriorly to include costal cell; eyes hairy. Male eye facets scarcely differentiated; eyes hairy.

T. epistates is found throughout New York but is rarely found in numbers. It is on the wing from May through August but is most common in June and early July.

Tabanus fairchildi Stone (Fig. 58)

Moderate in size (14 mm.); blackish brown with three rows of pale spots on abdomen; antennae black with first segment swollen above; eyes bare or with short scattered hairs; wings hyaline. Male eye facets somewhat differentiated but line of demarcation not distinct; eyes often with short scattered hairs but sometimes apparently bare.

This species was long confused with *T. vivax* O.S. which is also found in New York and most references to *T. vivax* previous to 1938 actually refer to *T. fairchildi.* It is not commonly collected and does not seem to be a serious pest of livestock. It is most abundant in June although it is occasionally collected in July and August.

T. fairchildi differs from most Tabanidae in that the immature stages are spent in swift flowing streams. The eggs are placed on projecting stones or logs in riffles and the eggs of many females are often deposited on the same object resulting in an accumulation of several hundreds of egg masses. The larvae are found under stones, often in the swiftest part of the stream. Pupation probably takes place in mud on the edge of the stream.

Tabanus frontalis Walker (Fig. 59)

Moderate in size (14 mm.); blackish brown; abdomen with faint grayish or yellowish median triangles and yellowish or reddish sublateral spots which, at least on the second and third tergites, reach the hind margins; wing hyaline, costal cell tinged with yellow; eyes hairy. Male eye facets slightly differentiated but line of demarcation indistinct; sublateral abdominal spots usually confluent and often forming a broad sublateral band; eyes hairy.

The writer has seen only 2 specimens of typical *frontalis* from New York. They were collected at Peru (Clinton County) in June and Fargo (Jefferson County) in July.

Tabanus frontalis subspecies **septentrionalis** Loew (Fig. 59)

Moderate in size (14 mm.); blackish; abdomen with faint pale median triangles and rounded gray or pale grayish yellow sublateral spots which usually do not reach the hind margins of the tergites and often are small and faint; wing hyaline, the membrane sometimes with a brownish tint, costal cell tinted; eyes hairy. Male eye facets slightly differentiated but line of demarcation indistinct; sublateral spots larger and more reddish than in female; eyes hairy.

This form is found only in the northern part of the State where it has been collected in June, July and August.

Both *septentrionalis* and typical *frontalis* are serious pests of livestock and wild animals in many parts of Canada but at the southern portion of their range in New York they are not commonly found.

Tabanus fulvicallus Philip

Moderate in size (14.5 mm.); dark brown; abdomen with 3 rows of pale spots with median spots reaching length of tergite on third to fifth segments; vertex notched and somewhat swollen; third antennal segment dark brown to black with last annulus orange brown; wings hyaline; eyes bare.

The writer has seen a single specimen of this rare species from New

York. It was collected at Saranac Inn (Franklin County) on July 27, 1900. Since *T. fulvicallus* has been collected in southern Ontario, it may eventually be found in western New York.

Tabanus fulvulus Wiedemann

Moderate in size (14 mm.); yellowish to orange; abdomen with a yellow median line of large contiguous triangles and sublateral yellow spots; frons very narrow and widened above; third antennal segment moderately broad, orange, annuli black; thoracic dorsum without stripes; wings hyaline; eyes bare. Male eye facets differentiated but not markedly so; eyes bare.

This species has not been collected in New York but since it is found in New Jersey it may be present on Long Island or Staten Island.

Tabanus hinei Johnson (Fig. 60)

Small to moderate in size (11 mm.); abdomen shining black with orange laterally; subcallus denuded; wing tinged with yellow, a dark poorly defined band in vicinity of discal cell, costal cell dark yellow; eyes with short hair. Male eye facets little differentiated; frontal triangle prominent, grayish; eyes hairy.

T. hinei is a coastal form which is also found in a small area near the eastern end of Lake Ontario. It is not likely to be confused with any other species found in New York. It flies from June to August with most records in July. It never appears to be abundant.

T. hinei subspecies *wrighti* is a southern form but occasional New York specimens approach it. It may be separated from the typical form by the characters given in the key.

Tabanus illotus Osten Sacken (Fig. 61)

Moderate in size (13 mm.); brownish black; abdomen with faint median triangles and grey or yellowish gray sublateral spots; wings hyaline with pale yellow costal cell and faint brownish spots; eyes hairy. Male eye facets scarcely differentiated; sublateral abdominal spots larger than in female and usually more yellowish; eyes hairy.

T. illotus is a northern form which does not seem to be found in southeastern New York or on Long Island. Although not usually common in New York it is very aggressive and attacks man as well as livestock. The writer once found both sexes in abundance along the shores of Irondequoit Bay (Monroe County) and mating pairs were collected at this time.

The peak abundance of this species is in middle and late June but there are New York records for May and July.

The larvae are found under debris and in moist earth on the edges of ponds and swamps.

Tabanus lasiophthalmus Macquart (Fig. 62)

Moderate in size (14 mm.); brownish; abdomen broadly orange brown laterally; subcallus denuded; wings hyaline or faintly tinted, with conspicuous dark spots and yellow costal cell; eyes hairy. Male eye facets little differentiated; frontal triangle grayish; eyes hairy.

As is indicated on the map, this species is found throughout the State. It is a serious pest of livestock early in the season and is one of the major economic forms in New York. It first appears in late May and reaches its peak in mid June. Occasional specimens are found until early August.

The eggs are laid on various plants over moist ground but not over open water; the egg mass is small and shining black resembling a drop of tar on the leaf. The larvae are found in moist and wet sod. One year is normally required for the life cyle.

Tabanus lineola Fabricius (Fig 63)

Moderate in size (13 mm.); yellowish, brown or nearly black; abdomen with a pale median stripe and variable sublateral stripes; wings hyaline; frons narrow and distinctly widened above; median callus slender; hind femora mostly dark; scutellum entirely dark; eyes bare. Male eye facets distinctly differentiated; eyes bare.

Typical *lineola* is primarily a coastal form in New York being replaced upstate to a large extent by subspecies *scutellaris*. It is a pest of considerable economic importance since it often appears in large numbers and will attack both man and animals. It is often called Greenhead although that name applies to other species as well.

A melanistic variant of *T. lineola* is the form commonly seen in upstate New York. Long Island specimens often are quite pale. It is on the wing from May to October and is most common in June and early July.

The larvae are found in mud on the edges of ponds and streams but occasionally they are discovered in relatively dry areas. Larvae are also found in salt marshes and this species seems to be quite tolerant of varied conditions of moisture and salinity. Its life cycle normally requires one year but its wide seasonal range indicates the possibility that some individuals at least may complete their development in one season in the warmer portions of the State.

Tabanus lineola subspecies **scutellaris** Walker (Fig. 64)

Moderate in size (13 mm.); brownish to almost black; abdomen with a pale median stripe and sublateral stripes; wings hyaline; frons broader than in typical form, widened above; median callus somewhat broadened; hind femora reddish; scutellum reddish brown at tip; eyes bare. Male eye facets differentiated but size difference is small and line of demarcation often indistinct; general color usually brownish; eyes normally bare but sometimes with a few scattered hairs.

This is the common inland form of *T. lineola.* Probably most of the inland records in the State List refer to this subspecies. Although often quite abundant and frequently a pest of livestock, it never seems to reach the abundance of *T. quinquevittatus.* It is found from June into August with its peak in late June and early July filling the gap between the peaks of *T. lasiophthalmus* and *T. quinquevittatus.*

The larvae have been collected from the edges of ponds, in wet sod and in cultivated ground so apparently it is tolerant of a wide range of moisture conditions.

Tabanus longus Osten Sacken

Moderate in size (14 mm.); dark brown; abdomen with a pale median line of continguous or nearly contiguous triangles and yellowish gray sublateral spots which usually do not touch the hind margins of the tergites; frons moderately broad and parallel sided; third antennal segment fairly slender; wings hyaline; eyes bare.

In the State List this species is reported from Saranac Inn in July but since this is somewhat out of the normal range of the species, the record is doubtful. It is entirely possible that this is the same specimen on which the record of *T. fulvicallus* is based. However, *T. longus* is rare throughout its range and it may possibly be found in New York.

Tabanus melanocerus Wiedemann

Moderate in size (17 mm.); dark brown to blackish; abdomen with a median row of pale triangles and tergites with narrow, sometimes obsolete, pale bands on the hind margins; fore tibiae pale, dark at apex; wings hyaline or tinged faintly yellowish and costal cell sometimes yellow; eyes bare. Male eye facets distinctly differentiated; eyes bare.

This species has been recorded from Connecticut and New Jersey and the writer expected it would be found on Long Island. However, no specimens were seen until 1953 when a single female was collected by Mr. Roy Latham at Riverhead on June 11. On July 30, 1954 he collected three females and two males at the same locality and since the specimens were teneral there is no doubt that it is established on Long Island.

Tabanus metabolus McDunnough (Fig. 65)

Moderate in size (13 mm.); brownish black; abdomen with faint median triangles and yellowish sublateral spots on the second, third and fourth tergites; wings hyaline with a dark yellow costal cell, faint brownish spots and a tendency for the veins toward the base of the wings to be outlined in yellowish brown; subcallus denuded; eyes hairy. Male eye facets scarcely differentiated; thorax and abdomen rather shiny; eyes hairy.

This northern form is rare in New York. All New York records are in June.

Tabanus microcephalus Osten Sacken (Fig. 66)

Moderate in size (14 mm.); grayish black; abdomen with 3 rows of grayish or pinkish gray spots which are largest on the second tergite; legs uniformly brown or reddish; wings hyaline with yellowish costal cell and tendency for veins to be outlined in pale yellow; eyes hairy. Male eye facets scarcely differentiated; sublateral abdominal spots often reddish; eyes hairy.

This species is not common although widely distributed over the State except for the extreme southeastern portion and Long Island. In the writer's experience it usually is found in hilly and mountainous areas. The great majority of the records are in July with a few August finds and one September record.

Tabanus minusculus Hine (Fig. 67)

Small to moderate in size (11 mm.); rather shining blackish brown; abdomen with considerable orange brown laterally; wings tinted with tendency for veins to be outlined in a deeper tint, costal cell yellow; second palpal segment very slender; eyes hairy. Male eye facets scarcely differentiated; eyes hairy.

All the collections of this small species made by the writer have been in sphagnum bogs. Both sexes, which are found in about equal numbers, make short flights between clumps of vegetation and are easily collected. It is found in July and August.

The larva of this species has been found in sphagnum.

Tabanus nigrescens Palisot de Beauvois

Large (22 mm.); black; wing pale yellowish with dark spots and dark costal cell and a deeper color in the basal cells and base of discal cell; eyes bare. Male eye facets distinctly differentiated; thorax often with a brownish tinge; eyes bare.

The writer has seen no specimens of this species from New York and has been unable to locate the specimens from Rochester, Nyack and Staten Island on which the records in the State List are based. A record of this species from Lockport published by the writer (1938) actually is *T. stygius*. However, there is no reason to doubt the occurrence of *T. nigrescens* in New York.

Tabanus nigripes Wiedemann (Fig. 68)

Small to moderate in size (12 mm.): blackish brown; abdomen with a median row of pale triangles and tergites with narrow pale bands on the hind margins; wings hyaline, occasionally with traces of spots and yellow costal cell; subcallus thinly pollinose or partly denuded; eyes bare. Male eye facets distinctly differentiated; frontal triangle prominent, denuded; eyes bare.

This small species is normally found only in the southeastern portion of the State and on Long Island. The writer has also seen specimens

collected while feeding on a cow at Ellis Hollow (Tompkins County). For many years this species was called *T. coffeatus* Macquart.

The larvae have been found in salt marshes and along the margins of small streams.

Tabanus nigrovittatus Macquart (Fig. 69)

Moderate in size (12 mm.); brownish yellow; abdomen with a pale median stripe superimposed on a wider dark stripe, tergites yellowish laterally; pollen of head grayish white, sometimes faintly tinged with yellow; wings hyaline with pale yellow costal cell; frons with sides essentially parallel; eyes bare. Male eye facets distinctly differentiated; eyes bare.

This species is the Saltmarsh Greenhead and is restricted to the coastal area of New York; records in the State List for Ramapo and Gloversville probably are in error. It occurs in great numbers and is of considerable economic importance because of its attacks on man and domestic animals. It is especially attracted to bathers and is a source of considerable annoyance during its flight season, which extends from June to September with a maximum abundance in July and early August.

A considerable amount has been written on the biology and attempted control measures of this species. Most of the larvae are found under marsh straw and mats of other vegetation.

Another "greenhead" *Tabanus lineola* often flies with *T. nigrovittatus* but is readily distinguished in life by two purple eye bands whereas *T. nigrovittatus* has a single eye band.

A larger form of this species with grayer mesonotum and with a greater extension of large eye facets in the male is found with the typical form. This is *Tabanus simulans* Walker (*conterminus* Walker) but because of apparent intergrades wih the typical form, it is not generally recognized as distinct. However, this name might be retained with subspecific rank as a convenient name for this form.

Tabanus nivosus Osten Sacken (Fig. 70)

Moderate in size (13 mm.); blackish brown; abdomen with 3 rows of pale spots, the median row being much smaller than the sublateral rows; wings hyaline; eyes bare. Male eye facets distinctly differentiated; sublateral abdominal spots of even greater extent than in female; eyes bare.

T. nivosus is widely distributed in New York but rarely is abundant enough to be considered a serious pest although it attacks man as well as livestock. It is most common in the hilly and mountainous areas of the State. Except for one August record, all collection records are in June and July.

Tabanus novae-scotiae Macquart (Fig. 71)

Fairly large (20 mm.); reddish brown with thorax sometimes fuscous; abdomen with a median dark longitudinal band which may be broad and distinct or nearly obsolete and a median row of small pale triangles; basal half of fore tibiae yellowish; wing hyaline or faintly tinged with yellowish especially in the costal cell; eyes bare. Male eye facets distinctly differentiated; eyes bare.

For many years this species has gone under the name of *Tabanus actaeon* O.S. but it has been suspected for some time that *novae-scotiae* was an earlier name for this form. This has been confirmed by Philip (in correspondence) who has studied Macquart's type. It resembles *T. catenatus* but may be separated by the characters given in the key.

T. novae-scotiae seems to be rare in New York and has been recorded only 3 times here. Two specimens were taken in late August and one in September. It is a late flying species and it is likely that late season collecting will add additional New York localities, especially near the coast.

Tabanus nudus McDunnough (Fig. 71)

Moderate in size (15 mm.); brownish; abdomen broadly orange brown laterally; subcallus denuded; basal callus rather dull and wrinkled; wings hyaline with veins near base and anteriorly outlined in dark yellow; costal cell yellow; second palpal segment greatly swollen and pale in color; eyes hairy. Male eye facets scarcely differentiated; eyes hairy.

This northern form has been collected in New York only in the Adirondacks. However, the writer has seen specimens from northern New Jersey and it is probably present in the adjoining portion of New York. It is of considerable economic importance in portions of Canada but it is not abundant enough to be a pest in New York. The males have been found hovering on mountain tops and in clearings in wooded areas. A series of hovering males was collected by Dr. Henry Dietrich on the top of Mt. Joe (Essex County) on June 12 and 14, 1949. All records except one in July are in June.

Tabanus pumilus Macquart (Fig. 72)

Small in size (9.5 mm.); dark brown to grayish black; abdomen with a row of faint median triangles and roundish sublateral spots: median callus subquadrate; second palpal segment rather slender and apex not sharply pointed; frons somewhat widened above: wings hyaline; eyes bare. Male eye facets distinctly differentiated; occipital tubercle conspicuous; eyes bare.

T. pumilus is the smallest *Tabanus* found in New York. It is widely distributed but has not been reported from the colder parts of the State. It attacks both man and animals and occasionally is abundant enough to cause considerable annoyance.

This species flies from June to August but is most abundant in July. Both sexes are attracted to lights at night.

The larvae have been found in water-saturated soil near brooks.

Tabanus quinquevittatus Wiedemann (Fig. 73)

> Moderate in size (12.5 mm.); yellowish; abdomen with a yellow median stripe bordered with black, lateral margins usually yellowish; pollen of head yellow; wings hyaline with a dark yellow costal cell; frons with sides essentially parallel; eyes bare. Male eye facets distinctly differentiated; eyes bare.

This greenhead is common throughout the State south of the Adirondacks and is probably our most important economic species. In western New York it is especially abundant and a severe pest of horses and other livestock during the flight season. It first appears in late June and is found well into August with a period of maximum abundance about the middle of July. At the height of its flight period it is not unusual to find fifty or more of this species feeding on a single animal with many more flying about it.

It is less common on Long Island than it is upstate, being largely replaced by the related *T. nigrovittatus*. Unlike *T. nigrovittatus*, it rarely attacks humans and is less aggressive in its attack.

T. quinquevittatus is referred to in much of the earlier literature as *T. costalis* Wiedemann and less extensively as *T. vicarius* Walker. It is separated from related species by the yellowish color which includes the palpi and pleurae and the deep yellow tint of the costal cell.

The larvae of *T. quinquevittatus*, unlike most species of Tabanidae, are found most commonly in relatively dry situations. Moist but not wet pastures and hay fields seem to be most suited but apparently tolerance to variations in moisture is considerable since larvae have been collected in dry cultivated fields and in mud along the margins of brooks. The high populations of this species probably result from this ability to breed in varied situations. Tashiro and Schwardt (1949) estimate that 19,360 potential feeders (females) could emerge from an acre of suitable breeding area in New York.

Because of the wide range of larval habitat it is doubtful if practical control measures could be devised for the control of the larvae.

Tabanus recedens Walker (Fig. 74)

> Large (23 mm.); brown; thorax with gray pollen; abdomen with a median row of very narrow pale triangles; fore tibiae uniformly brown; wing hyaline with dark yellow spots and costal cell; eyes bare. Male eye facets differentiated but line of demarcation sometimes indistinct; eyes bare.

This species is largely restricted to the southeastern portion of New York and never seems to be common. It is found in June and July.

Tabanus reinwardtii Wiedemann (Fig. 75)

Moderate in size (17 mm.); grayish black; abdomen with gray median triangles and larger pale sublateral spots; basal callus large and shining; frons broad and essentially parallel sided; wings spotted with brown; eyes bare or with short scattered hairs. Male eye facets somewhat differentiated but line of demarcation not distinct; eyes hairy.

This moderately large species is generally distributed throughout New York although there are few collection records for the Adirondack and Catskill areas. This species is frequently collected in its immature stages but is less commonly collected as an adult; this is probably due to its retiring and non-aggressive habits although it does occasionally attack livestock.

The larvae are found in mud along streams and ponds, usually in situations where the water is cool and the area shaded.

Tabanus sackeni Fairchild (Fig. 76)

Moderate in size (13.5 mm.); brownish; abdomen with a pale median line of contiguous triangles and pale sublateral spots which rarely reach the hind margins of the tergites; frons narrow and widened above; third antennal segment very slender; wings hyaline; eyes bare. Male eye facets distinctly differentiated; pale sublateral spots often reaching hind margins of tergites; eyes bare.

This species belongs to the *"longus"* group of *Tabanus* and probably most of the records for *T. longus* from north of Pennsylvania actually should refer to *sackeni*. It is a late season species, flying from mid July to early September. It probably is crepuscular and both sexes have been collected at lights in some numbers.

Tabanus sagax Osten Sacken

Moderate in size (14 mm.); orange brown; abdomen with a median line of contiguous triangles and rather indistinct sublateral spots; frons parallel sided and quite broad; third antennal segment variable but usually slender, dark orange with annuli black; second palpal segment swollen; wings hyaline; eyes bare. Male eye facets distinctly differentiated; eyes bare.

This species is uncommon throughout its range. The only New York records known to the writer are Copake Falls (Columbia County) in July and Riverhead (Suffolk County) as follows—7 July: 1 female, 1 September: 1 female, 2 September: 1 female and 14 September: 1 male. All the Riverhead specimens were collected by Mr. Roy Latham. Probably late season collecting will result in additional New York records.

Tabanus sparus Whitney (Fig. 77)

Small in size (10 mm.); blackish; abdomen with a row of small median triangles and oval sublateral spots which often reach the

hind margins of the tergites; median callus very narrow; second palpal segment swollen at base and sharply pointed; frons narrow and widened above; wings hyaline; eyes bare. Male eye facets distinctly differentiated; occipital tubercle inconspicuous and usually laterally compressed; eyes bare.

Although this species has been taken at inland localities in other states, in New York it seems to be restricted to Long Island and Staten Island. It attacks both man and animals but only occasionally is it abundant enough to be a pest. It flies from June through August.

Tabanus sparus subspecies **milleri** Whitney (Fig. 77)

No characters have been found to separate dried specimens of this form from typical *sparus* but living specimens and dried specimens which have been moistened and relaxed have a purple diagonal band across the eye whereas in typical *sparus* the eye is plain. The related *T. pumilus* has 2 diagonal bands across the eye and may be separated by other characters given in the key.

T. sparus subspecies *milleri* is typically southern in its range and Long Island seems to be its northern limit. On Long Island it is about as abundant as typical *sparus* and has the same flight season.

Tabanus stygius Say (Fig. 78)

Large (22 mm.); pile of thorax grayish white; abdomen black; frons brown and rather narrow; wings yellowish with dark spots, costal cell deep yellow; eyes bare. Male eye facets distinctly differentiated; pile of thorax dark brown; third antennal segment dark orange; eyes bare.

This rather striking species is not common in New York and seems to be restricted to the warmer portions of the State. It is most common in July and it also has been collected in June and August.

The egg masses are laid on aquatic plants, chiefly *Sagittaria*, growing in shallow water and the larvae are found in mud along ponds and streams. Two years is often necessary for this species to complete its life cycle.

Tabanus sublongus Stone

Moderate in size (13 mm.); dark orange brown; abdomen with a median line of contiguous pale triangles and grayish yellow to orange sublateral spots which usually reach the hind margins of the tergites; frons moderately broad with parallel sides; third antennal segment moderately slender; wings hyaline; eyes bare. Male eye facets distinctly differentiated; eyes bare.

The single New York record of this species is a paratype from Ithaca (Tompkins County) collected in June (Stone, 1938).

Tabanus subniger Coquillett (Fig. 79)

Large (23 mm.); pile of thorax grayish white; abdomen black; eye normally bare; wings pale yellowish with dark spots, costal

cell yellow; frons broad and gray, narrowed above and notched at vertex. Male eye facets distinctly differentiated; pile of thorax dark brown; third antennal segment dark brown or black; eyes bare.

This large species superficially resembles *T. stygius* but is easily distinguished by the characters given in the key. It is rare throughout its range. All specimens studied were collected either the last week in June or in early July.

Tabanus sulcifrons Macquart (Fig. 80)

Fairly large (21 mm.); reddish brown; abdomen with a median row of pale rather broad triangles and hind margins of tergites with pale bands which broaden laterally; fore tibiae pale at base; wing somewhat tinted, with dark spots and dark yellow costal cell; eyes bare. Male eye facets distinctly differentiated; eyes bare.

Because of its late flight season, this species is sometimes called the "Autumn Horsefly". It is a conspicuous form and is especially common in western New York; there are no records from the Adirondacks.

In western New York it is sometimes extremely numerous and because of its large size and capacity for blood, it is a serious pest. It is most abundant when the other economically important species are gone for the season or on the decline. The writer has seen as many as thirty-five of these large flies on a single cow with many others flying about. The adults of both sexes are frequently seen resting on country roads in considerable numbers and when disturbed the females will follow automobiles even when they are moving rather rapidly. They are active until dark and sometimes are found at lights at night.

Little is known about the immature stages of this species in nature. Egg masses have been found on small branches of trees and larvae have been found in dry and slightly moist soil as well as from the edges of ponds in saturated mud and plant debris. There is some evidence that the larvae will feed on white grubs and Japanese Beetle larvae. The life cycle normally is one year but sometimes takes 2 years.

Tabanus superjumentarius Whitney (Fig. 81)

Moderate in size (16 mm.); pile of thorax grayish white; abdomen black with small median white triangles on second to fifth tergites, the one on the second being very small or sometimes absent; fore tibiae uniformly dark; wings yellowish becoming deeper colored anteriorly especially along the veins and in the costal cell; eyes bare. Male eye facets distinctly differentiated; pile of thorax brownish; eyes bare.

This species has not been recorded from the Catskill or Adirondack areas. It is usually rather rare but occasionally is abundant enough to annoy cattle. It flies from June until August with the great majority of the collection records being in July.

Tabanus trepidus McDunnough (Fig. 82)

Moderate in size (14 mm.); brownish; abdomen broadly orange-brown laterally; basal portion of third antennal segment rather broad, annulate portion relatively short; palpi very slender; wing faintly tinted, costal cell yellow; eyes hairy. Male eye facets rather distinctly differentiated; second palpal segment very small; eyes hairy.

T. trepidus is a northern form most common in New York in the Adirondack area. There are no records in New York west of Oswego and Tompkins Counties. It is not common enough to be considered of economic importance. Except for two June records, all New York records are in July.

The larva has been found in sphagnum moss but it is likely that it will be found in other habitats as well.

Tabanus trimaculatus Palisot de Beauvois (Fig. 83)

Moderate in size (16 mm.); pile of thorax grayish white; abdomen dark with median white triangles on third, fourth and fifth tergites and occasionally 2 small sublateral white spots on second tergite; basal half of fore tibiae white; wings nearly hyaline except for dark costal cell and dark spots; eyes bare. Male eye facets distinctly differentiated; eyes bare.

This is a southern form which is noticed only occasionally in the southeastern portion of New York. It is found in June and July.

The egg masses are usually deposited on vegetation near the edge of ponds and slow streams and the larvae are found in the mud near the margin of the water.

Tabanus trispilus Wiedemann (Fig. 84)

Moderate in size (15 mm.): blackish; abdomen black with a median row of grayish white triangles; wings tinted, costal cell dark yellow; eyes with fine inconspicuous hairs. Male eye facets scarcely differentiated: sides of abdomen often tinted with orange brown; eyes hairy.

