

AN ABSTRACT OF THE THESIS OF

WAYNE N. MATHIS for the degree of DOCTOR OF PHILOSOPHY
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Title: A REVISION OF THE GENUS NOTIPHILA FALLÉN (DIPTERA:
EPHYDRIDAE) FROM AMERICA NORTH OF MEXICO

Abstract approved: _____

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John D. Lattin

The North American species of the shore fly genus Notiphila Fallén were taxonomically revised. Over 13,000 specimens were examined from throughout the Nearctic Region and information relating to the biology of many species occurring in the West was gathered from both field and laboratory studies. Previously used characters were reevaluated; new evidence from comparative morphological studies on the male and female postabdomens, from developmental stages, and from biological and ecological observations was collected. Forty-nine characters were selected, quantified, and analyzed using standard numerical taxonomic procedures. Collectively, all these data were assessed and a classification derived.

Forty-seven Notiphila species are now recognized from North America. These have been further classified into two subgenera and six species-groups. The subgenera were first erected by E. T. Cresson, Jr. and have been substantiated by the additional evidence

accumulated during this study. Likewise, the species-groups are essentially those of Cresson with additions and minor modifications.

Recognition of the subgenus Notiphila is supported by the external morphology of both sexes, by the morphology of the pupae and larvae, and by phenetic analysis using quantitative procedures. This subgenus includes 25 North American species of which three species are resurrected from synonymy (N. bicolor Cresson, N. cognata Cresson, and N. unicolor), two new names are proposed (N. cressoni and N. paludicola for N. bicolor and N. unicolor respectively), and 13 new species are described (N. adusta, N. footei, N. pallicornis, N. taenia, N. phaeopsis, N. pulcra, N. robusta, N. eleomyia, N. latigena, N. orientalis, N. pauroura, N. poliosoma, and N. shewelli). These species have been arranged into three species-groups that are based primarily on characters of the male genitalia. Most of the species of this subgenus occur in eastern North America.

The second subgenus, Agrolimna, comprises 22 species, including seven new species (N. scoliochaeta, N. atrata, N. deonieri, N. deserta, N. elophila, N. nanosoma, and N. paludia). In addition, the following synonymies are proposed (older name first: N. decoris Williston = N. atrisetis Cresson, N. quadrisetosa Thomson = N. occidentalis Cresson, and N. pulchrifrons Loew = N. signata Cresson). N. transversa Walker, listed as an Agrolimna species in

the latest North American catalog, is a species of the genus Dichaeta.

Three species-groups are recognized for the North American

species, and most species are distributed in western North America.

A Revision of the Genus Notiphila Fallén
(Diptera: Ephydriidae) from America
North of Mexico

by

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A REVISION OF THE GENUS NOTIPHILA FALLÉN
(DIPTERA: EPHYDRIDAE) FROM AMERICA
NORTH OF MEXICO

INTRODUCTION

The shore fly family Ephydriidae has attracted increased attention during the last ten years, resulting in several significant contributions to our understanding of the family, especially in basic biology. Despite renewed efforts, however, the shore fly fauna of most geographic regions remains poorly known. In the National Museum of Natural History alone, Dr. Willis W. Wirth (1968) reported that there are over 150 new species of Neotropical Ephydriidae awaiting revisionary work and description. Although the Nearctic ephydrid fauna is better known than most, recent revisions of major groups (Clausen and Cook, 1971; Deonier, 1971; Wirth, 1971) still required new species or new name status for approximately one-third of the taxa considered. As a result, meaningful conclusions regarding shore fly biogeography or species diversity, for example, would presently be premature, being limited to taxonomic data that are very incomplete. Basic taxonomic studies on the Ephydriidae are still desirable.