This species is found throughout the State and apparently is as much at home on Long Island and in western New York as in the higher Adirondacks. Although commonly collected, it rarely is abundant enough to be considered a serious pest. The writer has often collected both sexes of this species on flowers especially on *Ceanothus americanus* and *Spiraea latifolia*. It flies from June until mid August but is most abundant in July.

The larvae have been found both in very wet soil near the edge of a stream and in relatively dry sod. The writer collected a freshly emerged adult on the base of a tree growing in a well-kept lawn.

Tabanus typhus Whitney (Fig. 85)

Small to moderate in size (11 mm.); blackish; abdomen with a median row of grayish triangles and larger sublateral pale spots which are sometimes pinkish in ground color; prescutal lobe reddish; wings hyaline with a dark yellow costal cell and occasionally faint spots; eyes hairy. Male eye facets differentiated; eyes hairy.

This rather small species is found throughout the State but seems most common in the hilly and mountainous areas. It will attack both man and livestock but only occasionally is it numerous enough to cause much trouble.

T. typhus is a very variable species in general body color, color of legs and in shape and extent of basal and median calli. However, most specimens may be separated by the characters given in the key.

This species is most abundant in July but occasional specimens are collected in June and August.

Tabanus vittiger subspecies **schwardti** Philip (Fig. 86)

Moderate in size (13 mm.); dark brown to blackish; abdomen with a pale median stripe and sublateral stripes; wings hyaline; hind femora mostly fuscous; frons fairly broad, widened above; scutellum reddish at tip; eyes bare. Male eye facets distinctly differentiated, upper facets much larger than lower; eyes hairy.

The writer has seen specimens of this form only from western New York and Long Island as indicated on the map. Possibly some of the earlier records of *T. lineola scutellaris* should refer to this species since the females are difficult to separate. However, *schwardti* is a much less common form than *scutellaris* in New York. The males of *scutellaris* and *schwardti* are readily separated by the much enlarged upper eye facets and hairy eyes of *schwardti.*

All New York collection records for this form are from late June to mid July.

Tabanus vivax Osten Sacken (Fig. 87)

Moderate in size (14.5 mm.); dark blackish brown; abdomen with 3 rows of pale spots, the median triangle on second tergite not reaching the anterior margin; wings hyaline; eyes bare. Male eye facets distinctly differentiated; eyes bare.

This species seems to be rather rare throughout its range and for many years was confused with what is now called *T. fairchildi.* Most records previous to 1938 actually refer to *fairchildi.* One New York specimen was collected on June 12 and another on July 4 but all other specimens studied were collected between mid-July and mid-August. The adult is occasionally taken at lights at night.

The writer has seen a single specimen reared from a larva collected in pasture sod from along the edge of a permanently wet area.

Tabanus zonalis Kirby (Fig. 88)

Moderate in size (18 mm.); black; abdominal tergites with yellow bands along hind margins; eyes hairy. Male eye facets barely differentiated with no definite line of demarcation; eyes hairy.

This is a northern form and is rarely encountered except in the Adirondack area and it is unusual even there. It is a common form in many parts of Canada. Besides Adirondack specimens, the writer has seen a single specimen from Tompkins County. He has also seen a single specimen from northern New Jersey so it is likely *T. zonalis* will be found in adjoining portions of New York and possibly in the Catskills. It is found in June and July.

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* Synonyms in italics; most important reference page in heavy print.

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ROCHESTER ACADEMY OF SCIENCE

THE TABANIDAE OF NEW YORK

by

L. L. PECHUMAN, Ph.D.

FIGURES 1 to 88

Illustrations

and

Maps Showing

New York Localities

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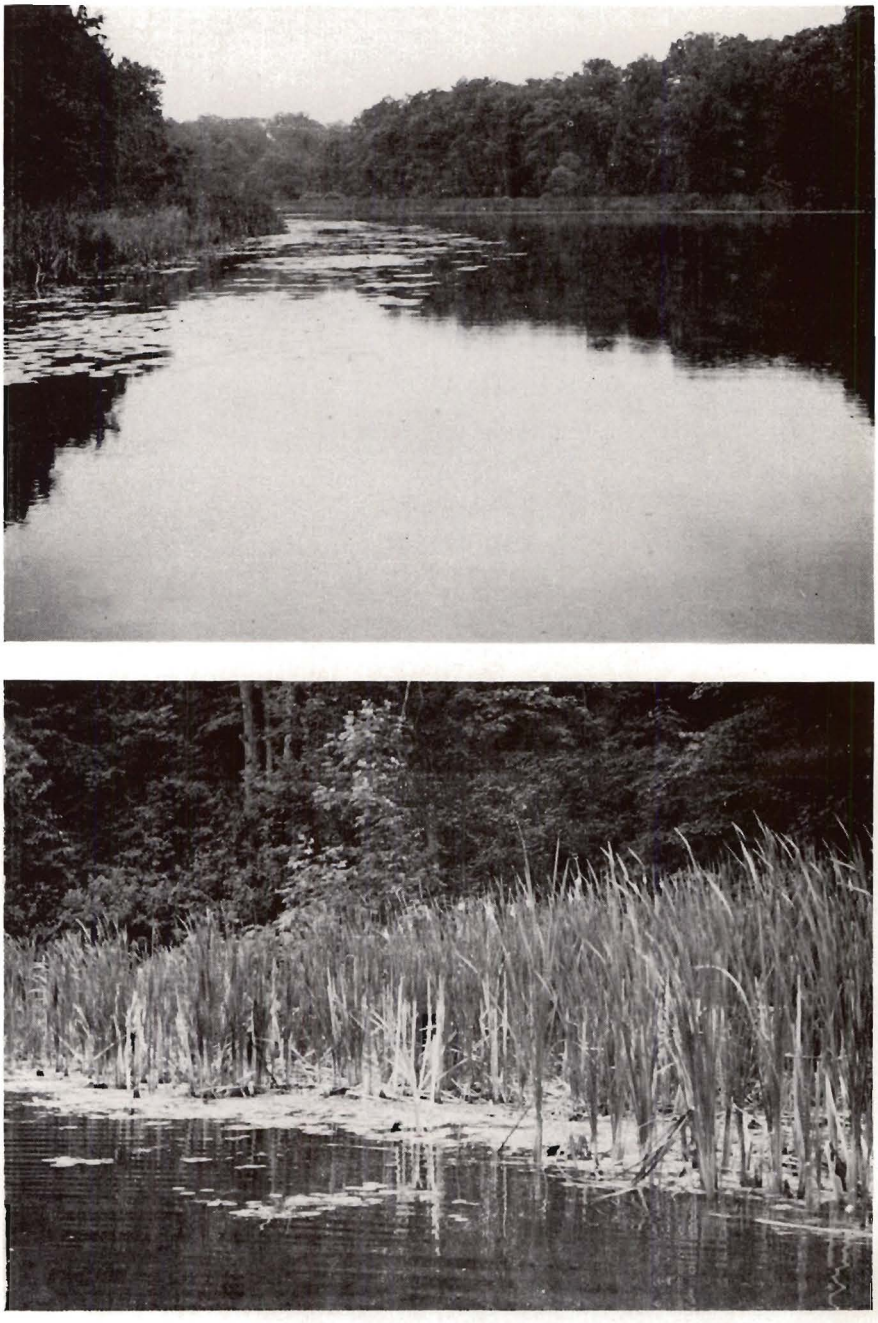


FIGURE 1. **Upper.** Lower portion of Oak Orchard Creek (El. 255 ft.). Cat-tails lining stream and bearing many egg masses of *Chrysops callida* and fewer masses of *C. celer*. Adults of both species as well as *C. brunnea, striata* and *aberrans* present in numbers. **Lower.** Closeup of cat-tails shown above. Egg masses of *C. callida* present only on cat-tails actually growing in water.

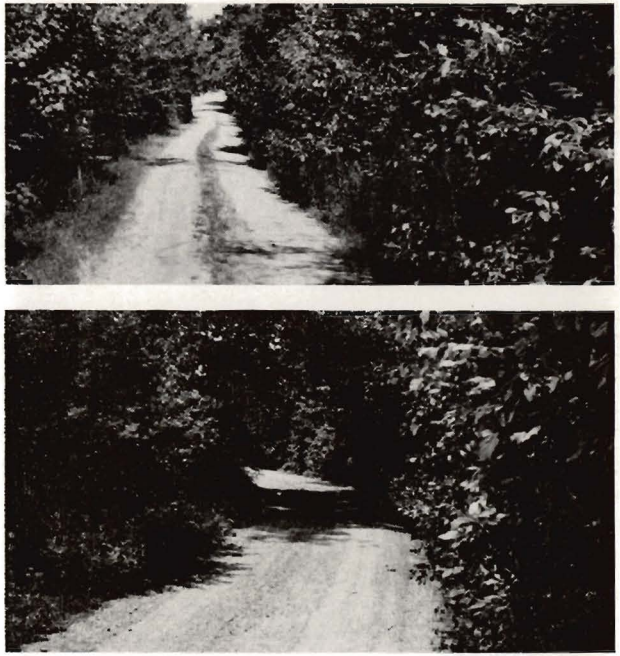


FIGURE 2. **Upper.** Road across Pine Hill, Steuben County (El. 2000 ft.). Males of *Tabanus lasiophthalmus*, *T. sulcifrons* and *T. pumilus* collected here; also females of several species of *Tabanus* and *Chrysops* including *C. lateralis* and *C. shermani*. **Lower.** Road along upper portion of Oak Orchard Creek, Orleans County near Genesee County line (El. 615 ft). *Chrysops pikei* collected in here in numbers; other species, such as *C. moecha* and *C. vittata*, and *Tabanus quinquevittatus* and *T. sulcifrons* also abundant at times.

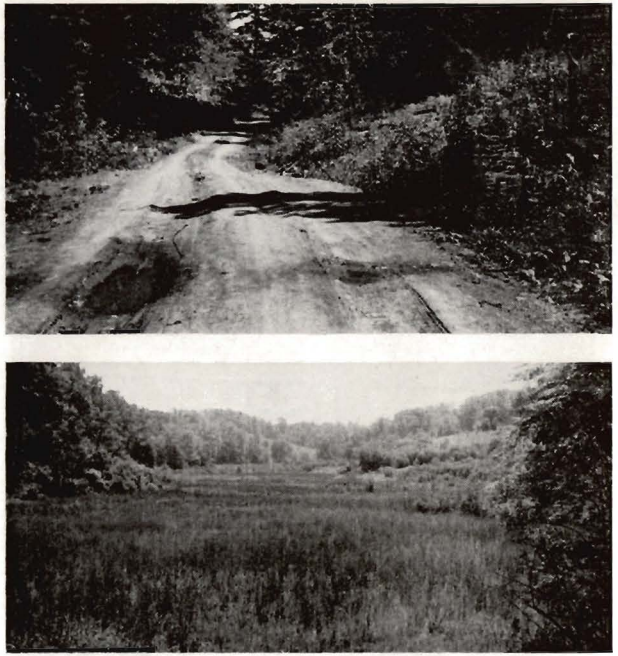


FIGURE 3. **Upper.** Road near edge of Labrador Lake, Onondaga and Cortland Counties (El. 1200 ft.). Males of *Chrysops lateralis*, *Atylotus thoracicus* and *Tabanus lasiophthalmus* collected at puddles in road. **Lower.** Marsh near head of Irondequoit Bay, Monroe County (El. 250 ft.). Species found here commonly include *Chrysops aberrans*, *brunnea*, *striata*, *vittata* and *wiedemanni*. Both sexes of *Tabanus illotus* abundant on July 10, 1941.

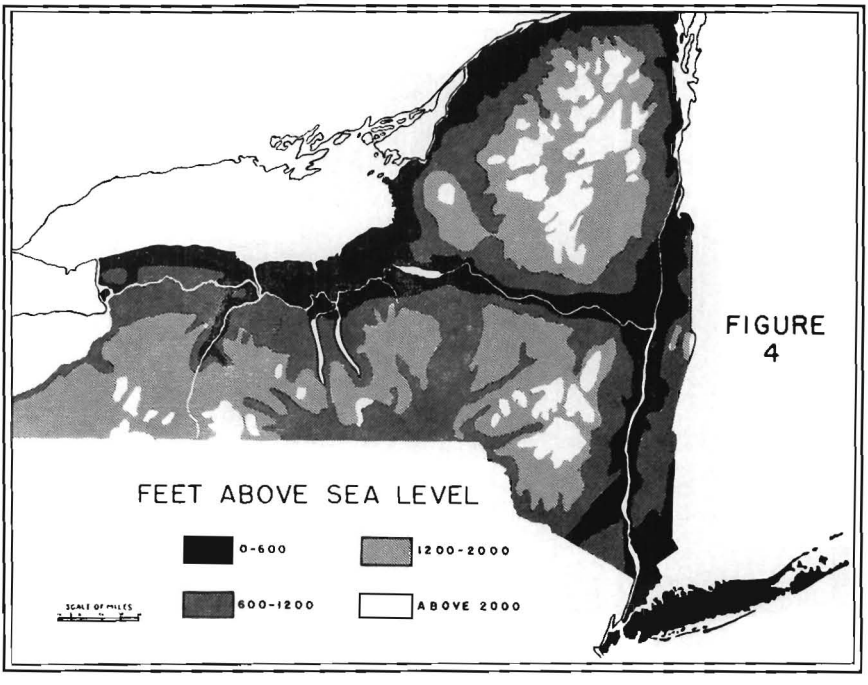


FIGURE 4

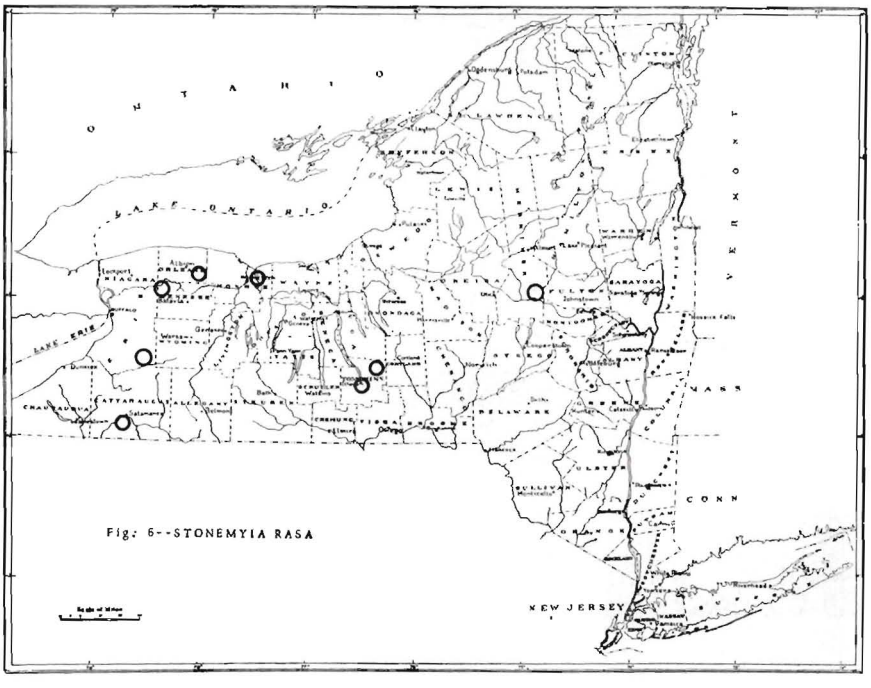
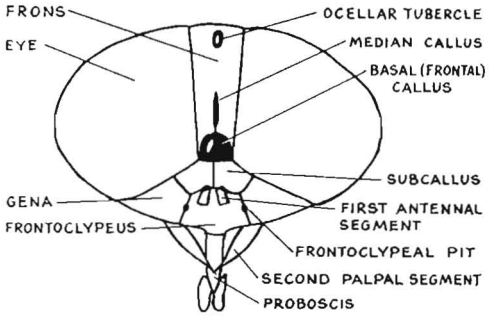
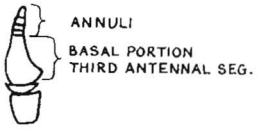


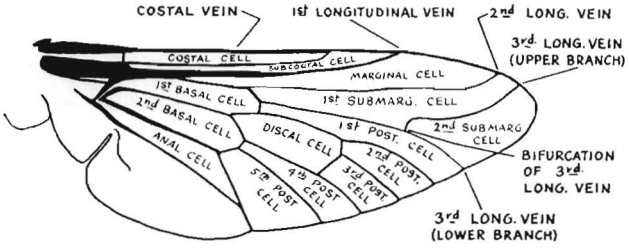
Fig. 6--STONEMYIA RASA



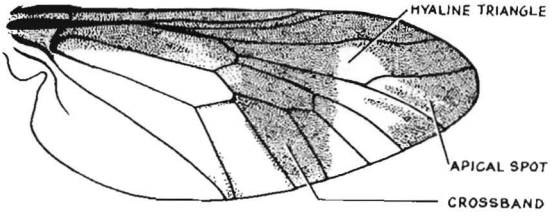
ANTERIOR VIEW OF HEAD OF *Tabanus illotus*.



ANTENNA OF *Tabanus illotus*.



WING OF *Tabanus illotus* (Markings not shown).



WING OF *Chrysops pikei*.

FIGURE 5

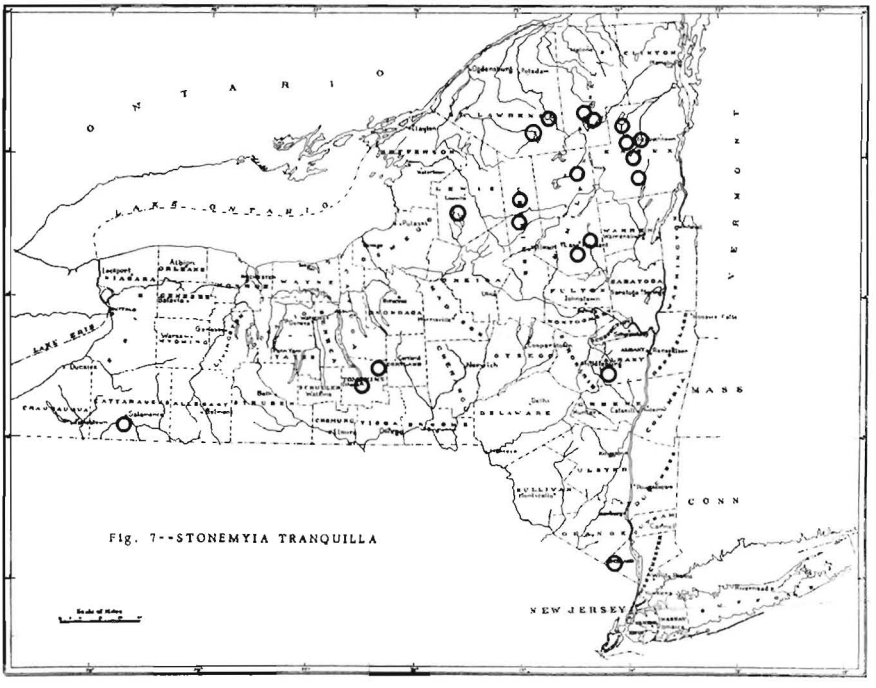


Fig. 7--STONEMYIA TRANQUILLA

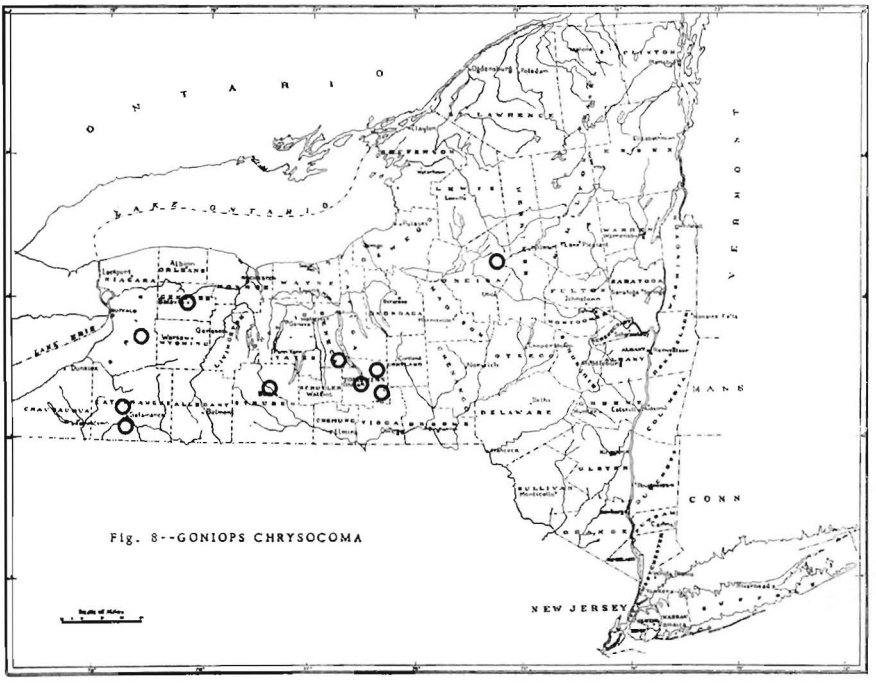


Fig. 8--GONIOPS CHRYSOCOMA

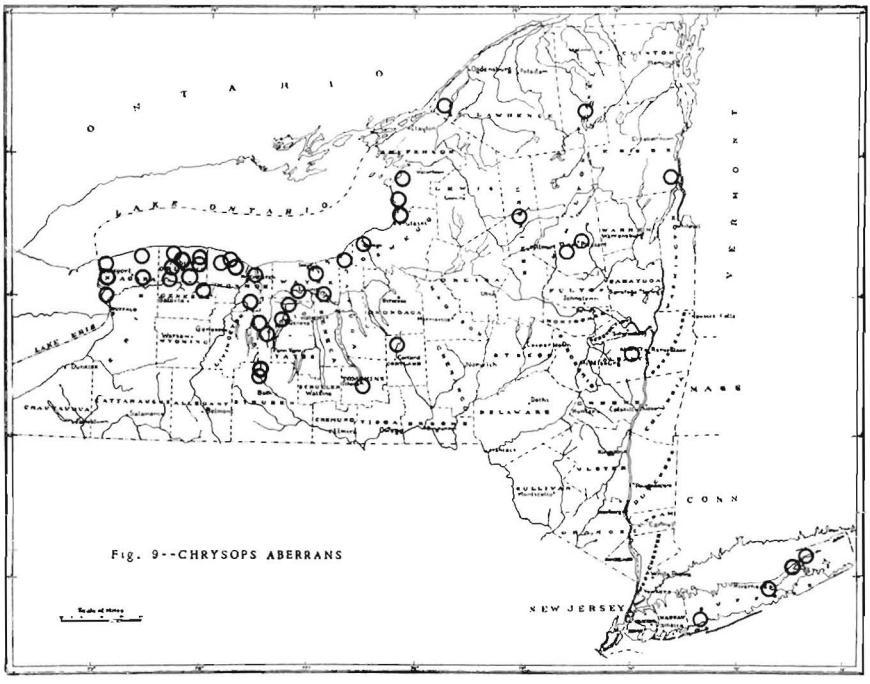


Fig. 9--CHRYSOPS ABERRANS

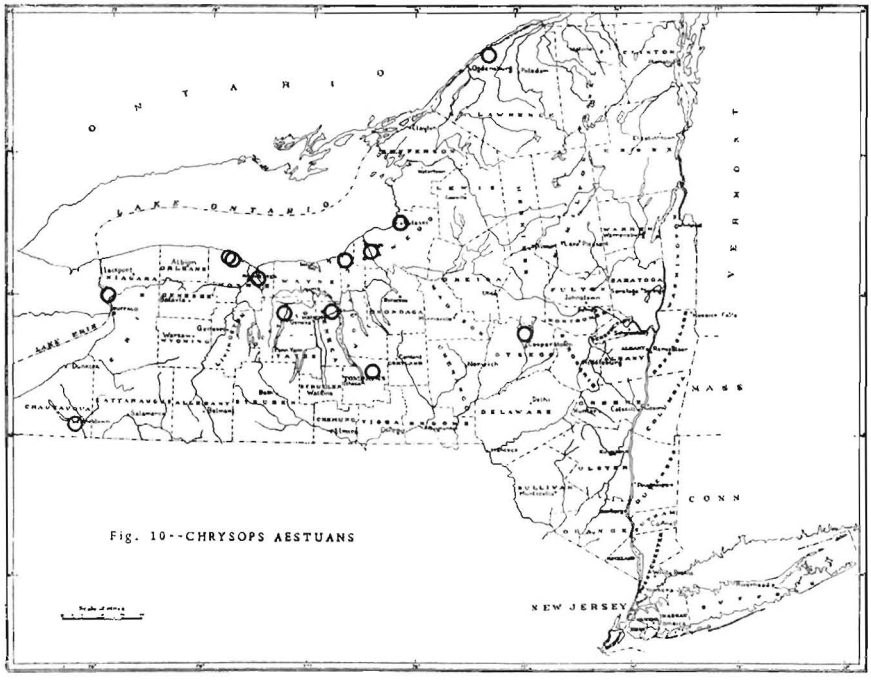


Fig. 10--CHRYSOPS AESTUANS

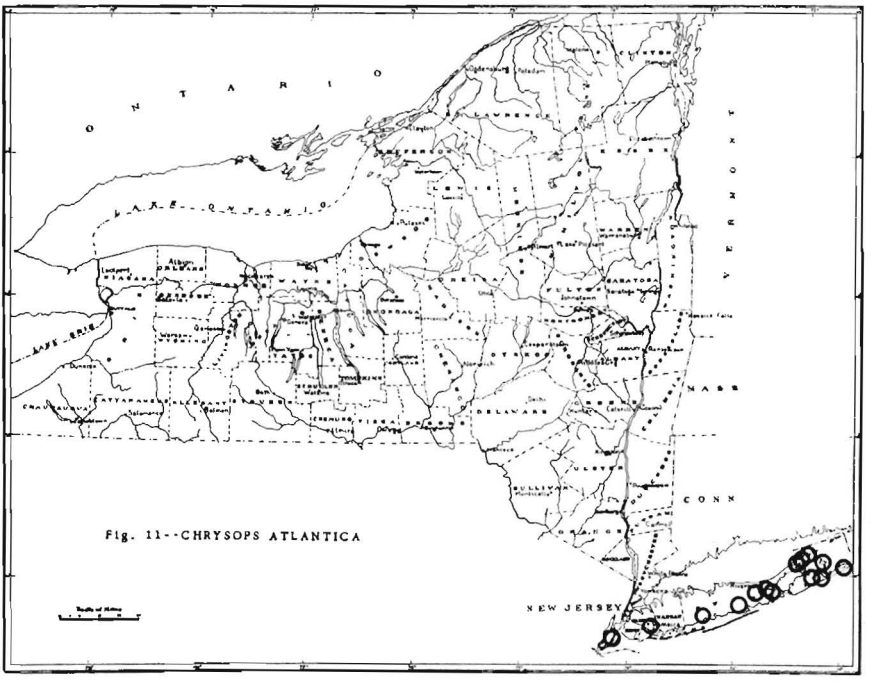


Fig. 11--CHRYSOPS ATLANTICA

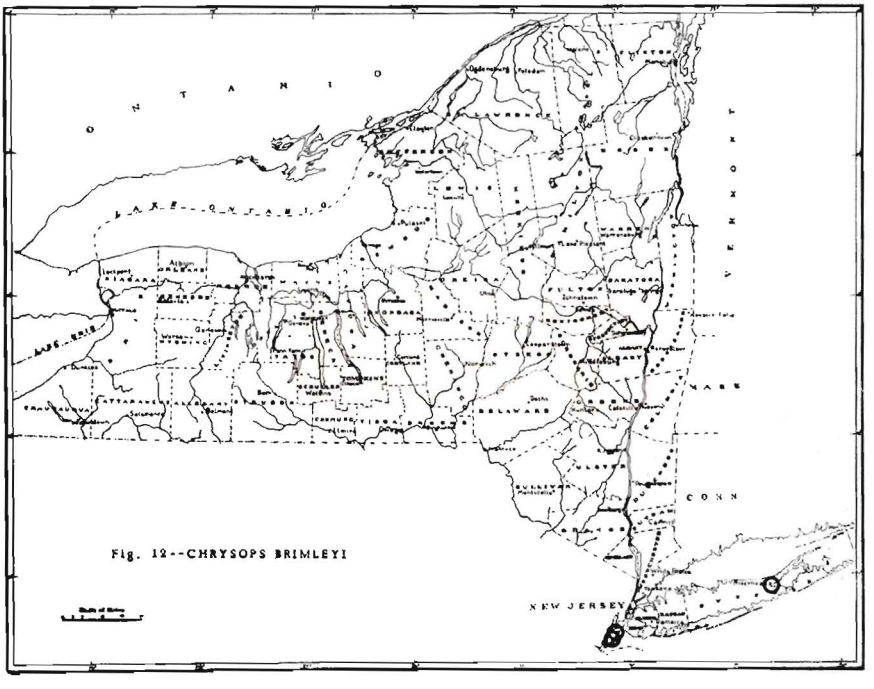


Fig. 12--CHRYSOPS BRIMLEYI

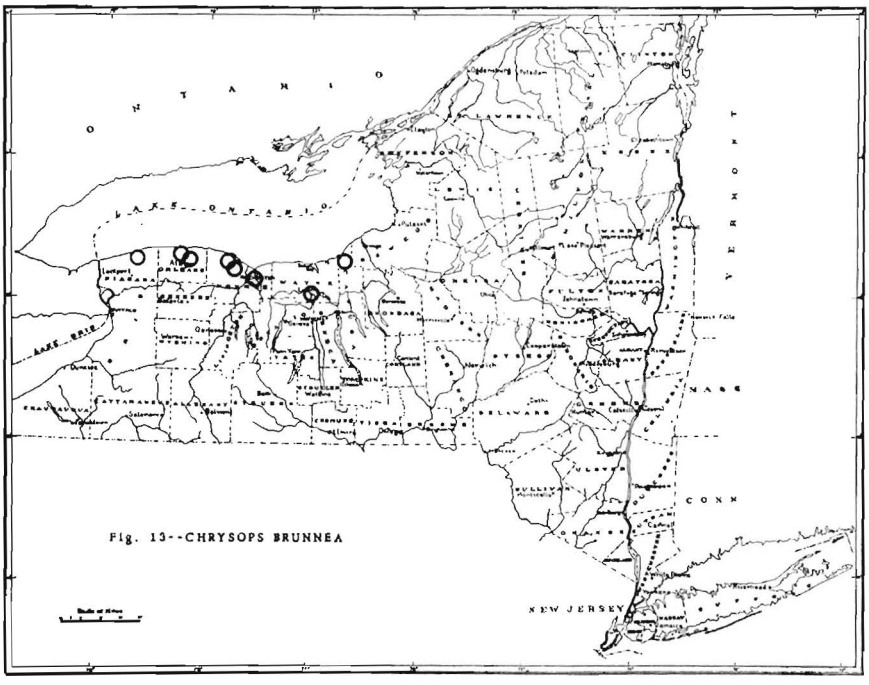


Fig. 13--CHRYSOPS BRUNNEA

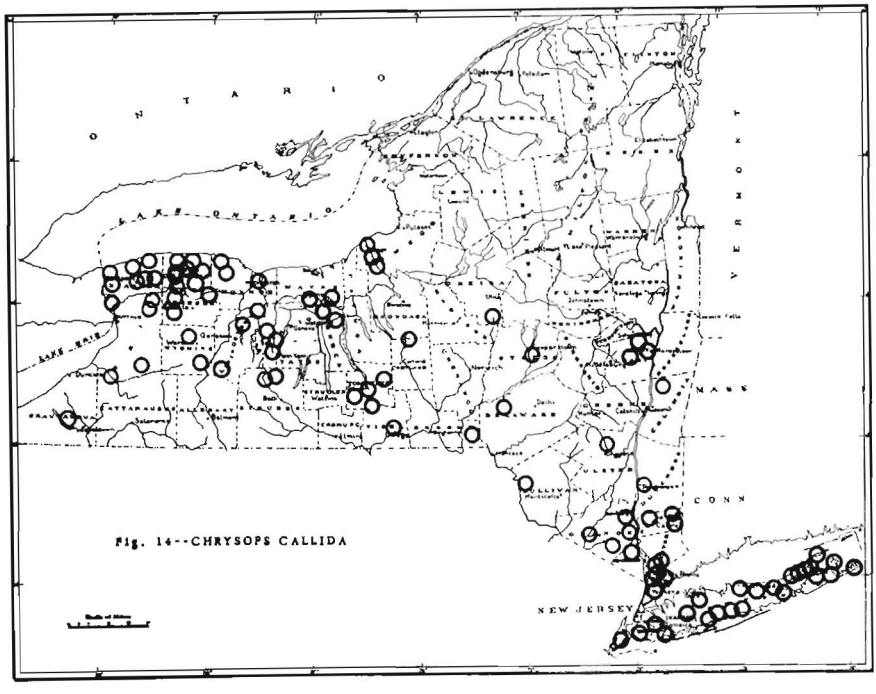


Fig. 14--CHRYSOPS CALLIDA

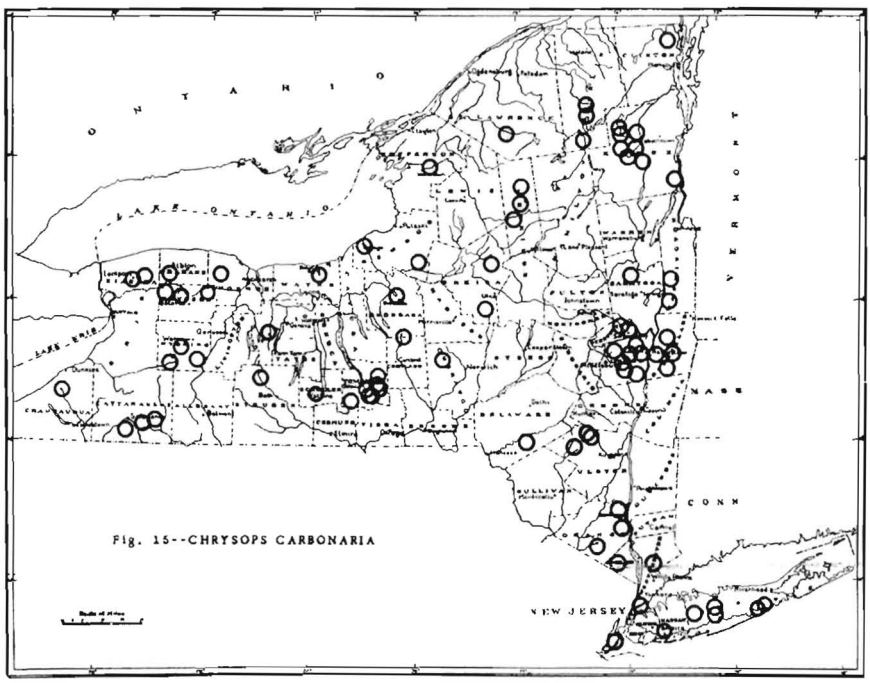


Fig. 15--CHRYSOPS CARBONARIA

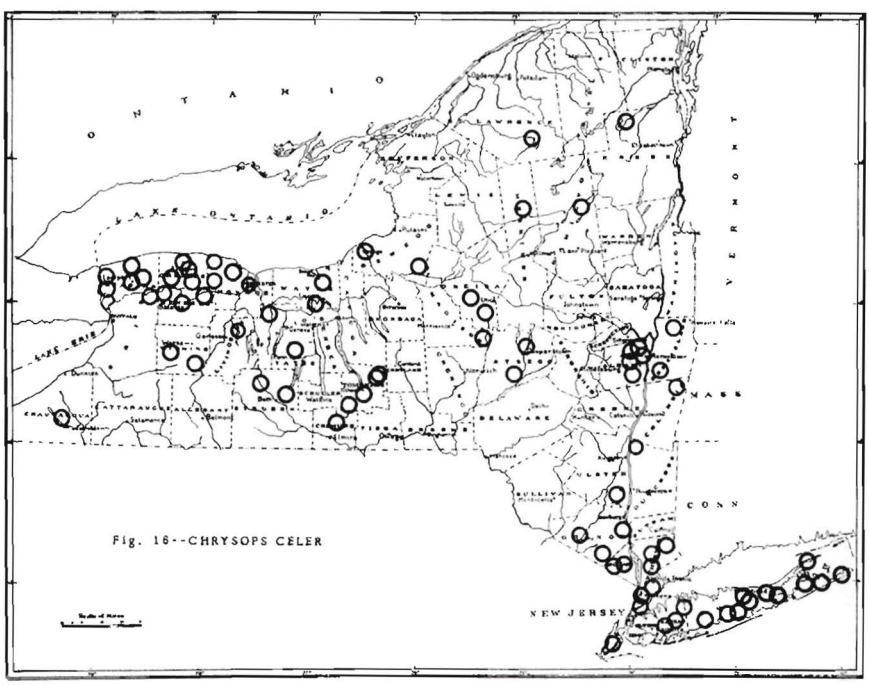


Fig. 16--CHRYSOPS CELER

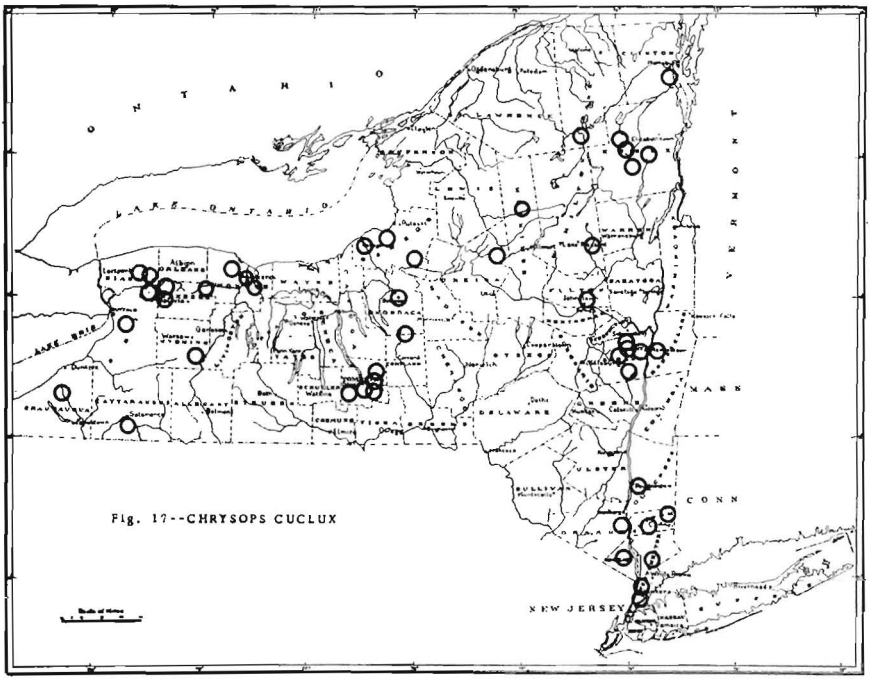


Fig. 17--CHRYSOPS CUCLUX

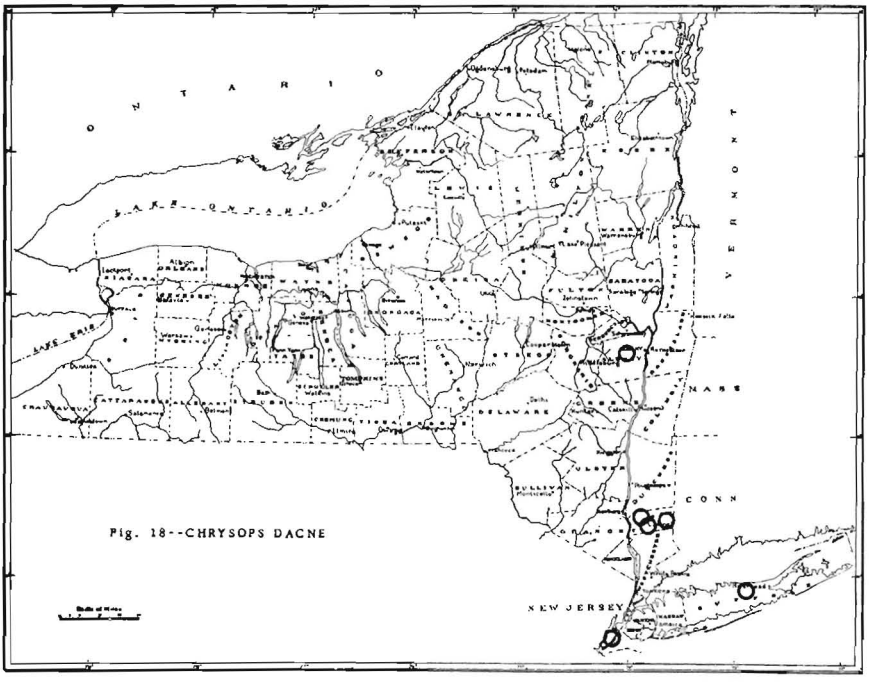


Fig. 18--CHRYSOPS DACNE

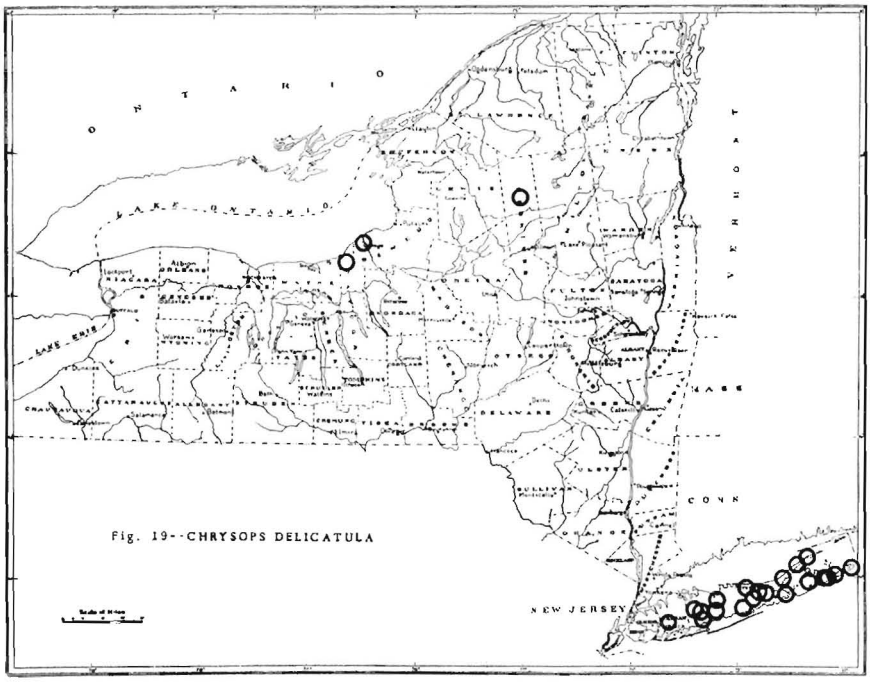


Fig. 19--CHRYSOPS DELICATULA