Members of the family Ephydriidae comprise an unusually diverse assemblage of aquatic or semi-aquatic shore flies. Most shore fly larvae are grazers or filter-feeders of organic material,

especially algae and bacteria. Others mine the foliage of aquatic and terrestrial plants or are saprophytic on dead snails; the larvae of a few species exist on spider and frog eggs. Many taxa are uniquely adapted to such inhospitable environments as sulfurous hot springs, highly alkaline or saline lakes, and perhaps most notably, to exposed pools of crude petroleum. In his book The Natural History of Flies, Oldroyd (1964:188) wrote:

Clearly, then, Ephydridae are nothing if not versatile.
. . . Evidently we are seeing in the Ephydridae a family of flies in the full flower of its evolution, and as such they offer attractive material for study, not only to the dipterist, but also to the student of insect physiology and behavior.

In an effort to better understand ephydrid diversity and to establish a systematic basis for further study, a taxonomic revision of the North American species of the genus Notiphila Fallén was undertaken. This paper presents the results of my study.

Notiphila is worldwide in distribution and occurs in all faunal realms, although the faunal composition of most areas is still poorly known. Even less is known about the biology, ecology, and behavior of the genus. In general, Notiphila species are associated with permanent aquatic environments where emergent vegetation is plentiful. Typically, the immature stages live underwater in the organic mud substrate near the shoreline of lakes, ponds, marshes or wet meadows. The larvae feed on particulate matter such as algae and diatoms, and respire by inserting their caudal spiracles into the

aerenchyma of aquatic plant roots to obtain oxygen. The adults of most species are small but vagile.

Notiphila was selected for study because of my long interest in Diptera; specifically in the unique family Ephydriidae, and because the present systematic knowledge of this genus is somewhat confused and in need of revision. An improved knowledge of Notiphila will result in clarified and accurate species identification which will facilitate the acquisition of specific ecological information. This information could contribute to both applied and basic research.

The basic difficulty encountered with our systematic knowledge of Notiphila was identified by Ezra T. Cresson, Jr., who wrote the last synopsis of the North American species in 1946. Cresson pre-faced his treatment of the genus with the following comments which outline the problem.

Many species of this genus can be distinguished only after intensive studies of large series from many localities. This difficulty is caused by the numerous apparently stable forms which break down the species limits. The study of the genitalia will probably clear up these problems.

The problem, alluded to by Cresson, is basic in nature to most systematic studies. What are the species concepts and limitations, and what is the evidence? Likewise, the same type of questions could be asked of higher taxa, particularly of the subgeneric and generic categories. From this basis, a number of subordinate though

pertinent questions could also be asked. For example: What is the inter- and intraspecific variation?

In response to the questions above, an evaluation of the genus Notiphila was proposed with the following specific research objectives:

1. To assess the taxonomic value of the male postabdomen for potential characters.
2. To gather as much biological and ecological information as possible.
3. To update the known distributions of the various species and to correlate this information with possible factors of biogeographic importance.
4. To analyze numerically the phenetic relationships.
5. To gain a better understanding of the classification, particularly of the higher categories.

HISTORICAL REVIEW

The conceptual and nomenclatural history of Notiphila is typical of common and widely distributed taxa that were described early in the nineteenth century and have become well established in the literature. Many species originally included in Notiphila during the 1800's were later transferred to other shore fly genera and in some cases to genera of other families. Very few species have gone the reverse route of being described in other genera, later to be transferred to Notiphila.

Notiphila (notios, Greek, "wetness," plus philia, Greek, "fondness") was proposed by Carl F. Fallén in 1810 as a genus of the family "Hydromyzides." Fallén did not designate a type-species. In two subsequent revisions of the genus in 1813 and 1823, Fallén described several new species. Of the 15 species he described in his first revision, only the second, N. cinerea, remains in the genus today, and in 1840, this species was fixed as the type-species by Westwood.