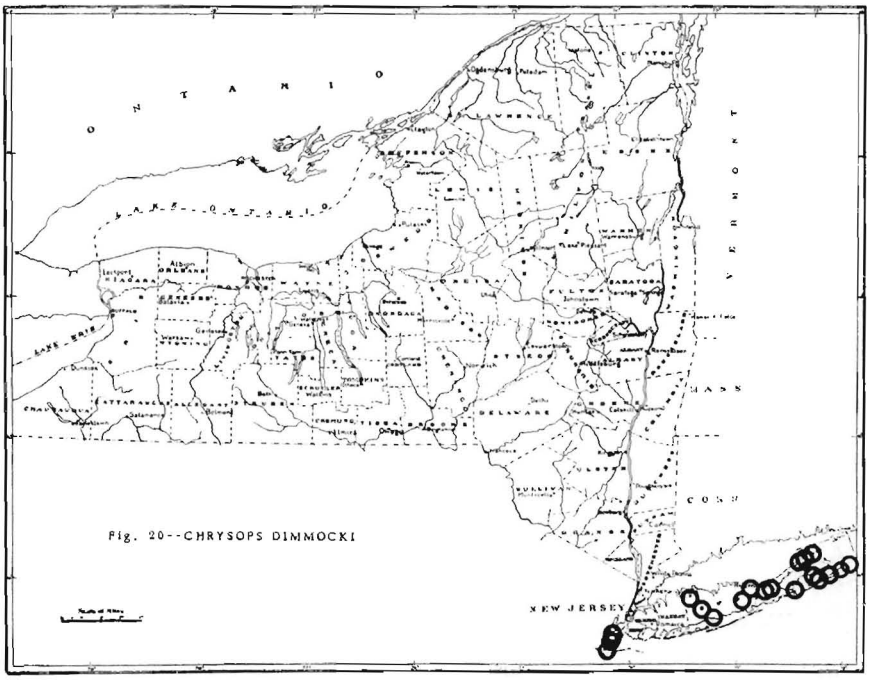


Fig. 20--CHRYSOPS DIMMOCKI

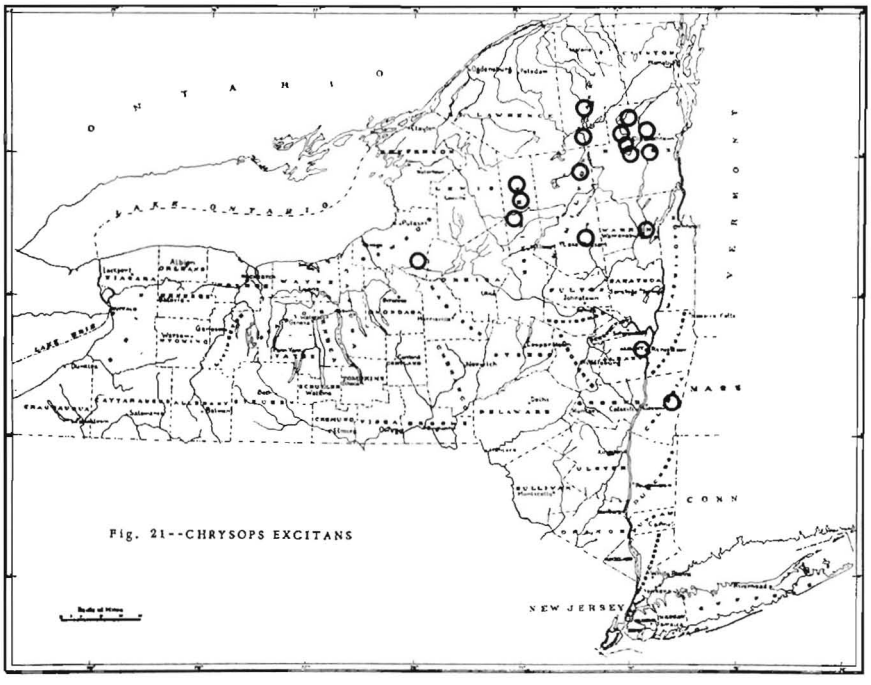


Fig. 21--CHRYSOPS EXCITANS

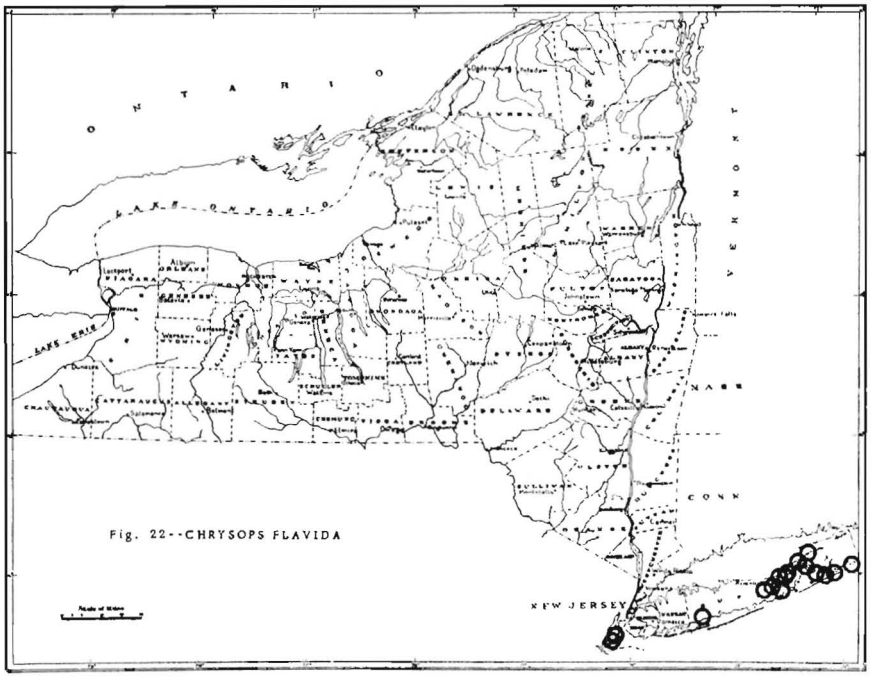


Fig. 22--CHRYSOPS FLAVIDA

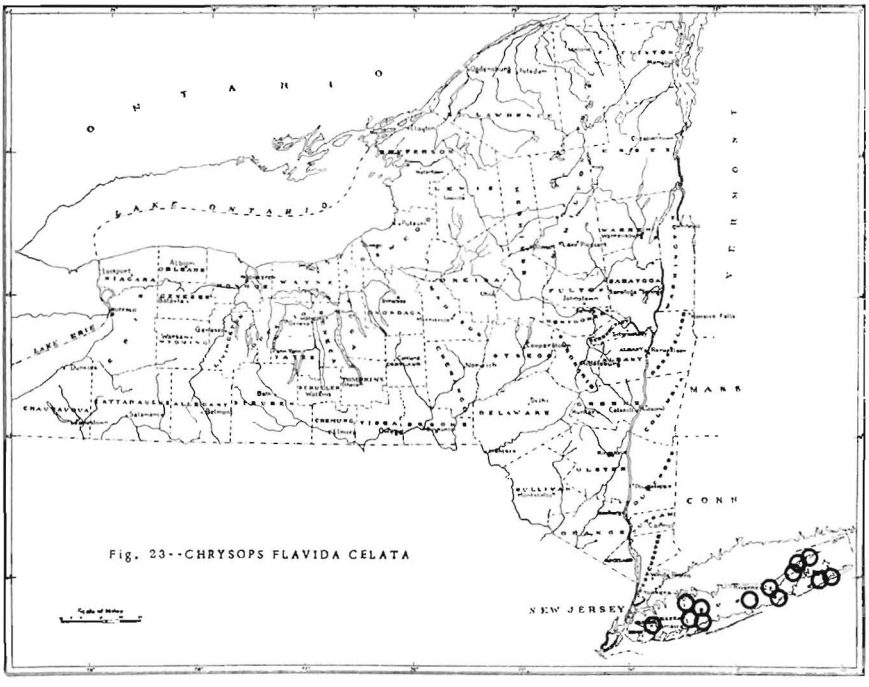


Fig. 23--CHRYSOPS FLAVIDA CELATA

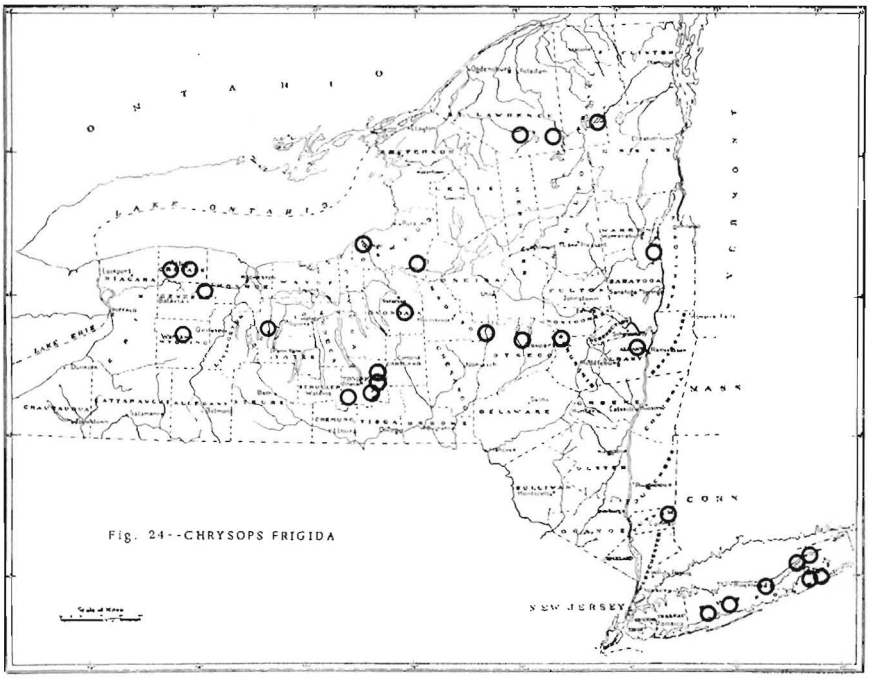


Fig. 24--CHRYSOPS FRIGIDA

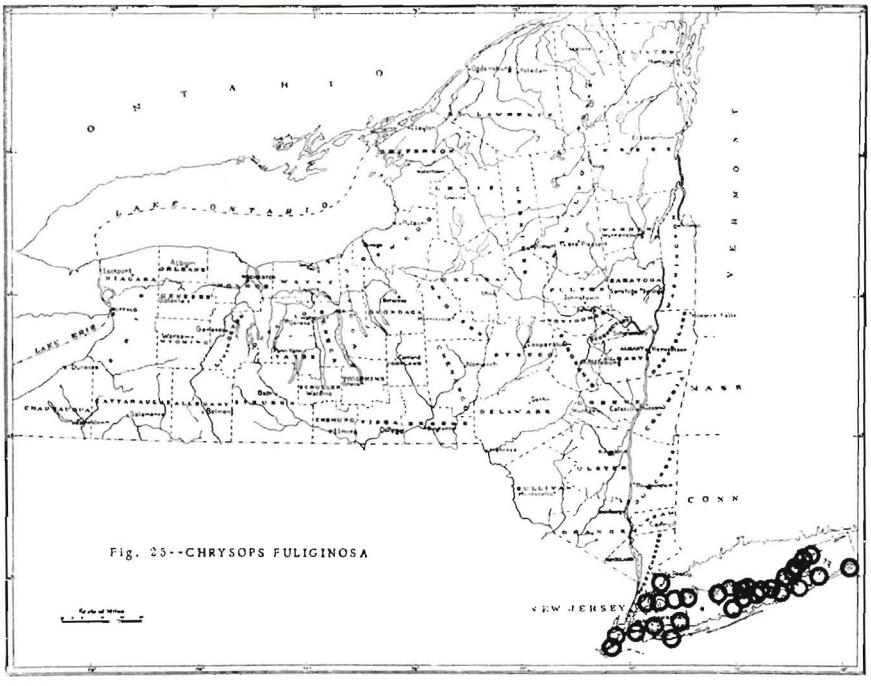


Fig. 25--CHRYSOPS FULIGINOSA

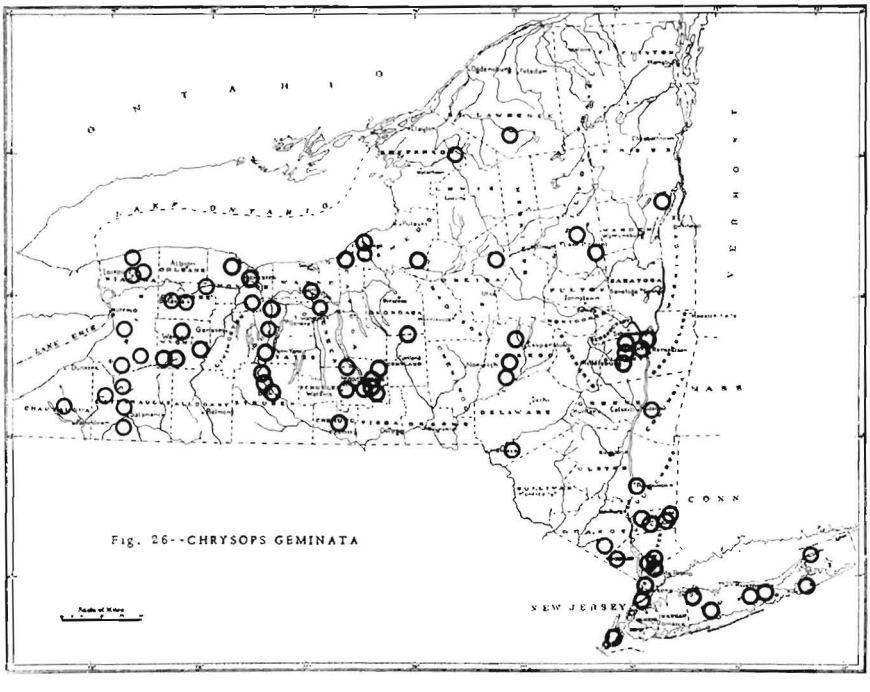


Fig. 26--CHRYSOPS GEMINATA

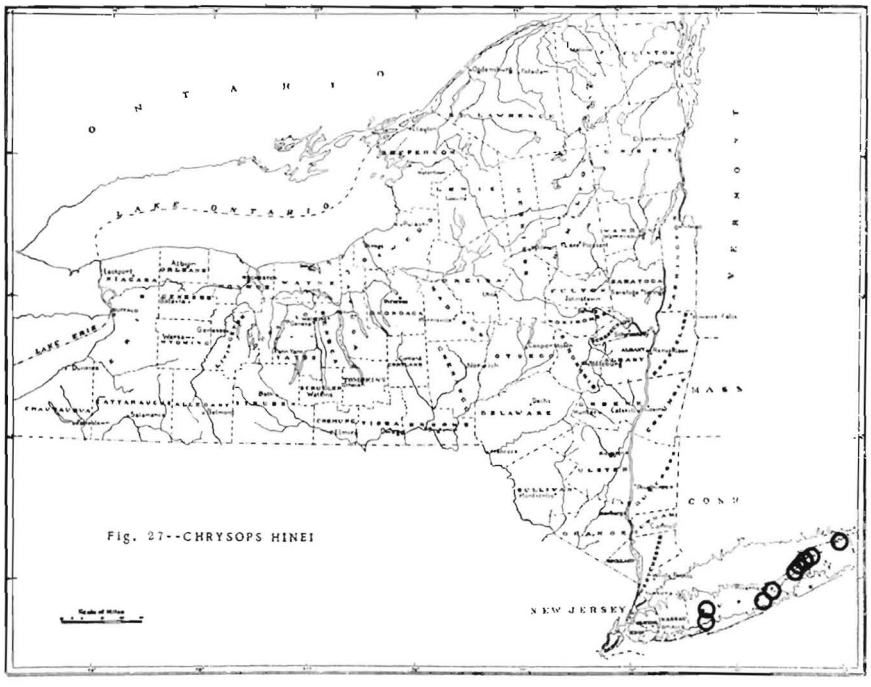


Fig. 27--CHRYSOPS HINEI

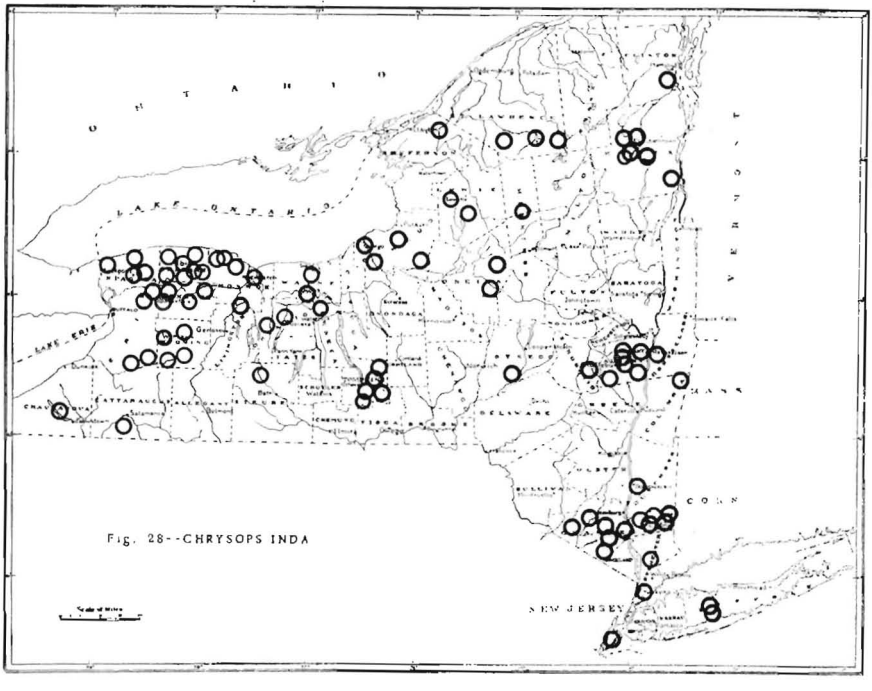


Fig. 28--CHRYSOPS INDA

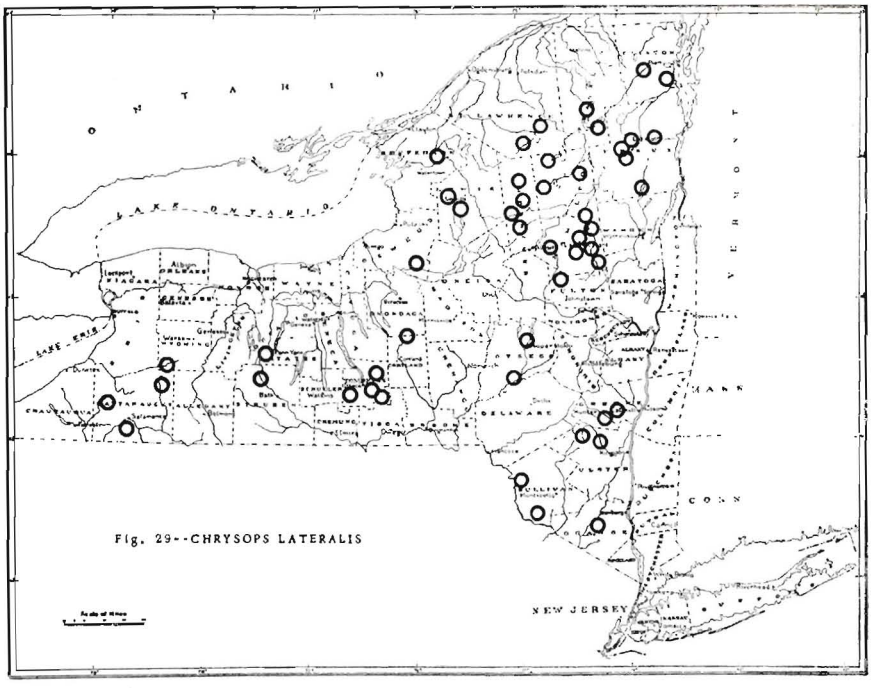


Fig. 29--CHRYSOPS LATERALIS

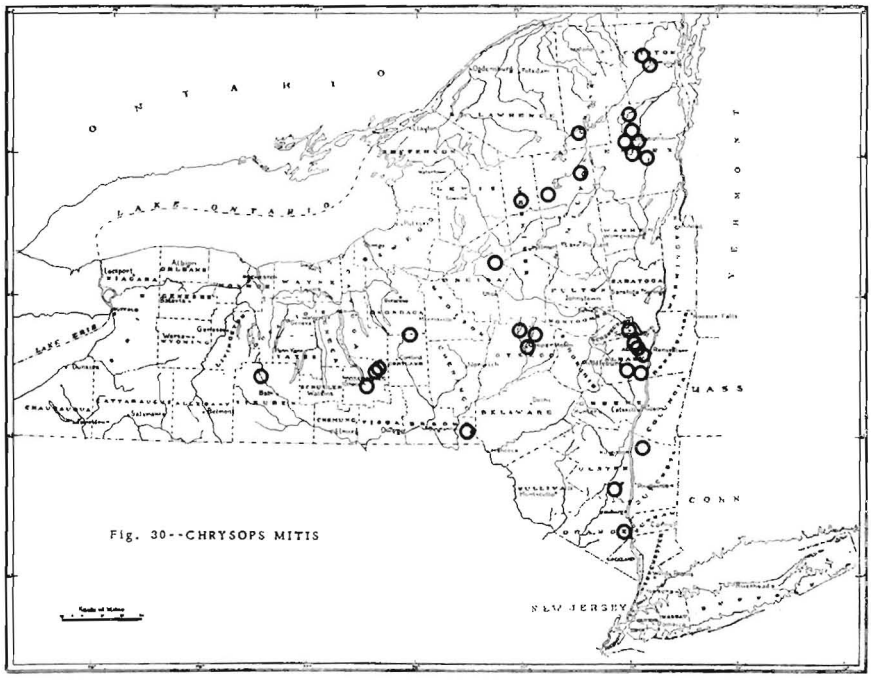
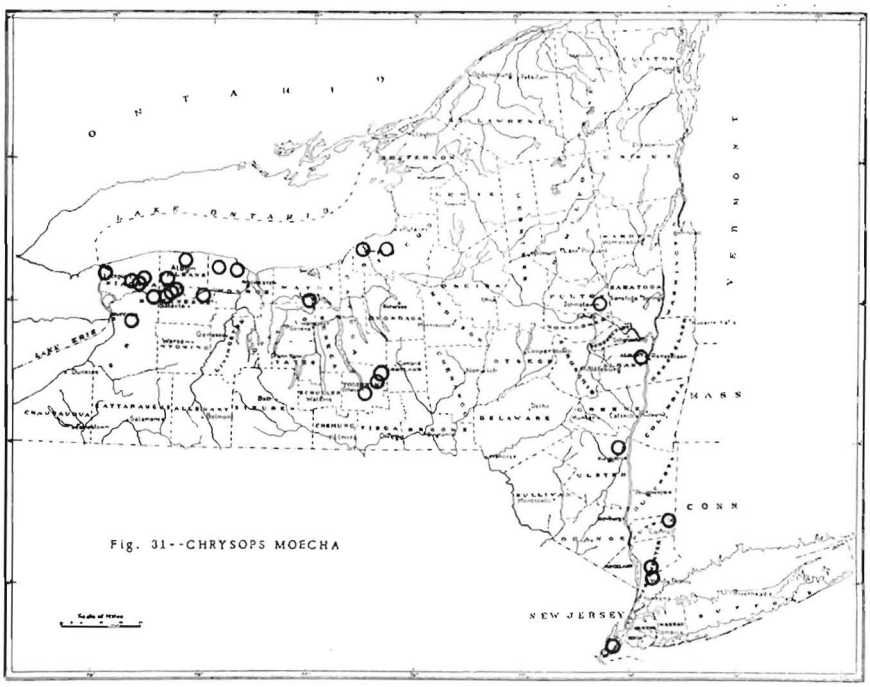


Fig. 30--CHRYSOPS MITIS



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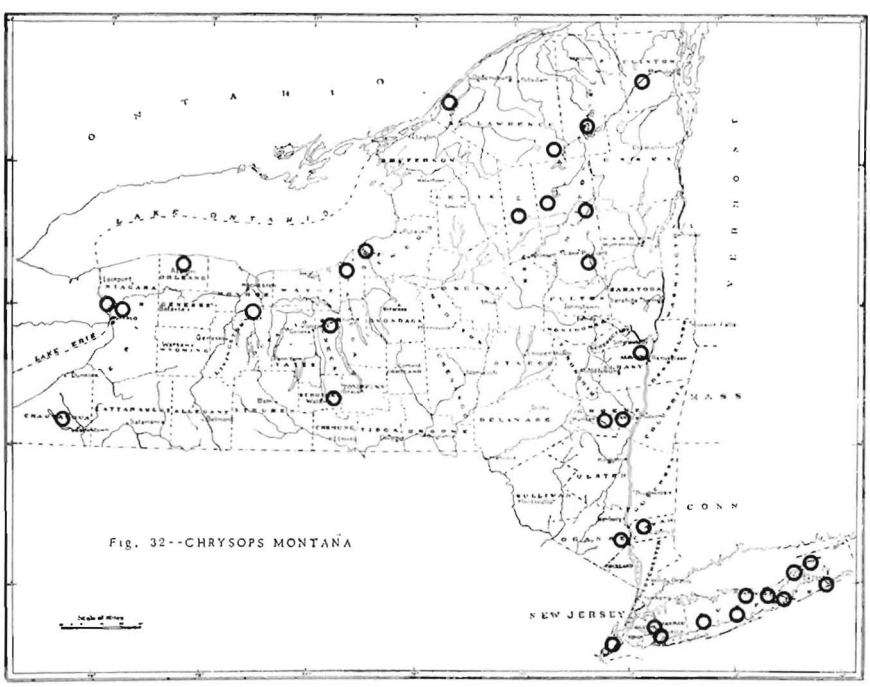

Fig. 32--CHRYSOPS MONTANA

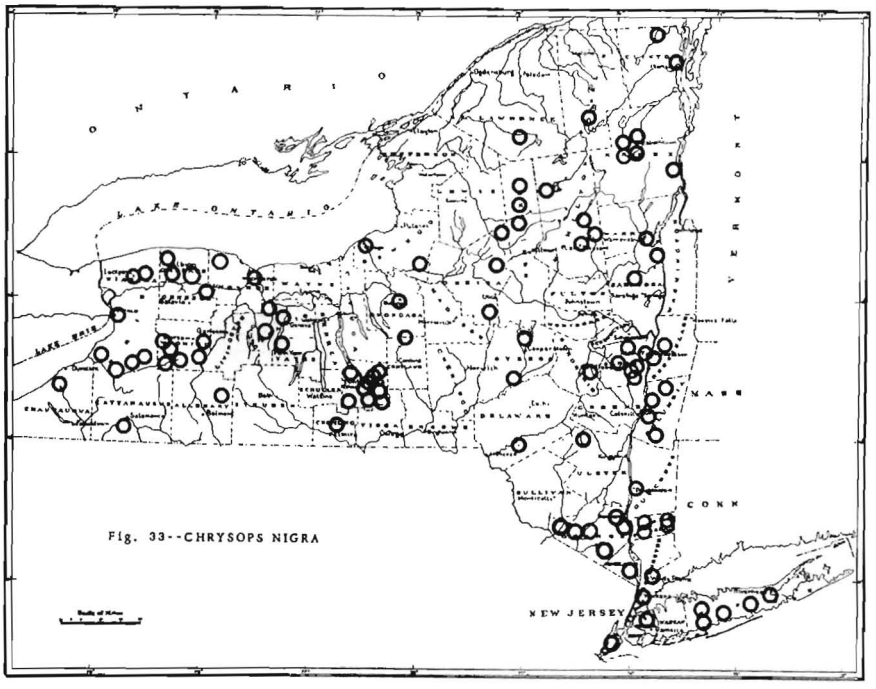

Fig. 33--CHRYSOPS NIGRA

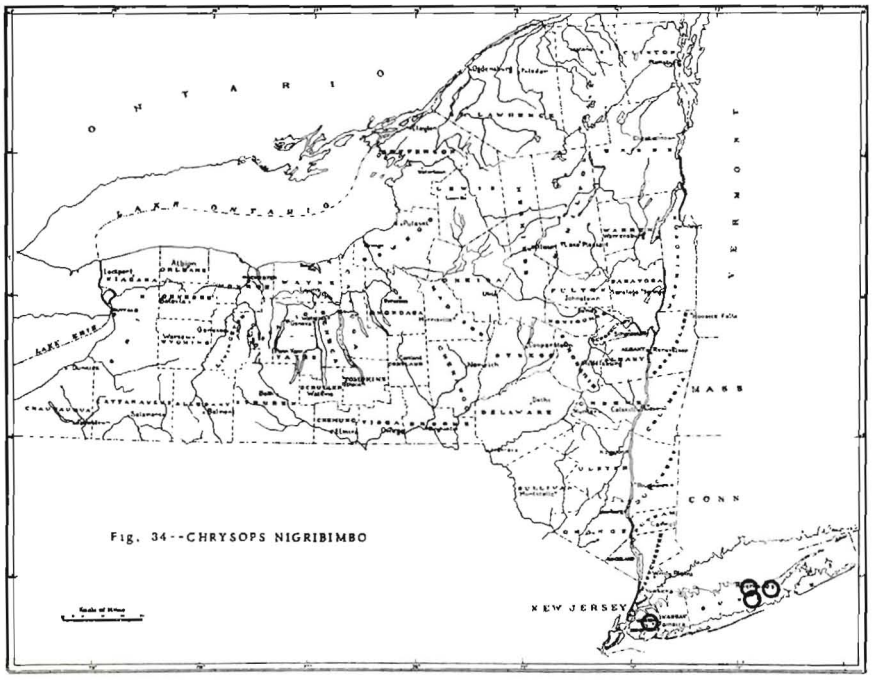

Fig. 34--CHRYSOPS NIGRIBIMBO

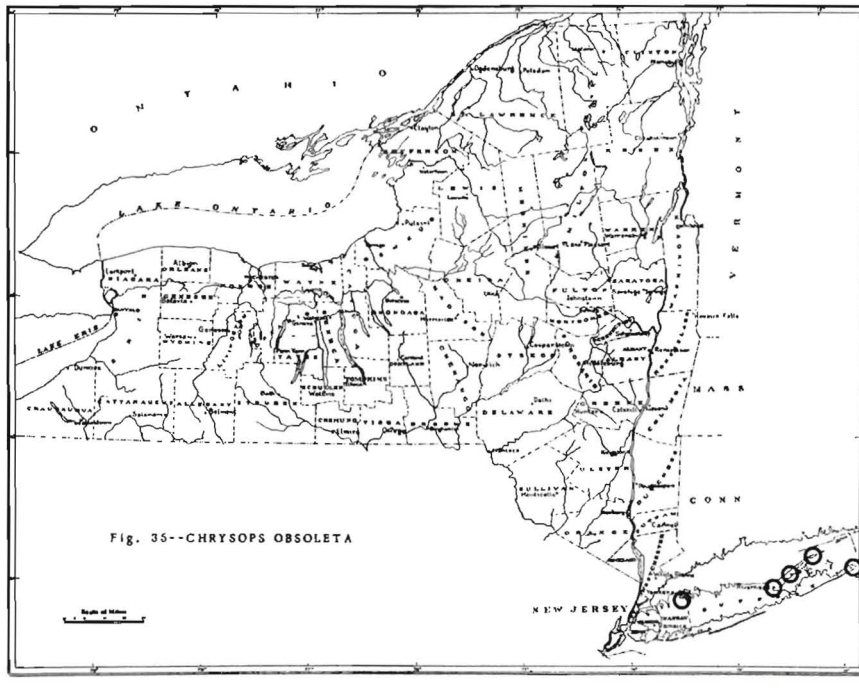

Fig. 35--CHRYSOPS OBSOLETA

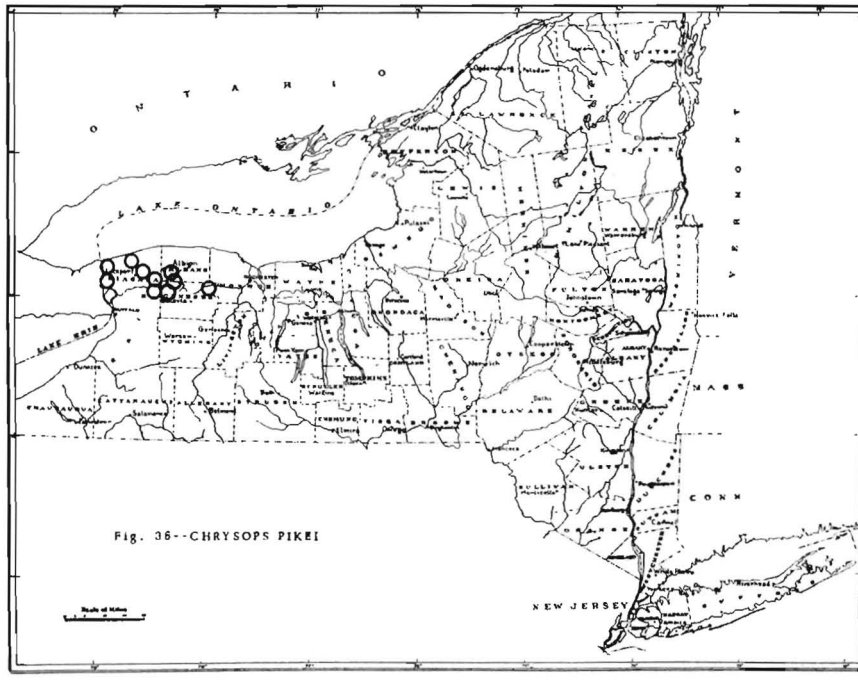

Fig. 36--CHRYSOPS PIKEI

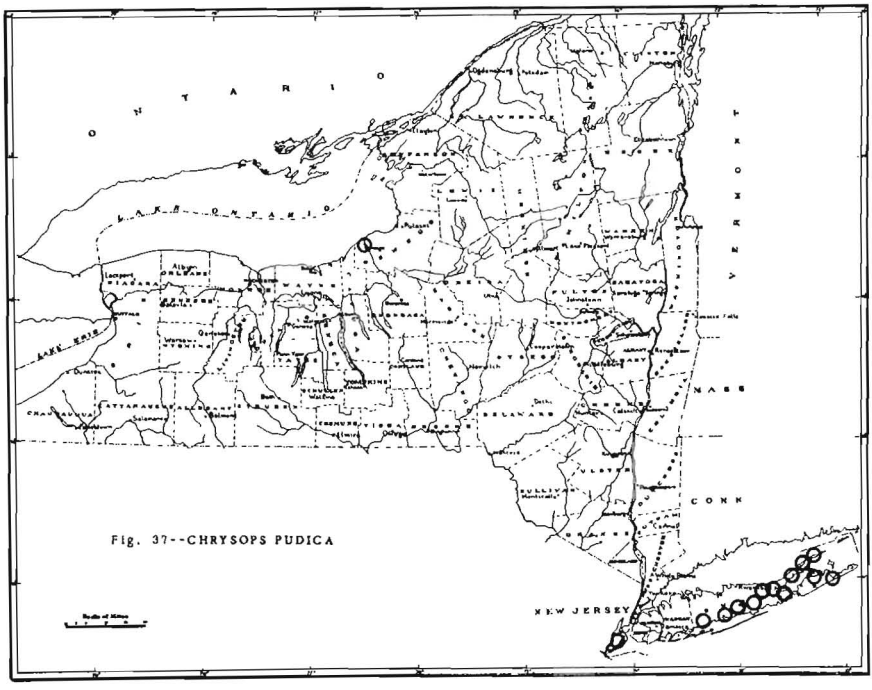

Fig. 37--CHRYSOPS PUDICA

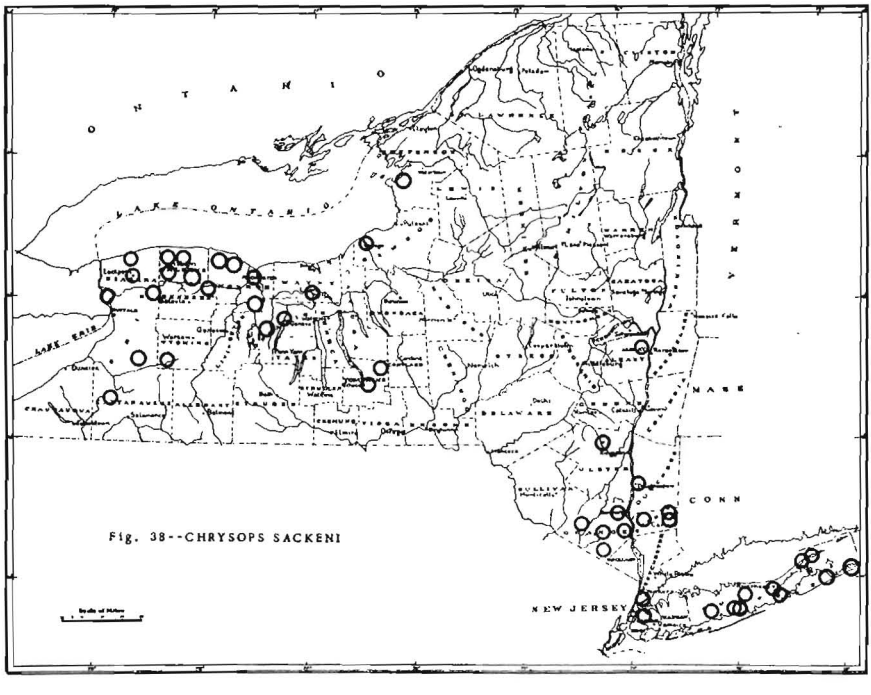

Fig. 38--CHRYSOPS SACKENI

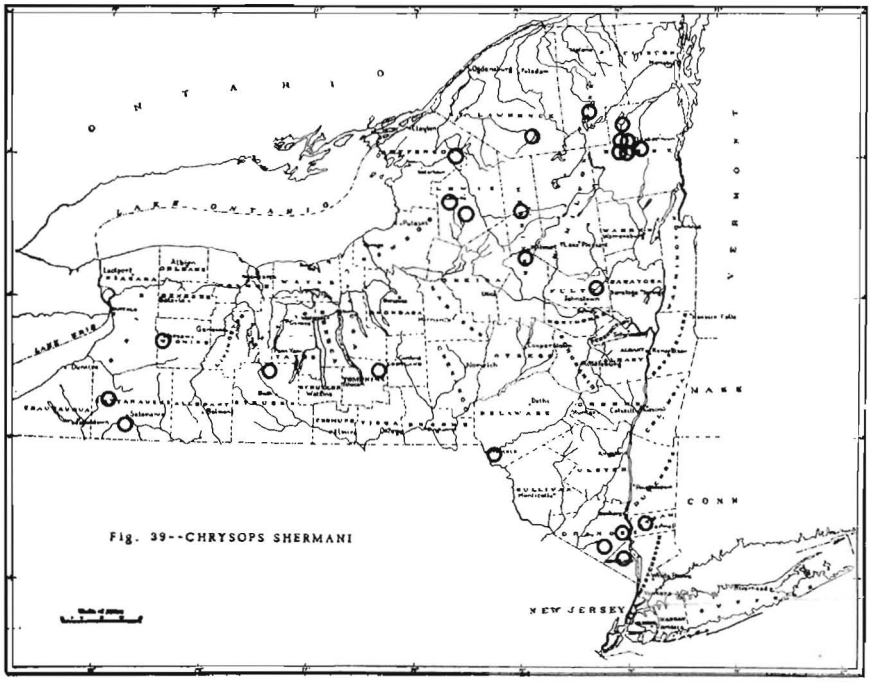

Fig. 39--CHRYSOPS SHERMANI

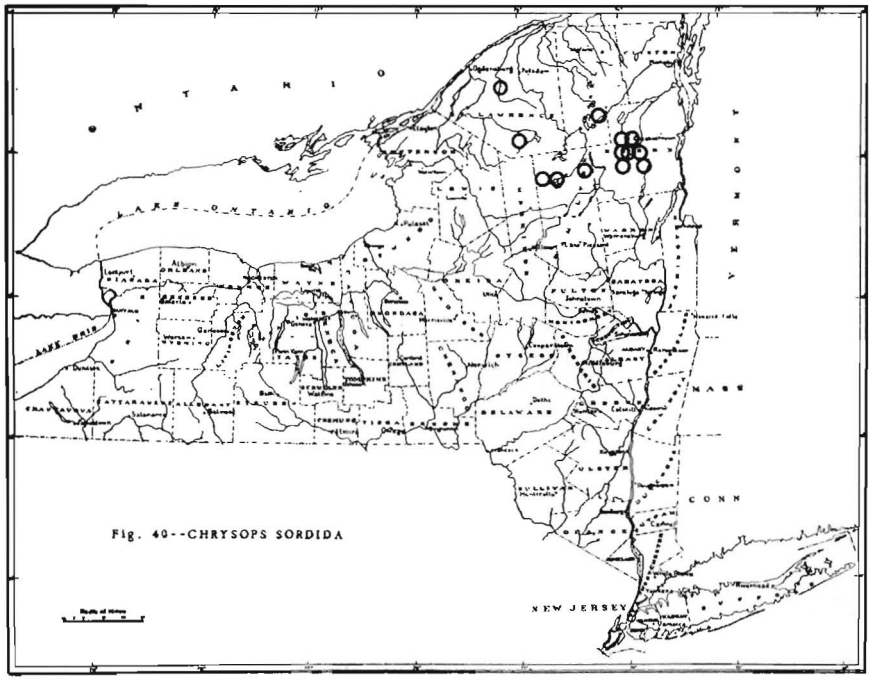

Fig. 40--CHRYSOPS SORDIDA

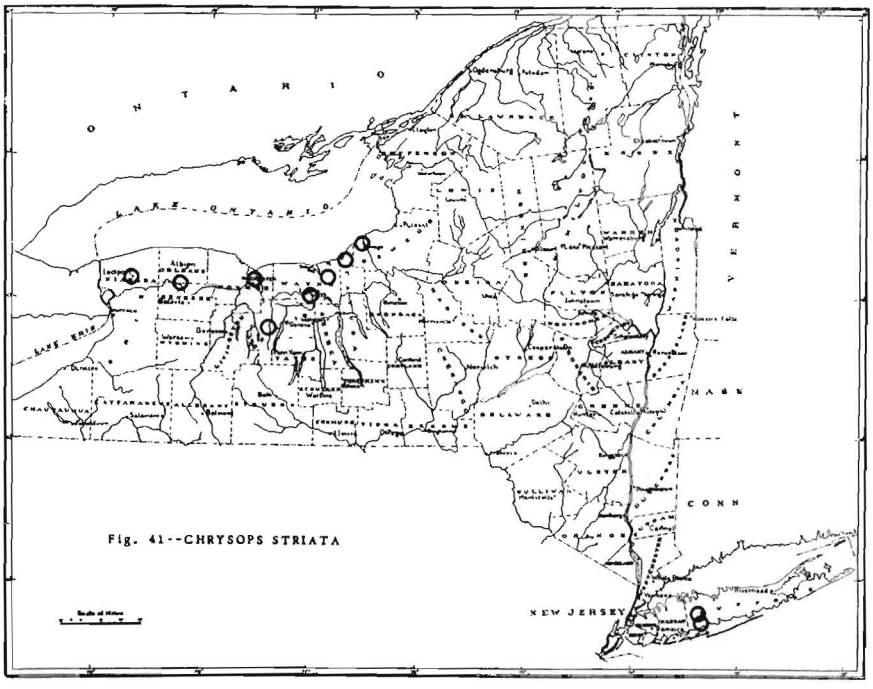

Fig. 41--CHRYSOPS STRIATA

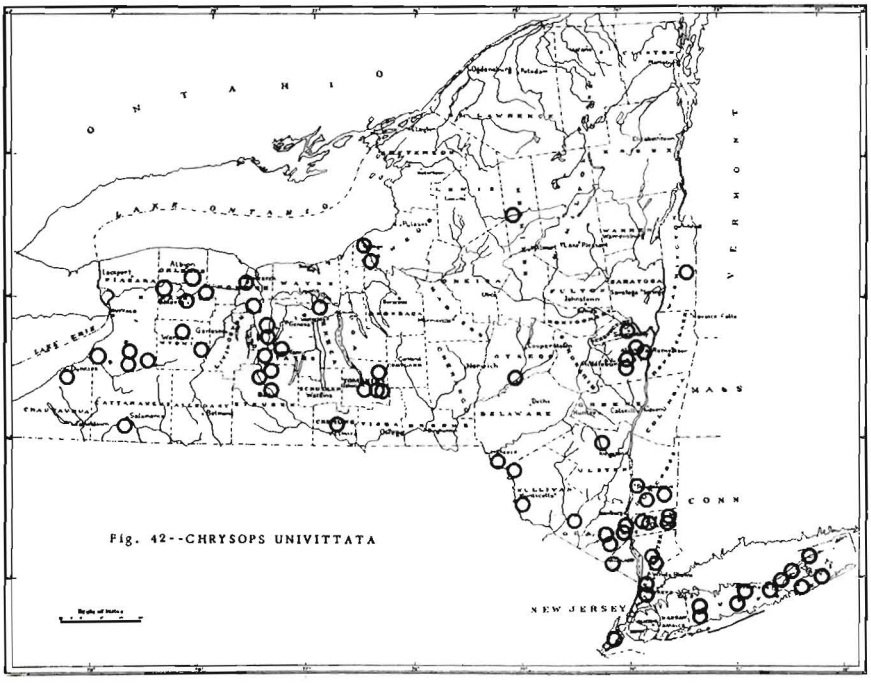

Fig. 42--CHRYSOPS UNIVITTATA

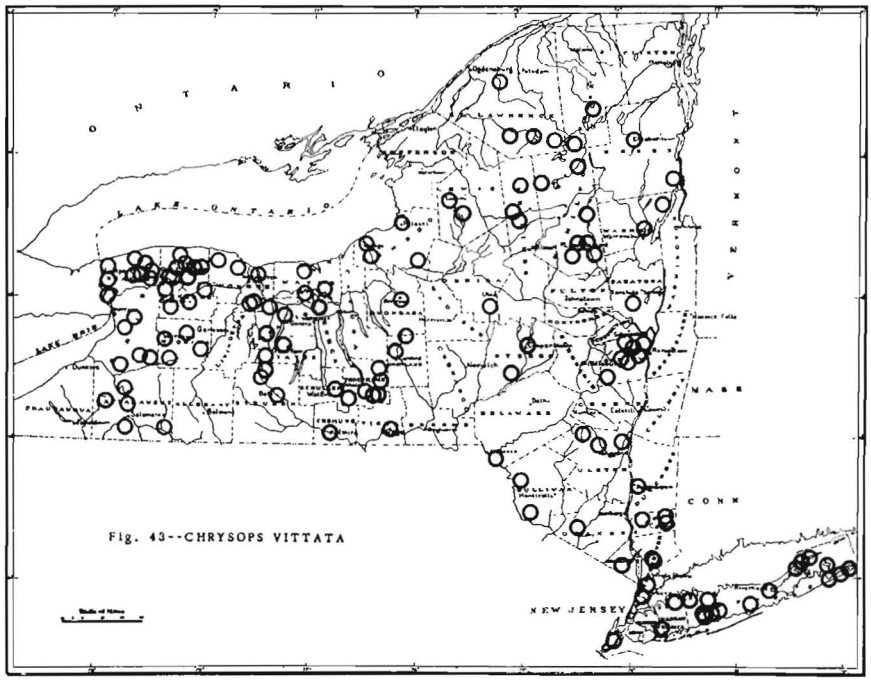

Fig. 43--CHRYSOPS VITTATA

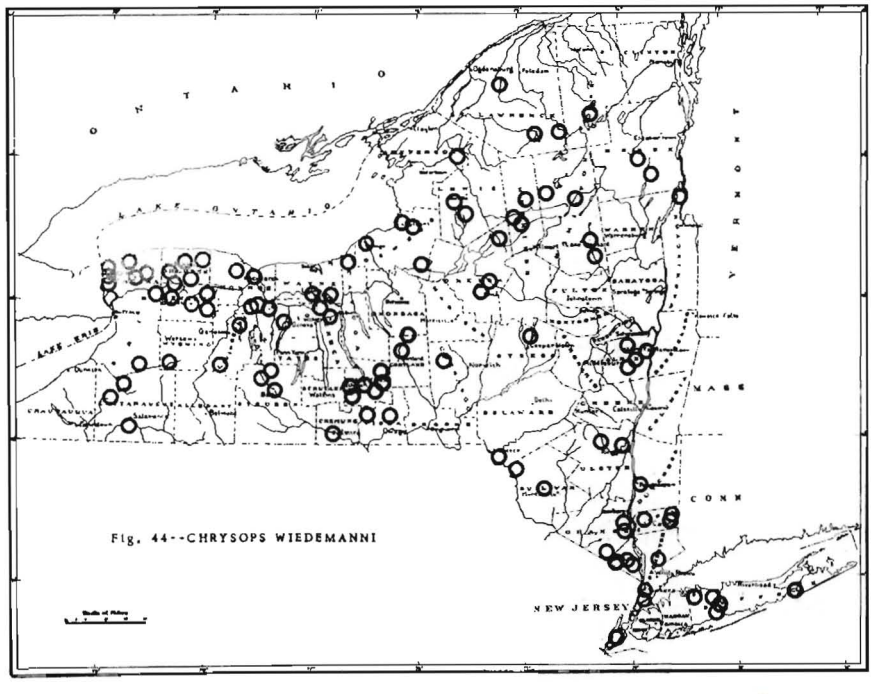

Fig. 44--CHRYSOPS WIEDEMANNI

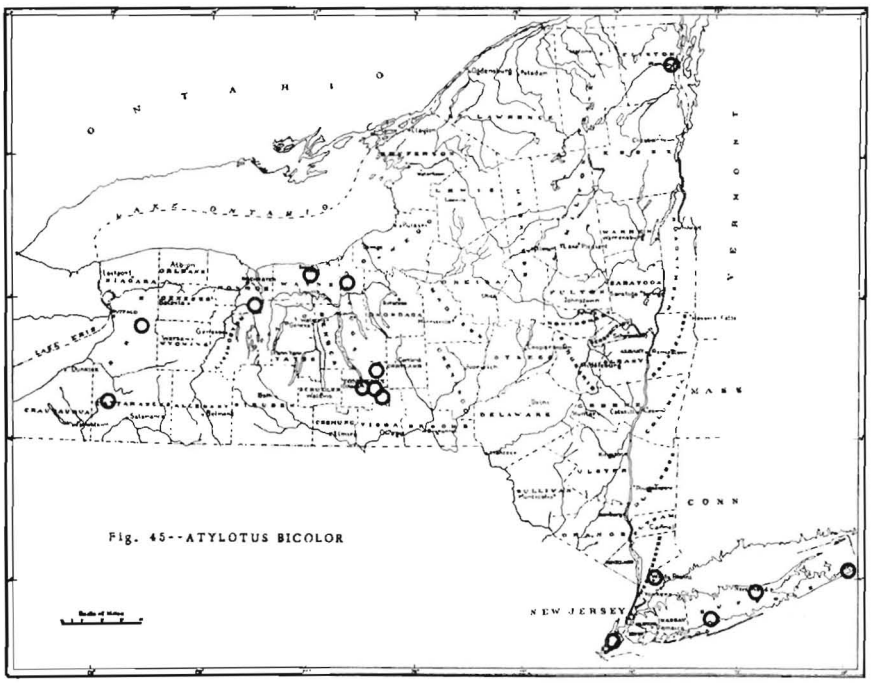

Fig. 45--ATYLOTUS BICOLOR

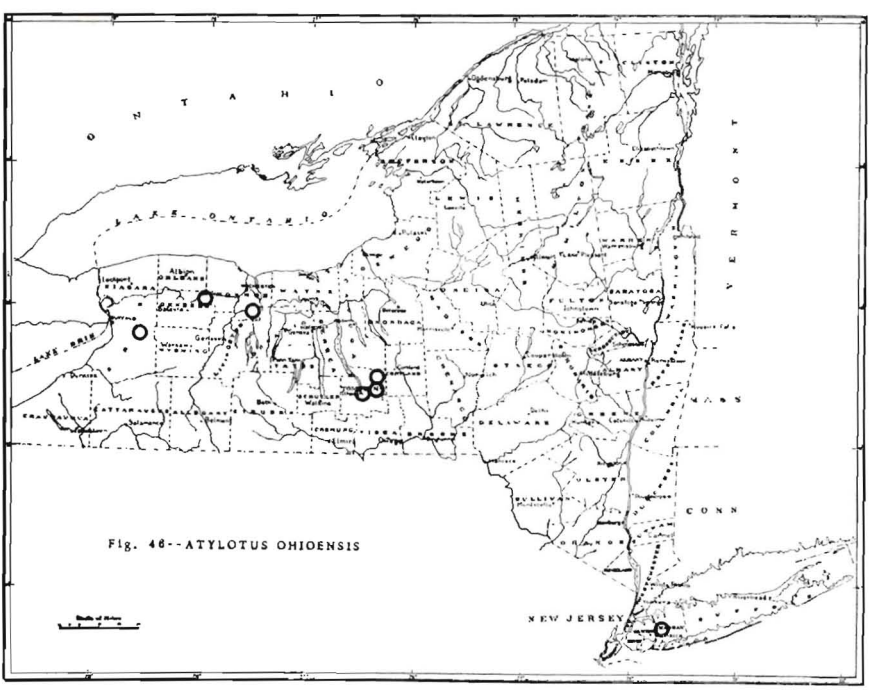

Fig. 46--ATYLOTUS OHIOENSIS

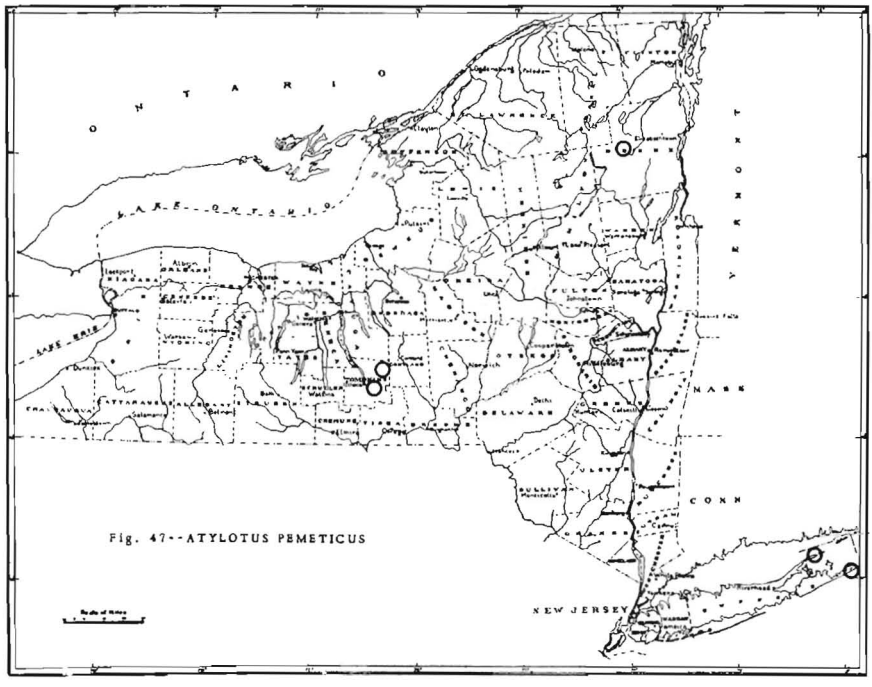