Most of the early nineteenth century treatments of Notiphila consisted of listings and diagnoses of described species, summarizing the work of previous authors, plus descriptions of new taxa. These studies were primarily based on collections from the Palearctic area (see Becker, 1926, for references). The only paper of this

nature that is pertinent to the Nearctic fauna is that of Haliday (1839). Haliday described the first Notiphila species known to occur in North America, N. uliginosa. Although this species was described from European specimens, it is Holarctic in distribution. Meigen (1830) described a European species, N. riparia, and until the present study, this name and authorship was also used for a North American species. N. riparia Meigen does not occur in North America so far as I am aware.

The first described species of Notiphila that is exclusively Nearctic is N. solita, which was named by Walker in 1852, although until the present study, the identity of this species was uncertain. Walker based his description of N. solita upon specimens in the collection of W.W. Saunders, who purchased insects from all parts of the world including the United States. A second Nearctic species described by Walker, N. transversa, was also named from specimens in Saunders' collection and like N. solita, its identity was questionable until the present study (see Species excluded from Notiphila, p. 259).

After Fallén's treatment of Notiphila as a genus of the family "Hydromyzides," few alterations in the classification were attempted by subsequent investigators of the early nineteenth century. Usually, the genera of one author were considered as subgenera by another and because Notiphila was an old, well-established genus, it was the name

under which several genera were often combined. This greatly increased the number of Notiphila species and subsequently resulted in the formation of some homonyms. With minor exceptions, this condition continued until Herman Loew (1860) published an important study on the European Ephydridae which established the classification for the rest of the century.

Loew's classification divided the family into sections which were later recognized as subfamilies. Notiphila became the nominate genus of the section Notiphilina and was restricted in concept to that of present-day usage. This classification and concept of Notiphila was used two years later (1862) in a monograph on the North American shore flies, also by Loew. Loew's monograph was the first major work to cover the Nearctic species and his classification became the standard for subsequent workers. Loew described five new species in his monograph and in two later publications (1872, 1878) he named four additional species. Of these species, only two, N. unicolor and N. vittata, have required nomenclatural changes in this study.

Aside from the species treated in Loew's papers, only two others were described during the latter half of the nineteenth century from North America. Thomson (1869) named N. quadrisetosa from specimens collected in California and Williston (1893) described a second Californian species, N. decoris, from a single female specimen collected at Panamint Springs, near Death Valley.

Early in the twentieth century, Coquillett (1902) described a very unusual Notiphila species in the genus Dichaeta. Like species of the genus Dichaeta, N. furcata possesses a complex arrangement of bristles on the terminal segments of the abdomen but in most other respects, it is a typical notiphiline. This situation was later corrected when Cresson (1917) transferred furcata to Notiphila.

In 1906, Jones published a catalogue and bibliography of the Ephydriidae which included descriptions of new species. The first described species was Notiphila varia which was later synonymized with N. erythrocerata Loew. Jones' work also contained a key to the known American shore flies of Notiphila although it is now practically useless, as the species concepts and key characters have changed considerably.

Prior to Jones' publication, the Nearctic species of Notiphila had been catalogued three times. Baron Osten Sacken compiled the first two and each reflects the era in which they were published. The first catalogue (1852) lists only one name currently in use, N. solita, but all of the names in the second catalogue (1878) were used in the 1965 catalogue by Wirth. In 1905, Aldrich also catalogued the Notiphila species from North America.

Following Loew's monographic study in 1862, the next substantive paper considering the North American Notiphila fauna was a revision published in 1917 by E.T. Cresson, Jr. This paper was

among the first of several publications over a period of four decades in which Cresson set forth the classification and a sizable portion of the descriptive work of the world's shore fly fauna. His 1917 study of Notiphila was the most comprehensive work on the fauna from the Western Hemisphere until the present study. Cresson erected two subgenera, Notiphila and Agrolimna, and recognized 27 species or varieties of which 16 were new. Although Cresson did not have the opportunity to examine the types of many of the previously described species, his names and species concepts have, with few exceptions, remained largely unchanged to the present.