Fig. 47--ATYLOTUS PEMETICUS

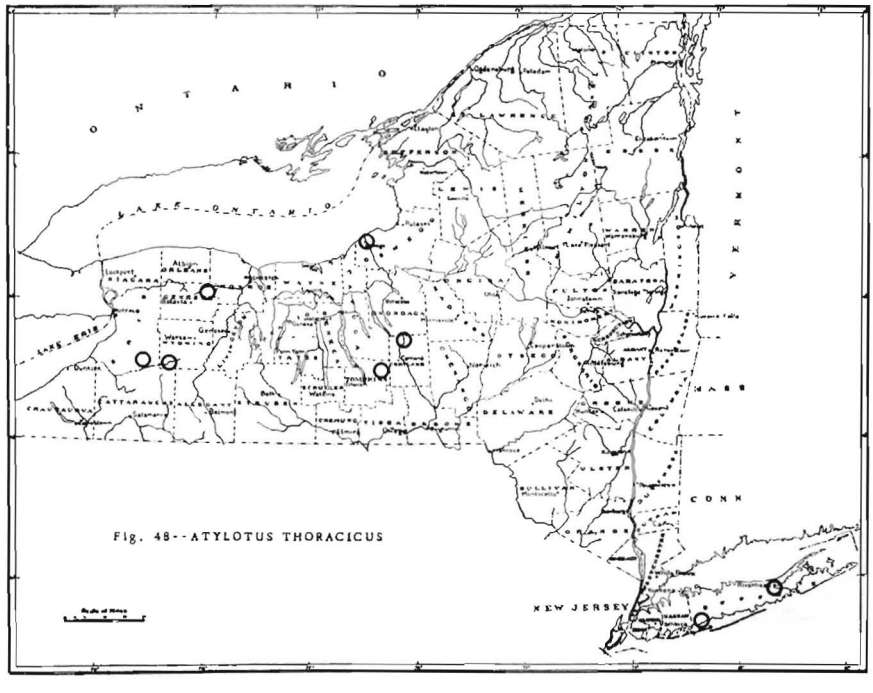

Fig. 48--ATYLOTUS THORACICUS

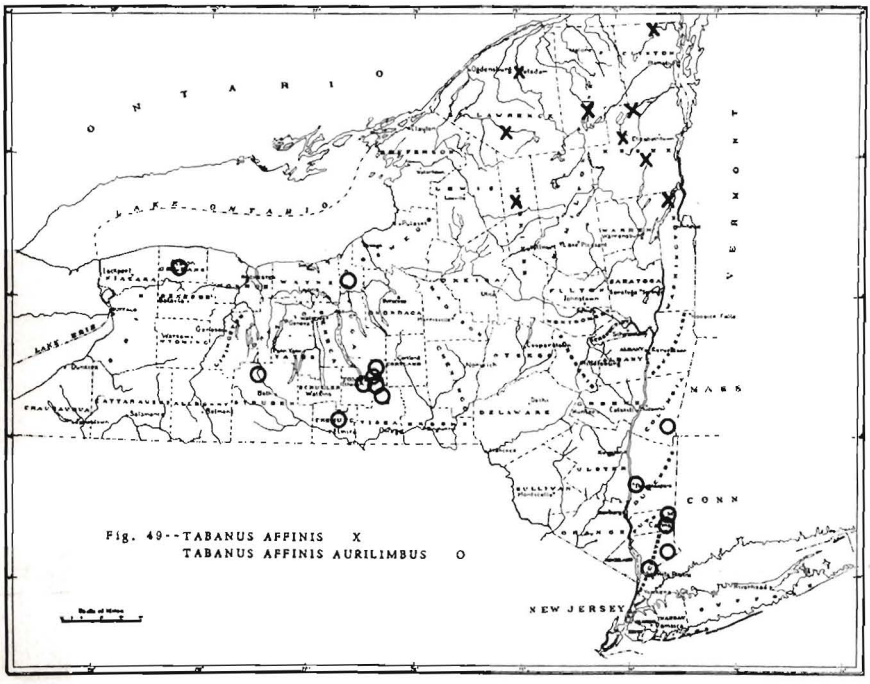

Fig. 49--TABANUS AFFINIS X
TABANUS AFFINIS AURILIMBUS O

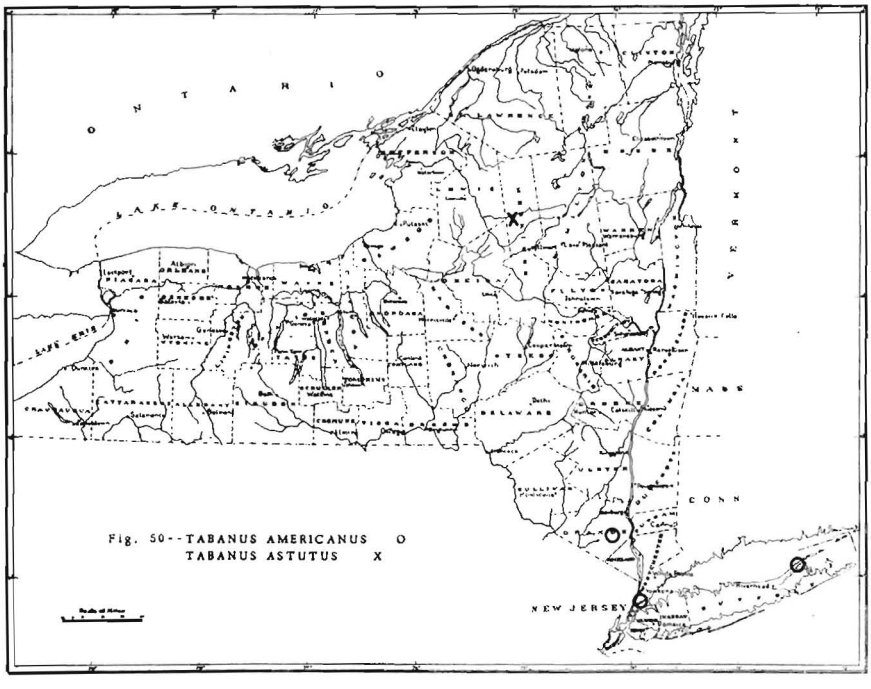

Fig. 50--TABANUS AMERICANUS O
TABANUS ASTUTUS X

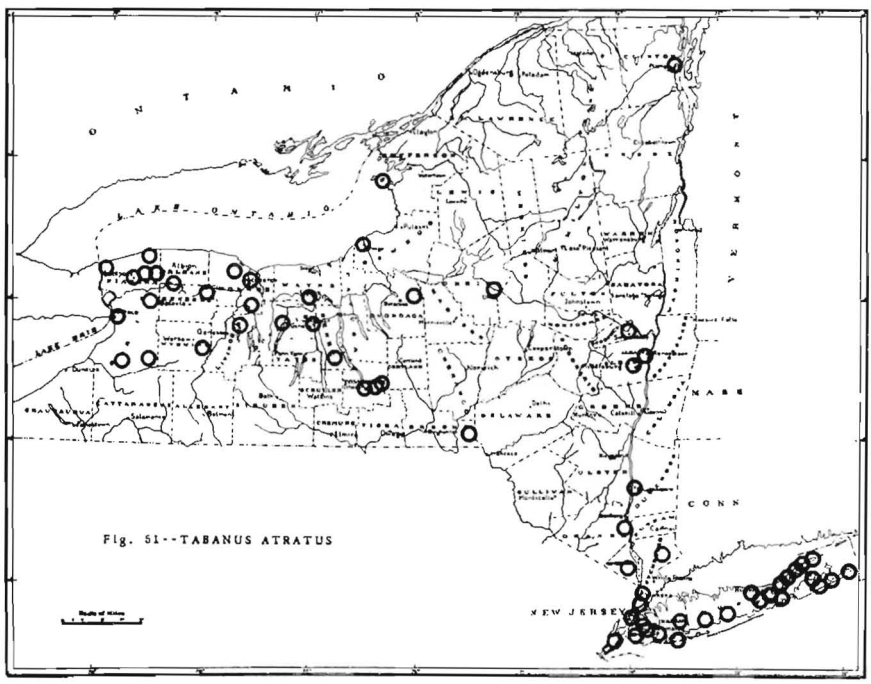

Fig. 51--TABANUS ATRATUS

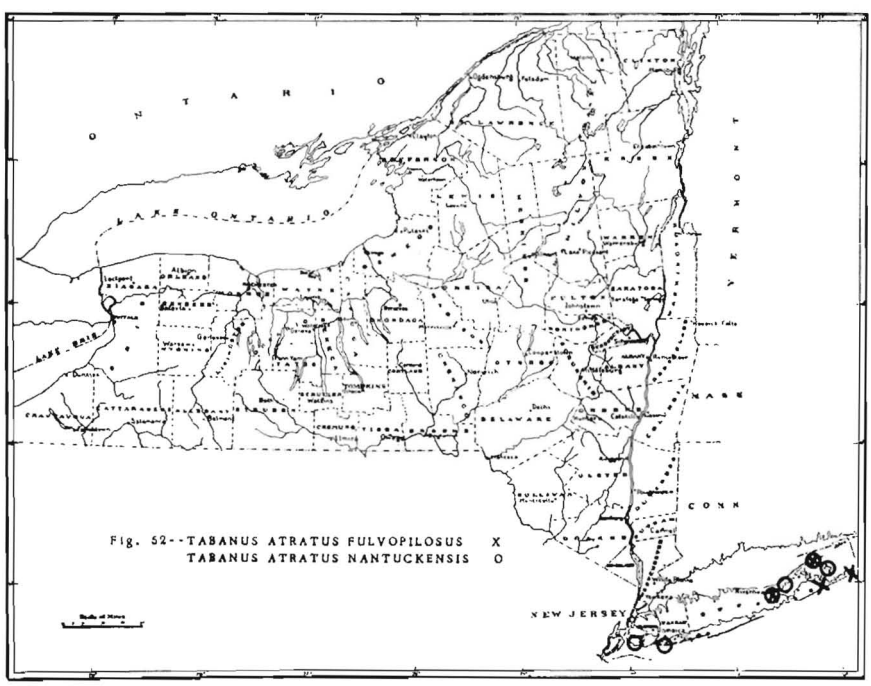

Fig. 52--TABANUS ATRATUS FULVOPILOSUS X
TABANUS ATRATUS NANTUCKENSIS O

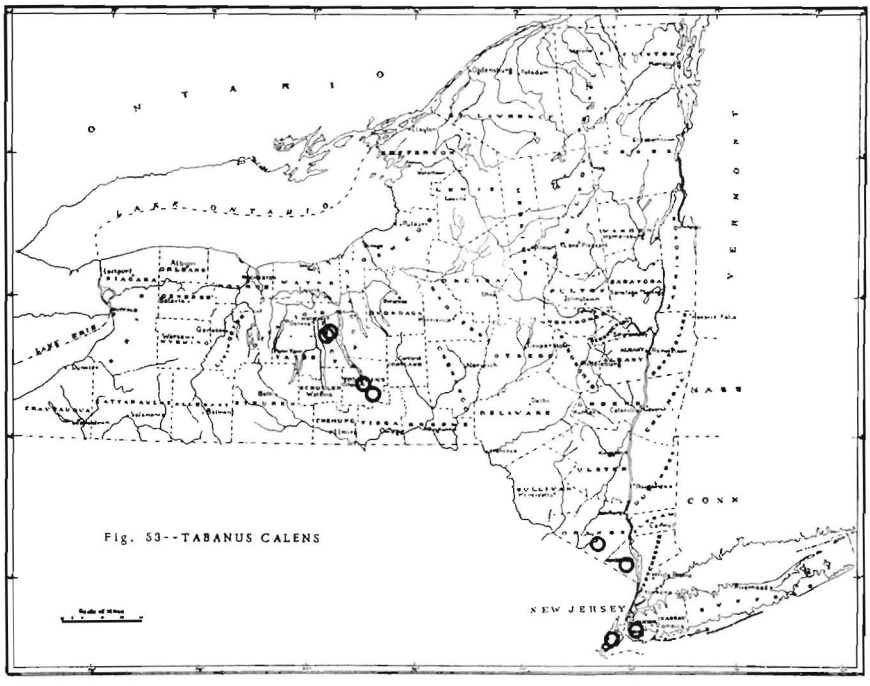

Fig. 53--TABANUS CALENS

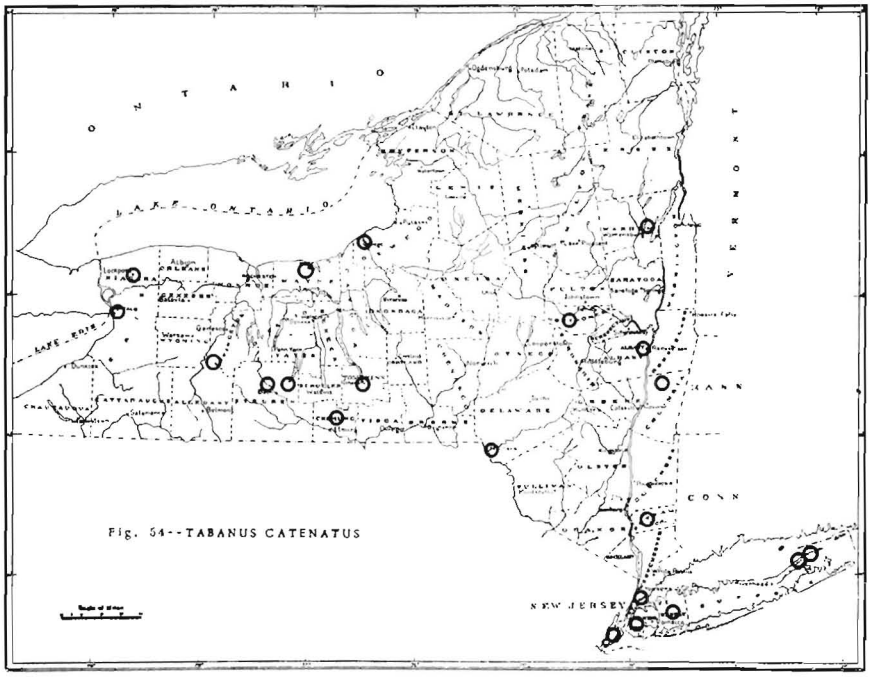

Fig. 54--TABANUS CATENATUS

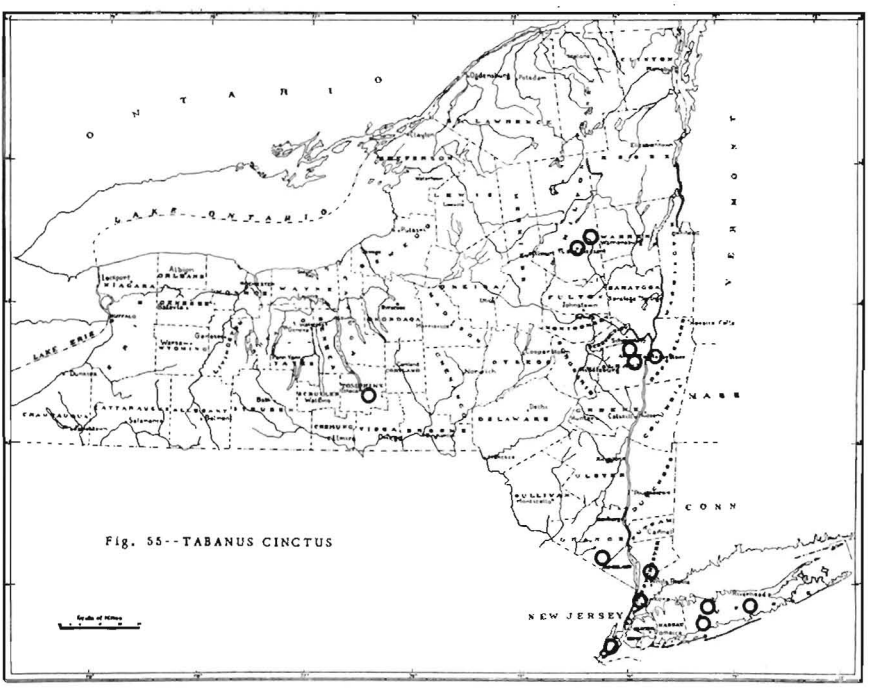

Fig. 55--TABANUS CINCTUS

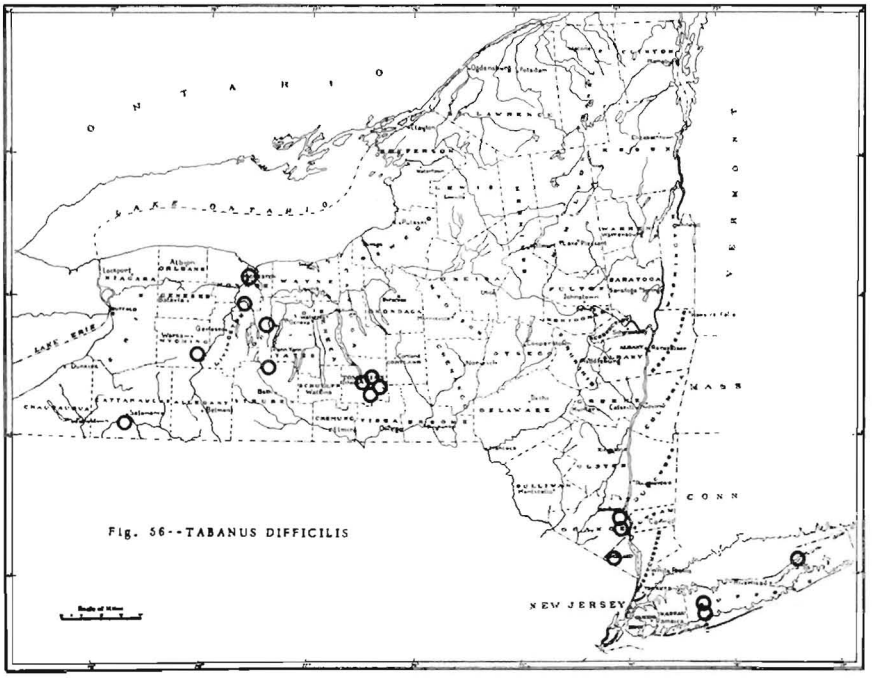

Fig. 56--TABANUS DIFFICILIS

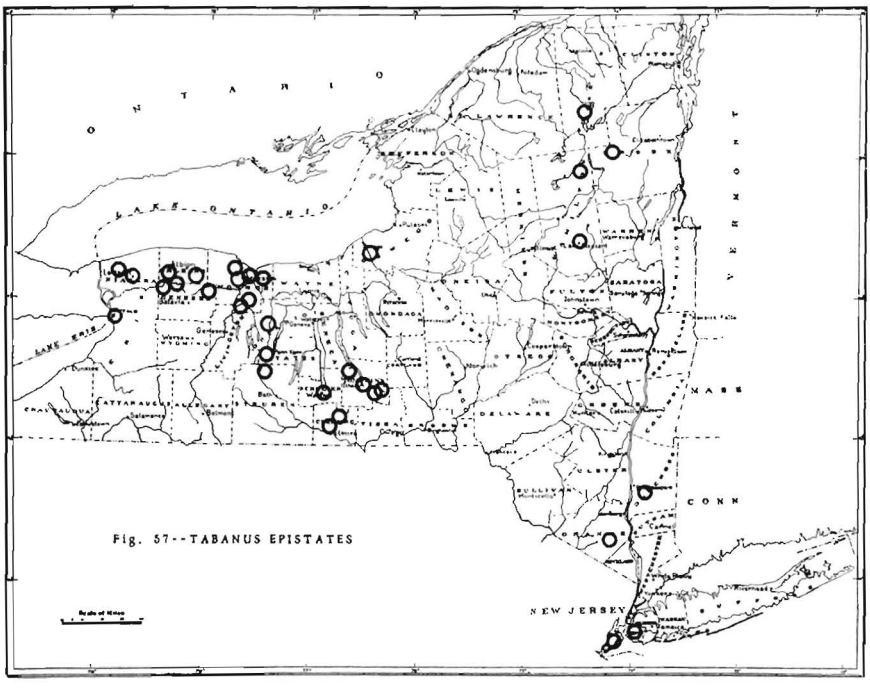

Fig. 57--TABANUS EPISTATES

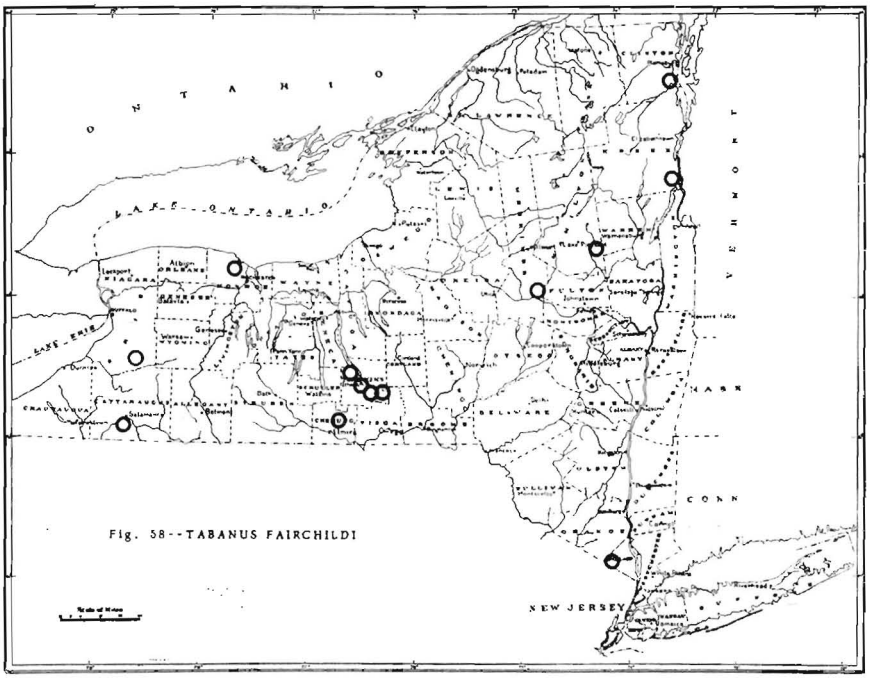

Fig. 58--TABANUS FAIRCHILDI

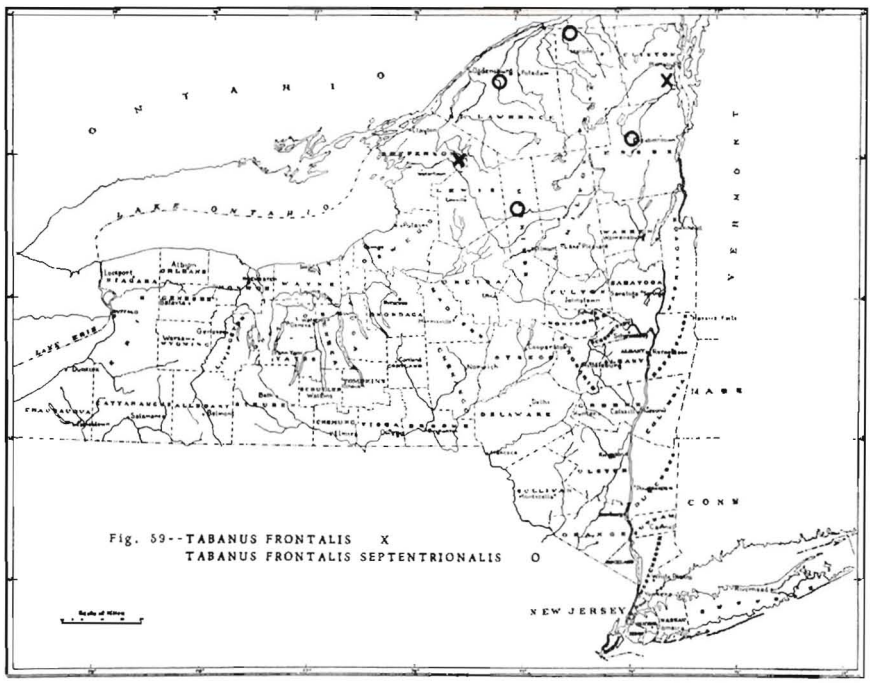

Fig. 59--TABANUS FRONTALIS X
TABANUS FRONTALIS SEPTENTRIONALIS O

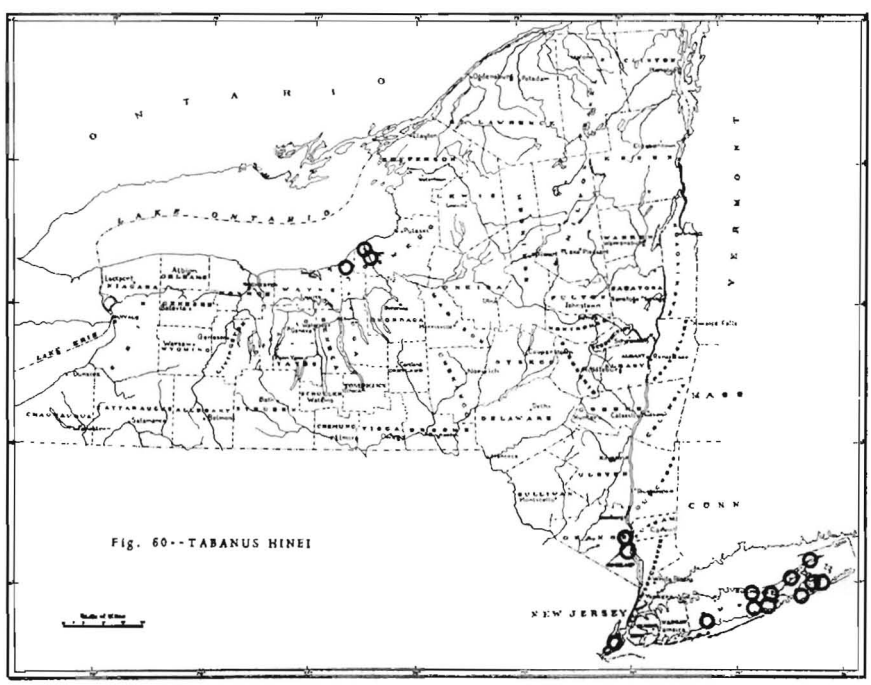

Fig. 60--TABANUS HINEI

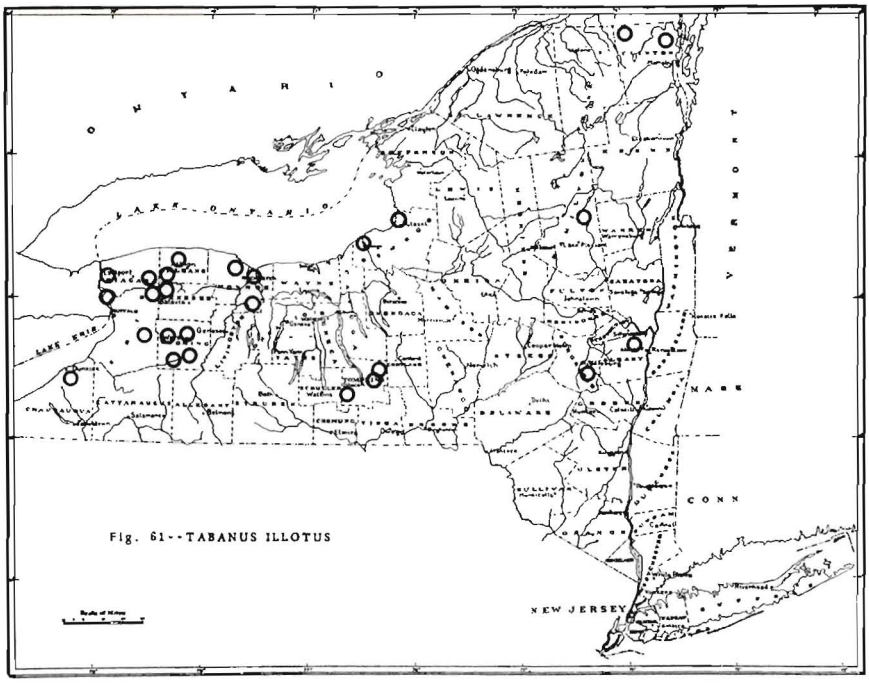

Fig. 61--TABANUS ILLOTUS

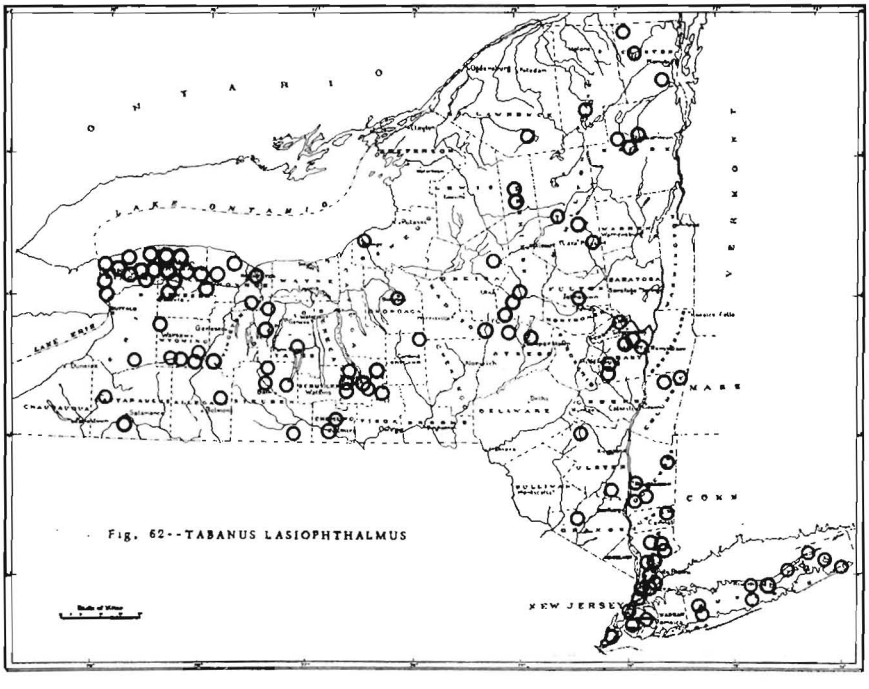

Fig. 62--TABANUS LASIOPHTHALMUS

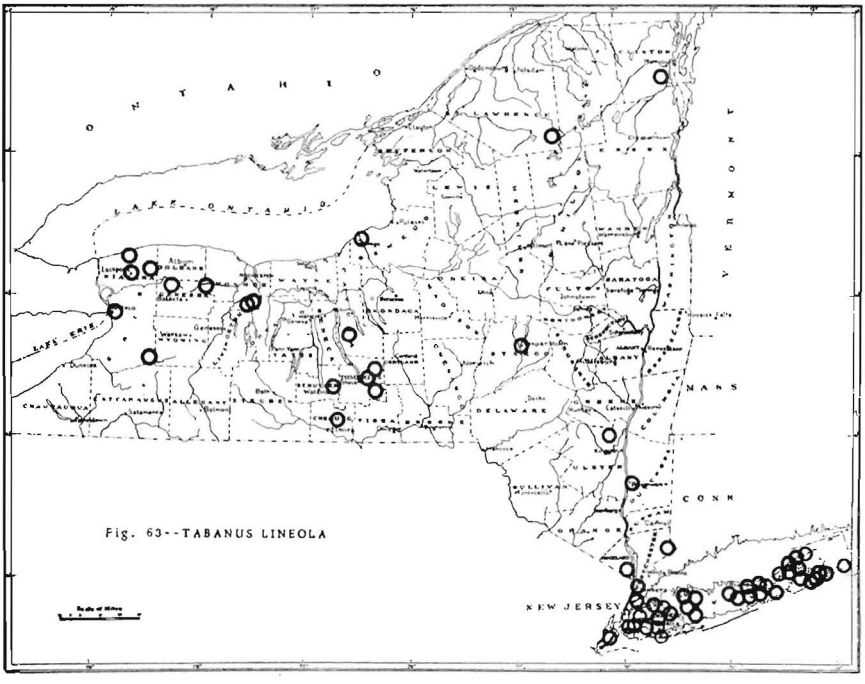

Fig. 63--TABANUS LINEOLA

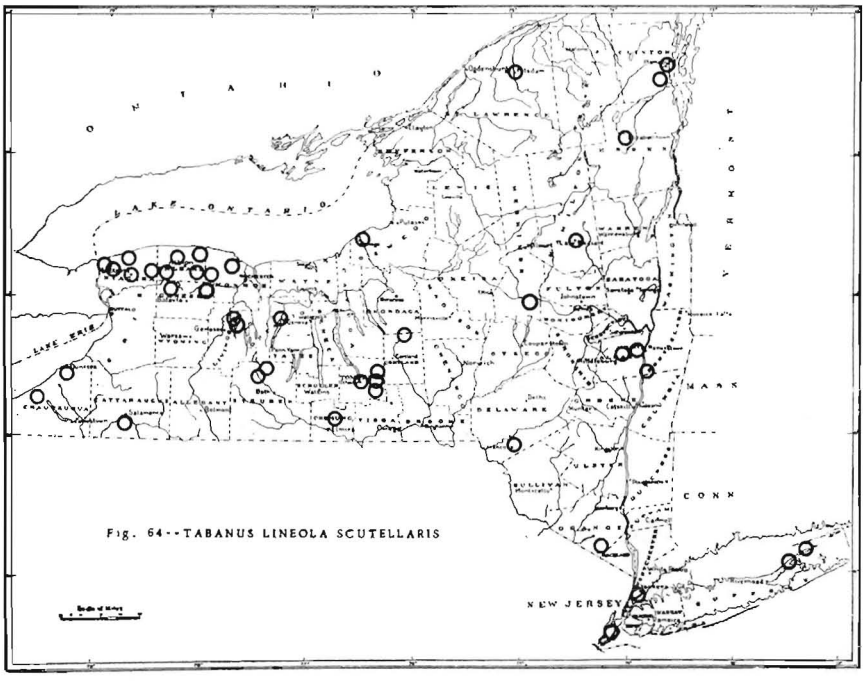

Fig. 64--TABANUS LINEOLA SCUTELLARIS

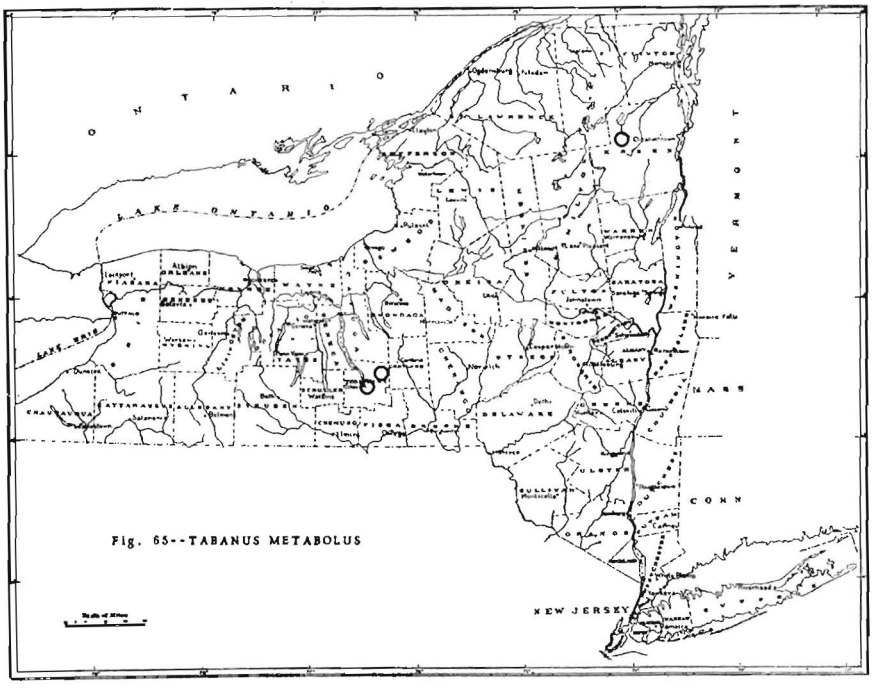

Fig. 65--TABANUS METABOLUS

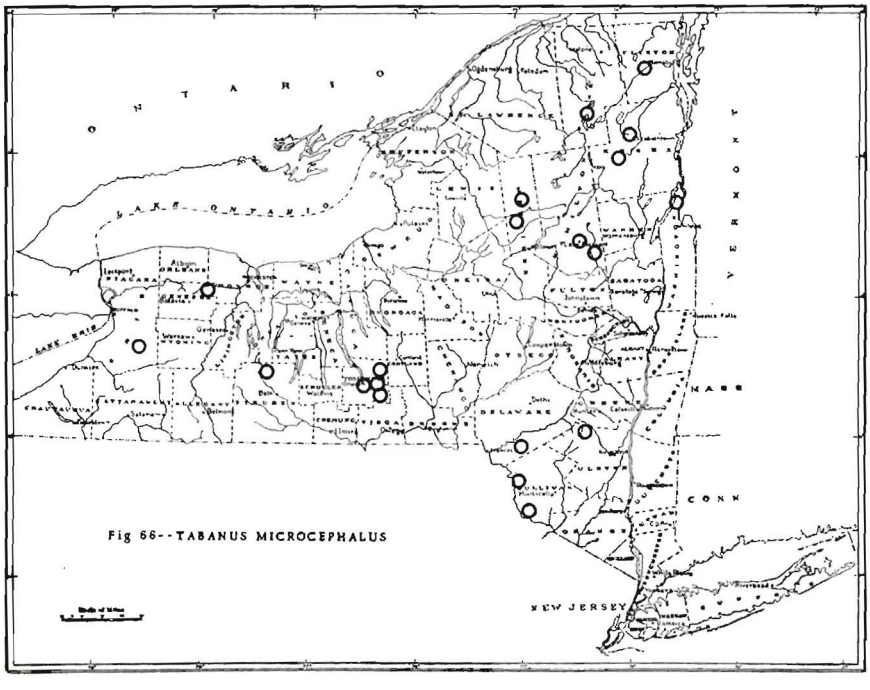

Fig 66--TABANUS MICROCEPHALUS

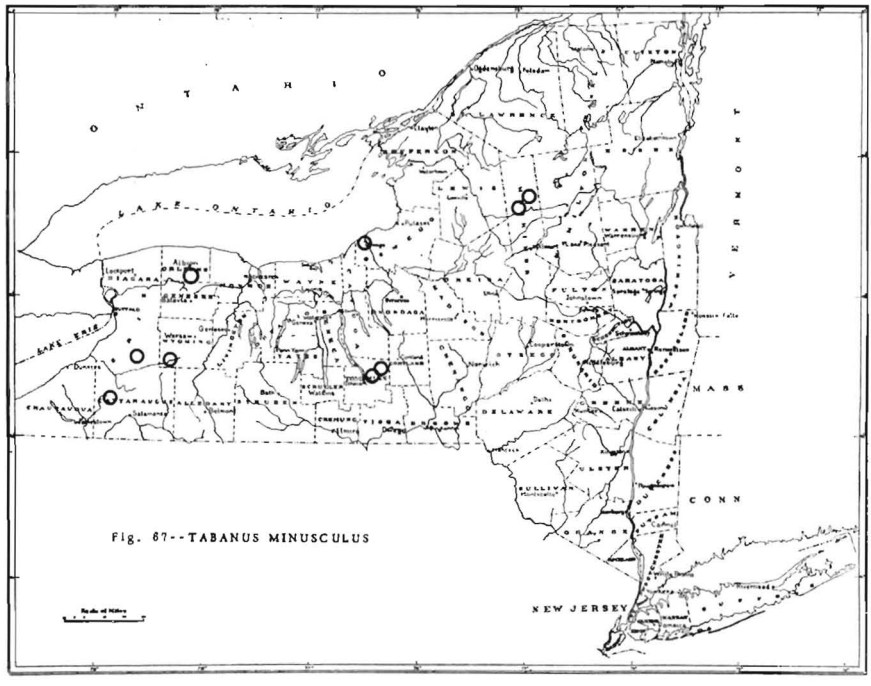

Fig. 67--TABANUS MINUSCULUS

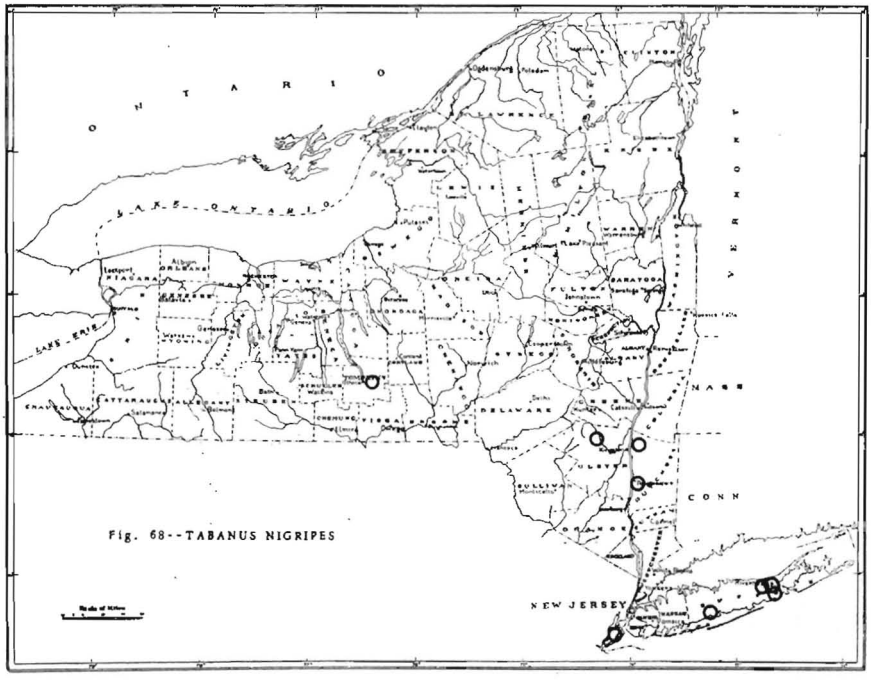

Fig. 68--TABANUS NIGRIPES

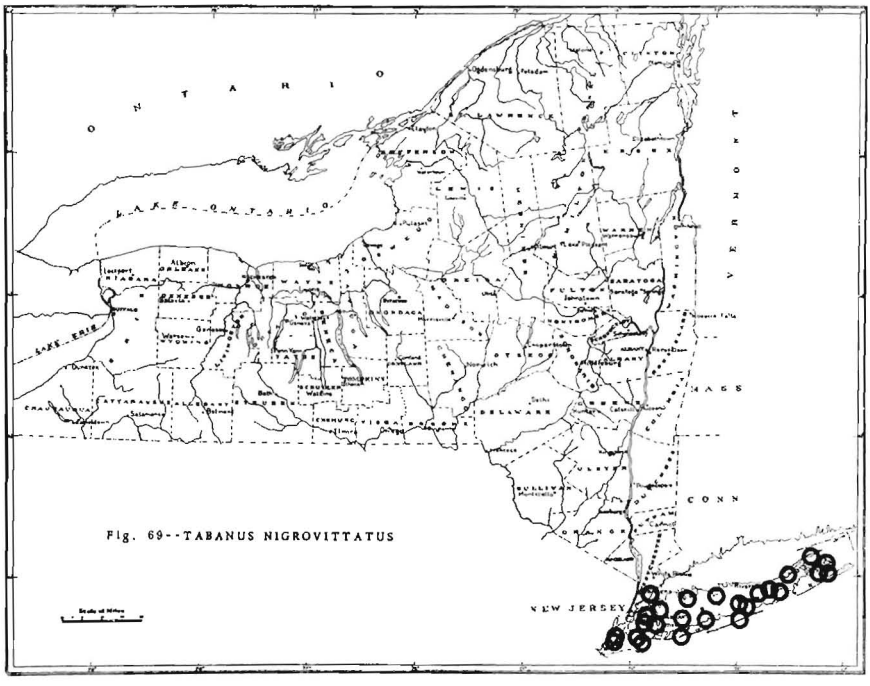

Fig. 69--TABANUS NIGROVITTATUS

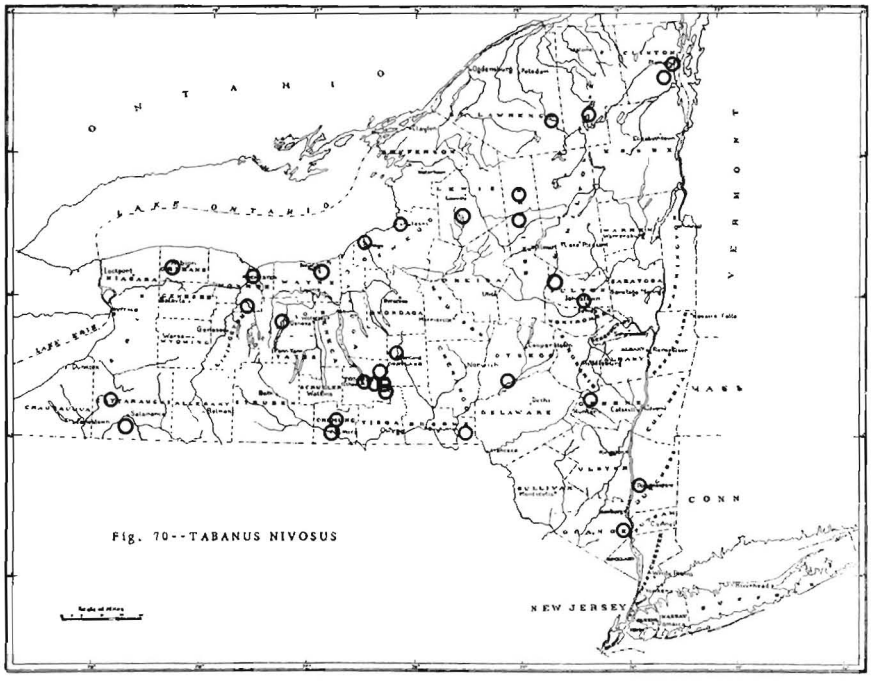

Fig. 70--TABANUS NIVOSUS

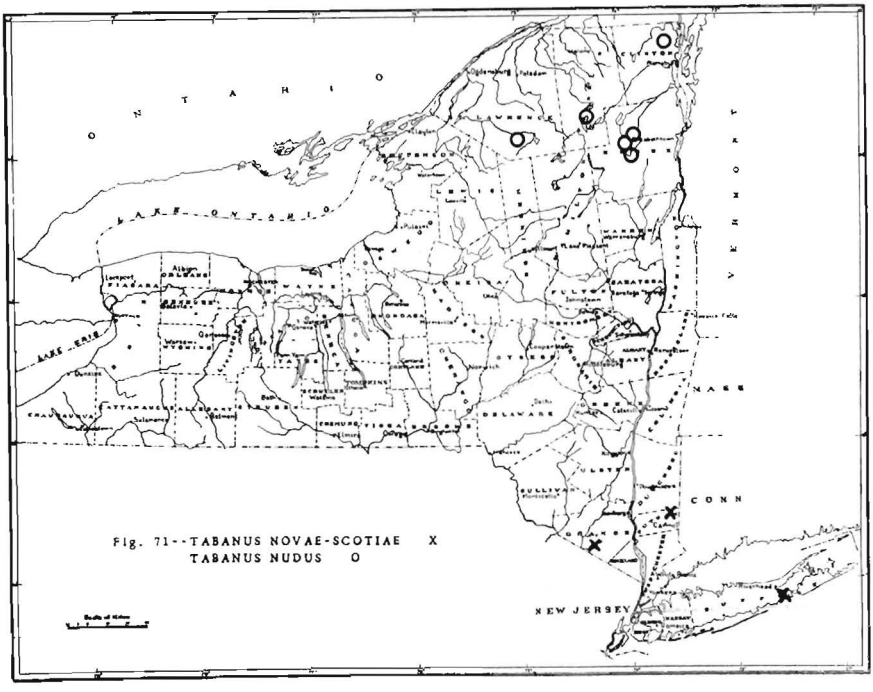

Fig. 71--TABANUS NOVAE-SCOTIAE X
TABANUS NUDUS O

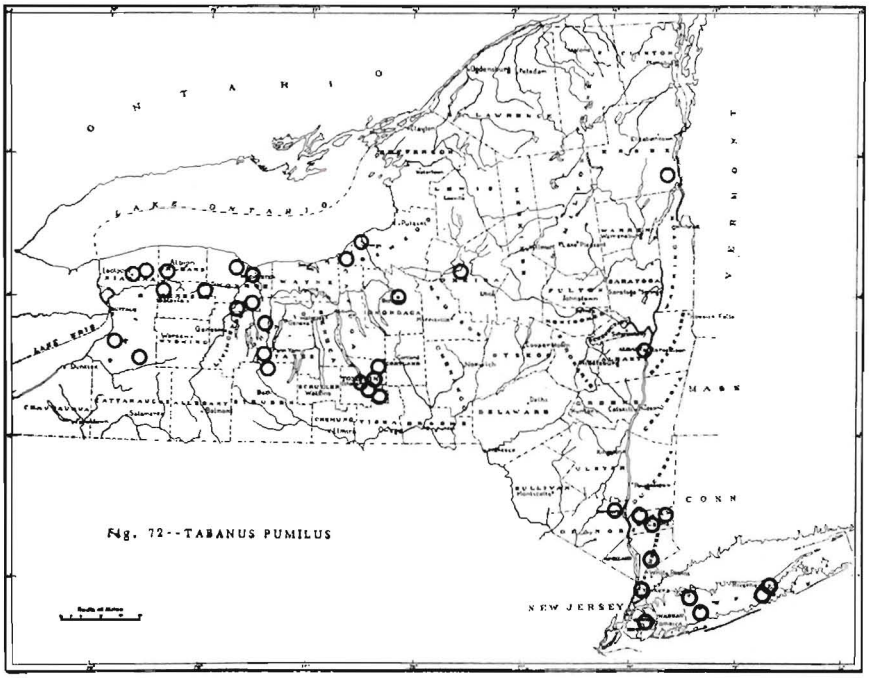

Fig. 72--TABANUS PUMILUS

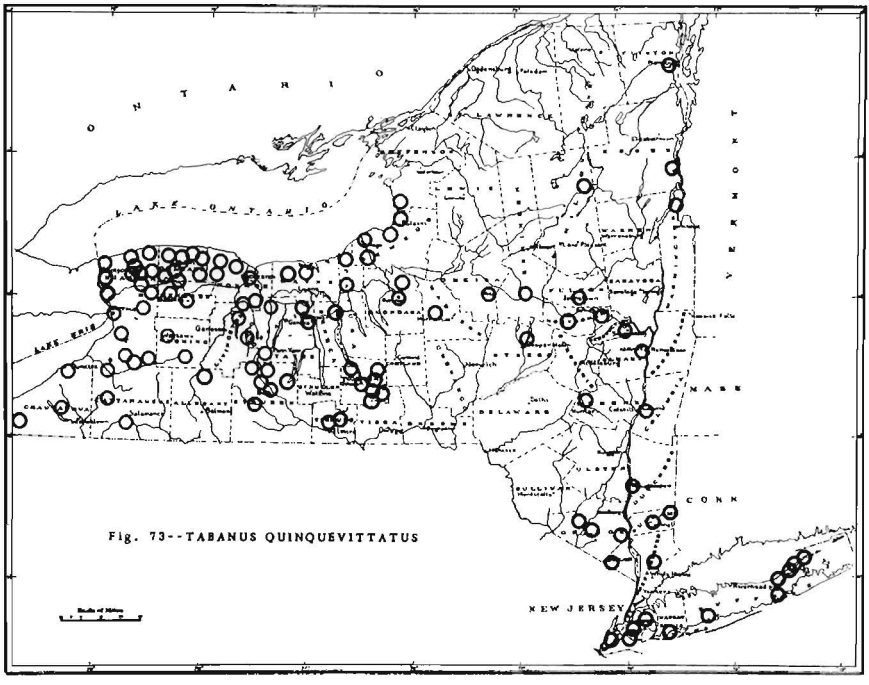

Fig. 73--TABANUS QUINQUEVITTATUS

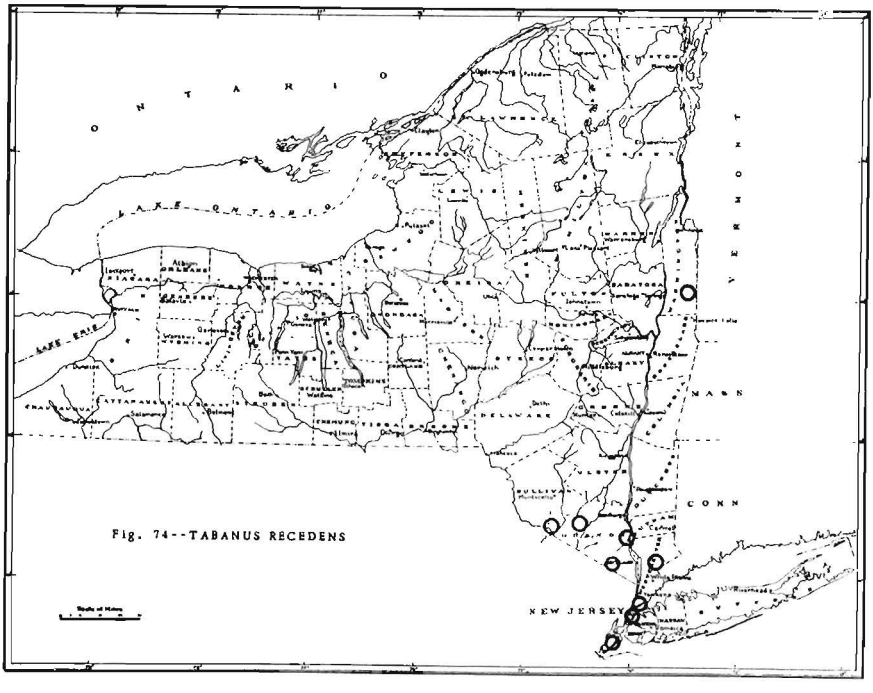

Fig. 74--TABANUS RECEDENS

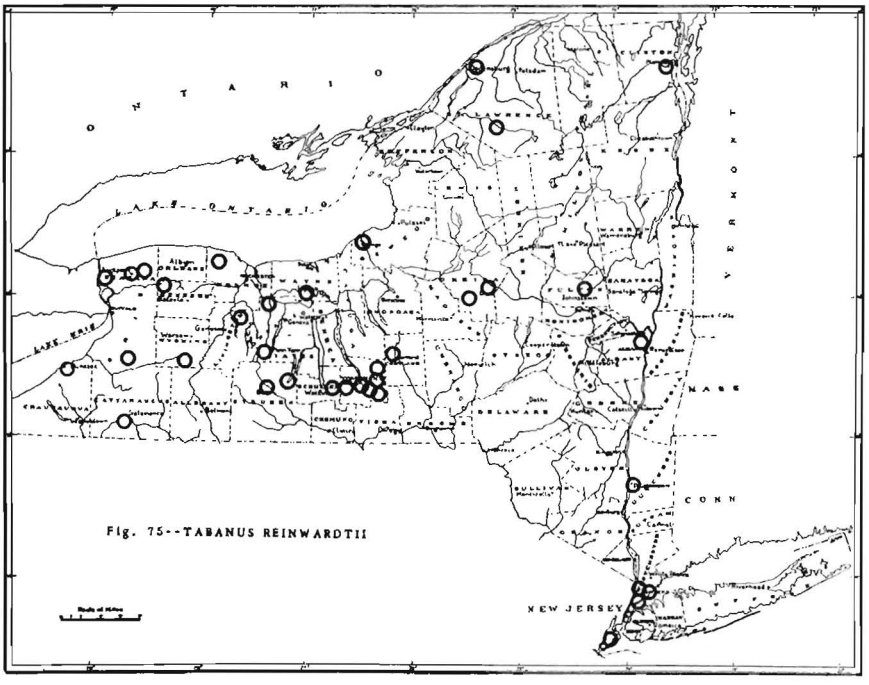

Fig. 75--TABANUS REINWARDTII

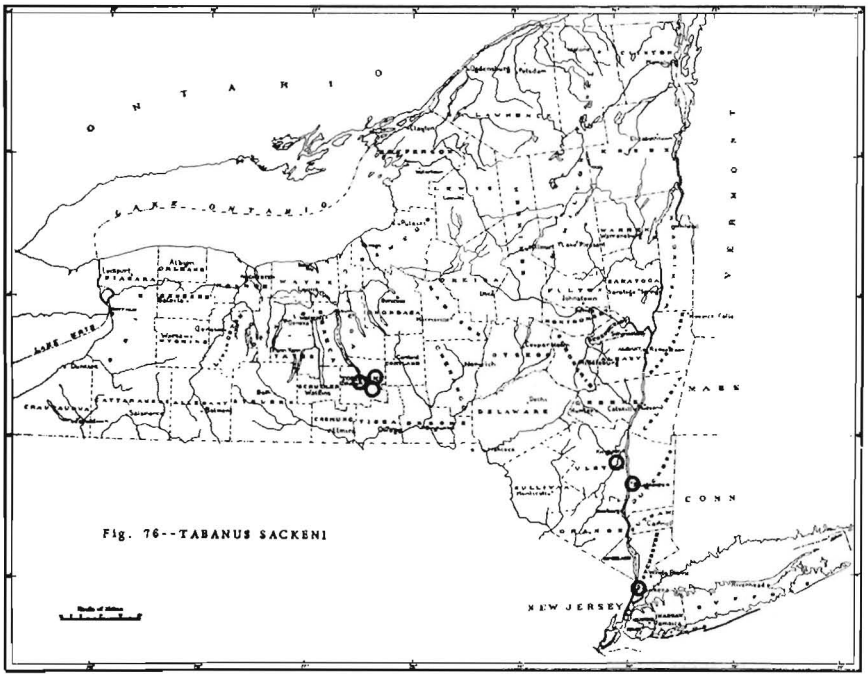

Fig. 76--TABANUS SACKENI

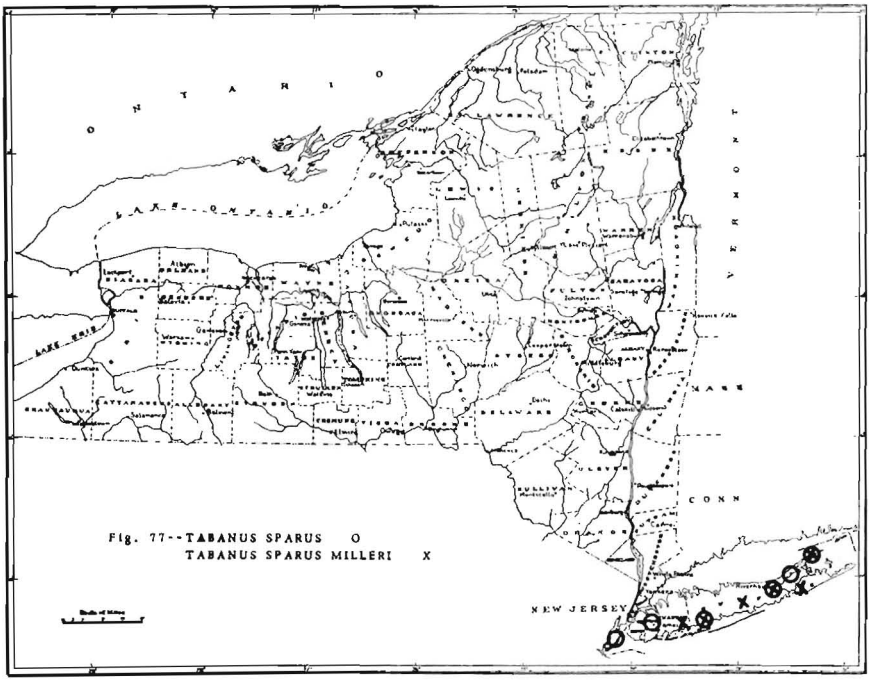

Fig. 77--TABANUS SPARUS O
TABANUS SPARUS MILLERI X

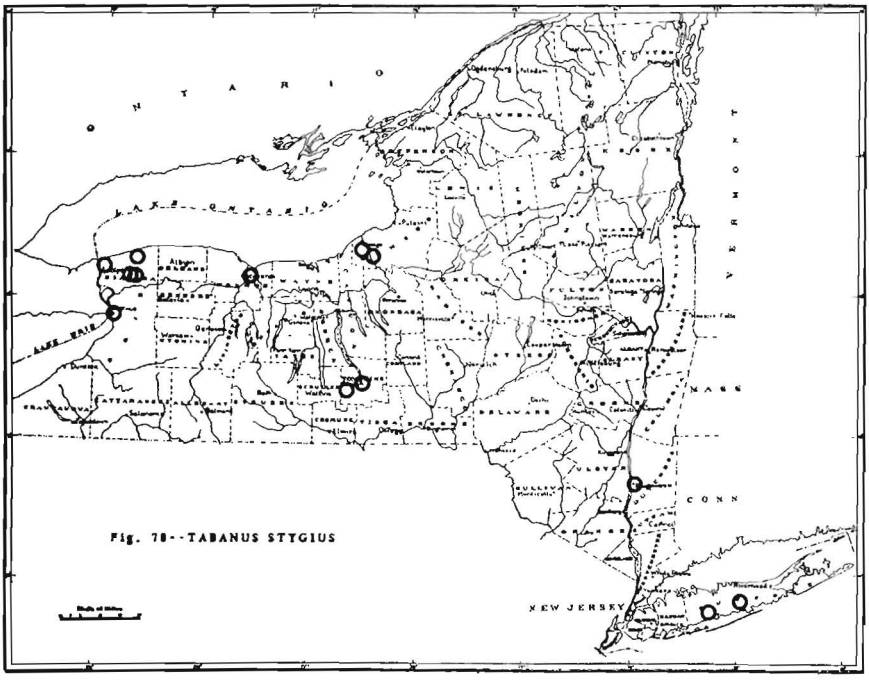

Fig. 78--TABANUS STYGIUS

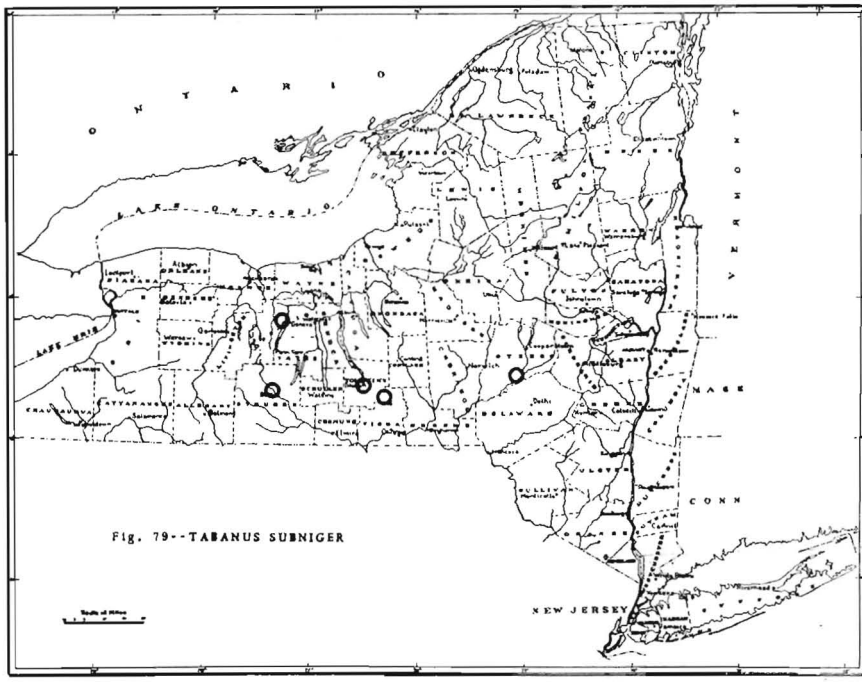

Fig. 79--TABANUS SUBNIGER

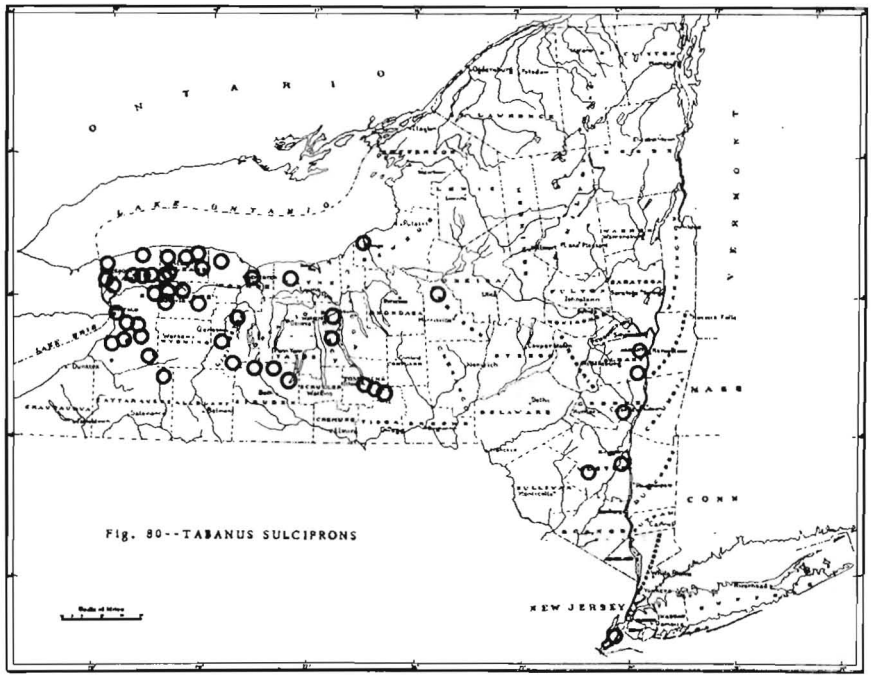

Fig. 80--TABANUS SULCIPRONS

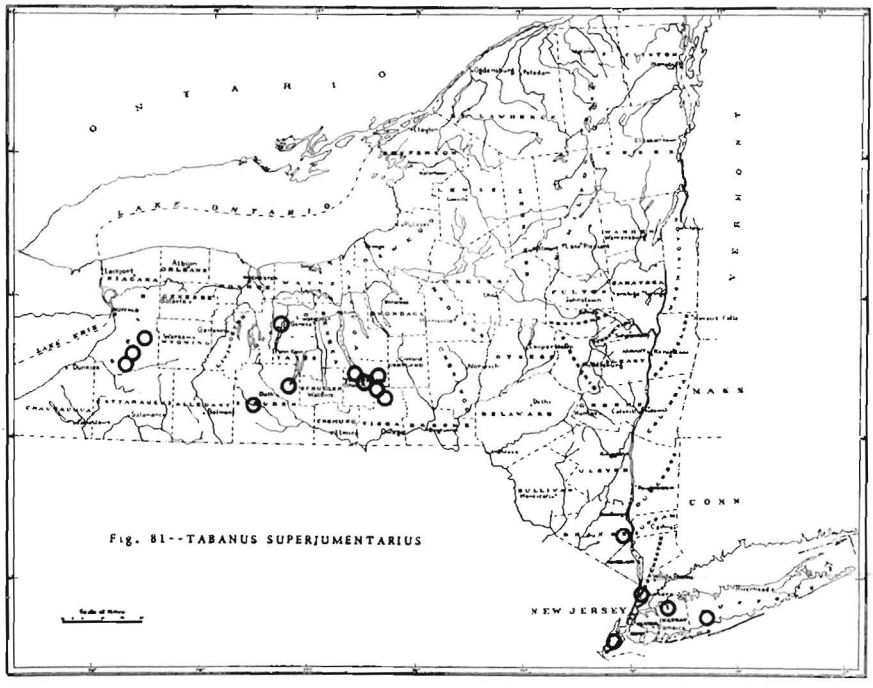

Fig. 81--TABANUS SUPERJUMENTARIUS

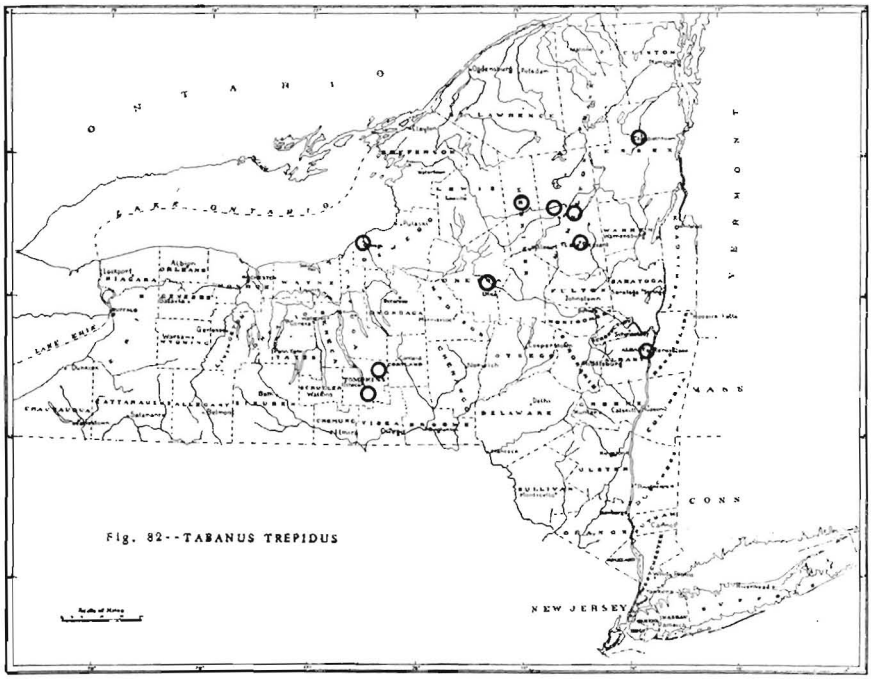

Fig. 82--TABANUS TREPIDUS

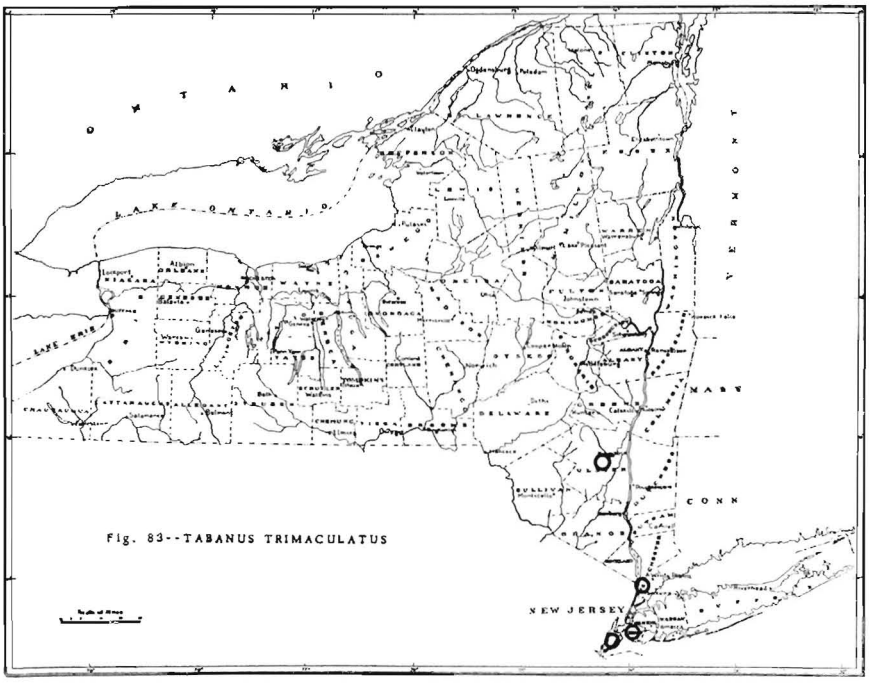

Fig. 83--TABANUS TRIMACULATUS

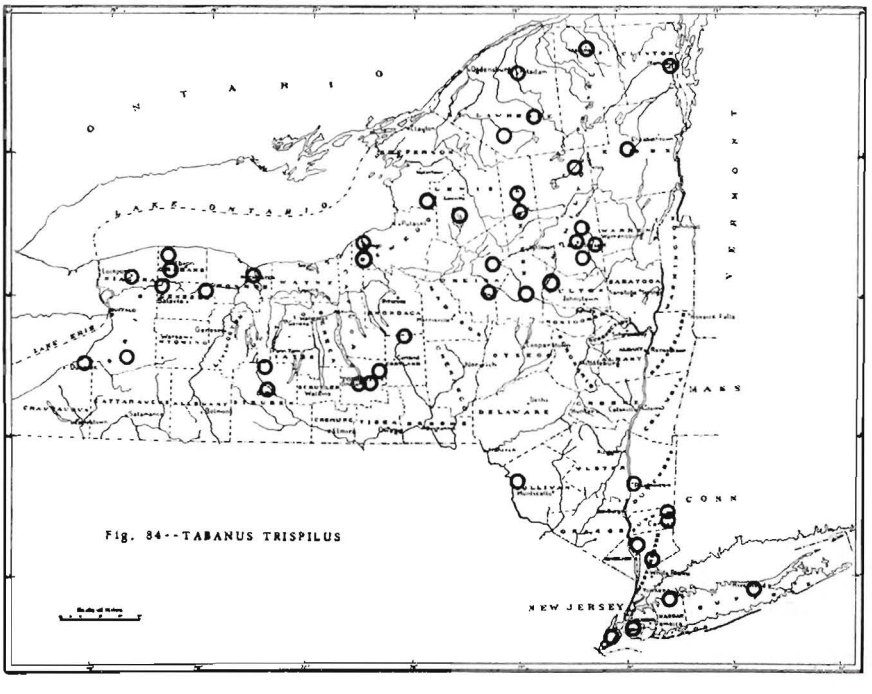

Fig. 84--TABANUS TRISPILUS

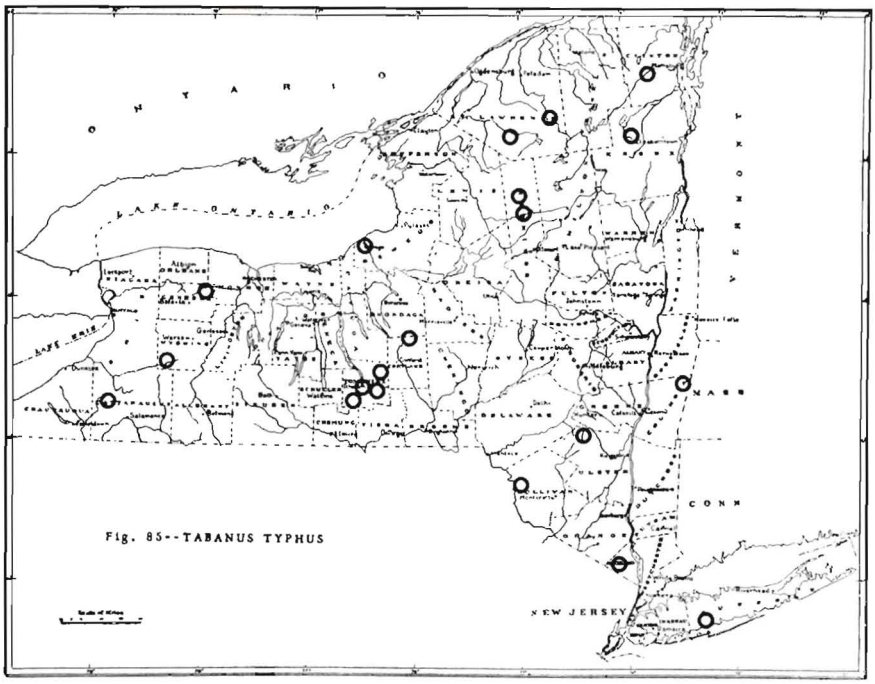

Fig. 85--TABANUS TYPHUS

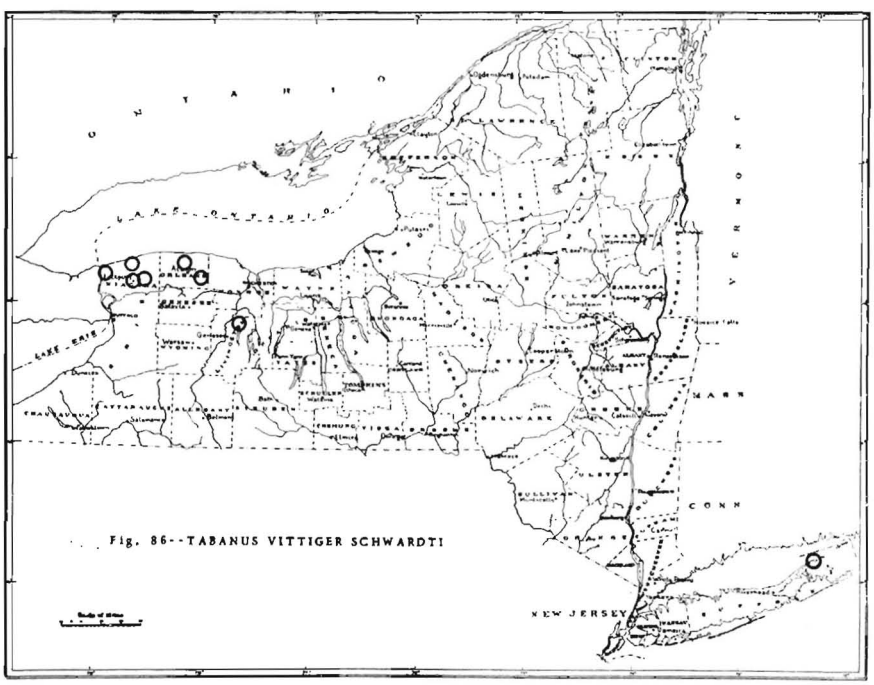

Fig. 86--TABANUS VITTIGER SCHWARDTI

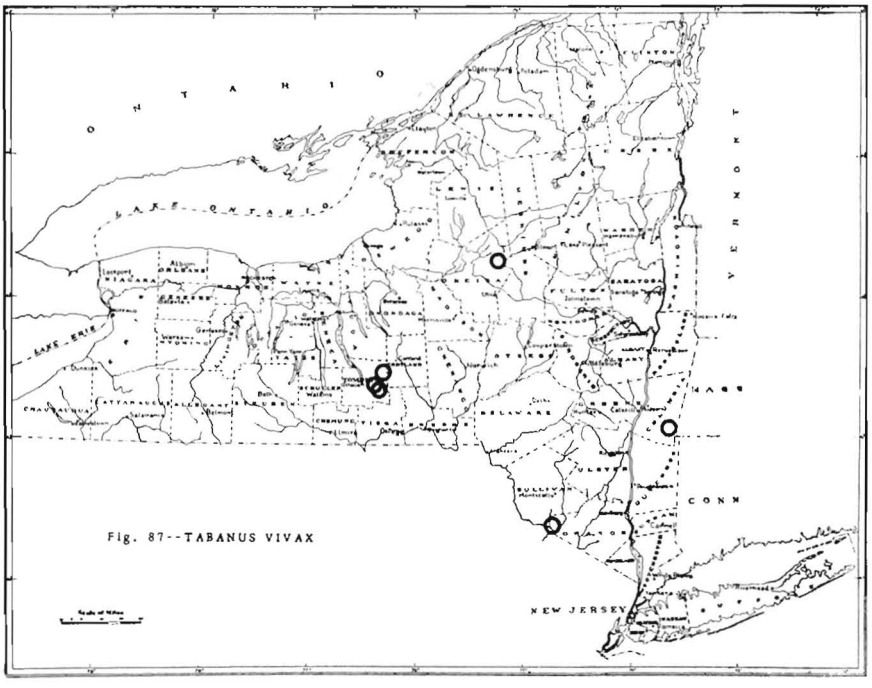

Fig. 87--TABANUS VIVAX

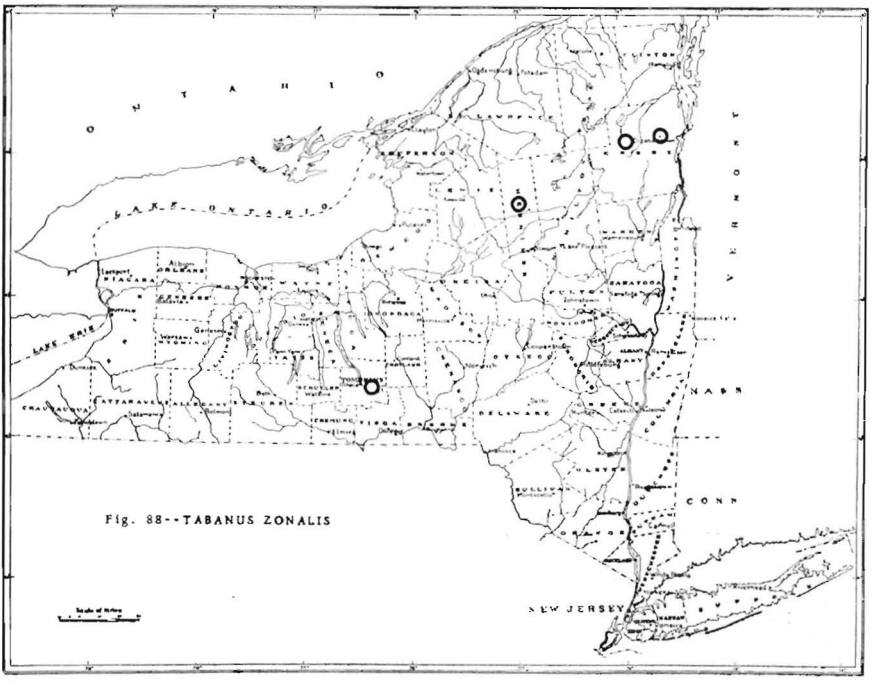

Fig. 88--TABANUS ZONALIS

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