Cresson described two additional species in 1940; in 1946 he also published a synopsis of the genus as part three of a synoptic series treating all Nearctic Ephydriidae. Included in the latter paper is a key to North American species and a tribal classification. Notiphila became the nominate genus for the tribe Notiphilini which then included three other genera: Dichaeta Meigen, Oedenops Becker, and Paralimna Loew. In a study on the African species of this tribe by Cogan (1969), Notiphilini was expanded to include two other genera, Dryxo Robineau-Desvoidy and Karema Cresson.

In 1966, Miyagi reviewed the Japanese species of Notiphila and used characters of the male postabdomen for the first time in characterizing the species. Three years later, Cogan's revision of African Notiphilini was the first to incorporate characters of the male

postabdomen in defining the higher categories. More recently, Dahl (1972) reviewed the Notiphila species of Afghanistan, describing several new species with accompanying figures of the ventral processes of the epandrium. These studies substantiate Cresson's early proposal of two subgenera and demonstrate the usefulness of the male genitalia at the species level, confirming Cresson's suggestion in his 1946 synopsis of the genus.

Between Cresson's 1917 revision and his 1946 synopsis, only one other author treated the genus from North America. In 1930, Curran described a new species from New York, N. latelimbata. The status of Curran's species is still uncertain, as it was named from a unique female that cannot be satisfactorily placed. Only one Nearctic species has been described since Cresson's last synopsis. Wheeler (1961) described N. hamifera from specimens collected in Oak Creek Canyon, Arizona.

Two state level faunistic studies which consider the species of Notiphila then known to occur in California and Iowa were published by Wirth and Stone (1956) and Deonier (1964) respectively. The first includes some ecological data and a generic key to the larvae of many ephydriids. Other papers treating various aspects of the ecology or biology of Nearctic Notiphila are those of Berg (1950), Deonier (1964), and Scheiring and Foote (1973).

METHODS AND MATERIALS

Materials and Generalized Procedures

During the course of this study, approximately 13,000 specimens from throughout North America were examined. In addition to my own collection, specimens were borrowed from most major collections in the United States and Canada. A listing of the collections, curators, and abbreviations used in the text may be found in the Acknowledgements. I also examined many extralimital species and the type specimens of all nominate species except for N. uliginosa and N. riparia. The type specimen of the former has not been located but is presumably in the National Collection of Ireland. The syntypes of N. riparia are in the Muséum National D'Histoire Naturelle, Paris. Through the kindness of Dr. M. Alfred Balachowsky, Director of the Entomological Laboratory and Dr. Loïc Matile, Maitre-Assistant, Department of Diptera, Nearctic specimens were compared with the syntypes. I have examined European specimens of N. uliginosa. Where appropriate, lectotypes have been designated as indicated in the text.

Label data for each specimen were recorded, condensed, and organized alphabetically under each species according to country, state or province, county, etc. State or provincial localities that could not be located or were too large to be included in one county

were listed before the county label data. Names of collectors were omitted and collection dates have been summarized. However, label data accompanying each examined holotype were recorded as given with the specimen; in some cases, clarifying or more complete information is included parenthetically. Distribution maps are also given for many species.

All specimens that I was able to identify satisfactorily have been individually labeled with appropriate determination labels. In a few cases, single female specimens were identified to species-group only. So long as a male was extant, previously undescribed species among the material examined were described, no matter how poorly represented.

Biological information was collected from both field and laboratory observations. All rearing was done in the laboratory and was limited to the beginning and final instars (eggs to first instar; third instar to adult). Field-collected third instar larvae and pupae were placed in enamel pans or petri dishes which had lantern chimney enclosures and cotton substrates. The pans or dishes were kept in Sherer constant temperature cabinets at a temperature of approximately 21°C. Humidity was maintained by keeping shallow pans filled with water in the bottom of the cabinet. A photoperiod regime of 12 hours of darkness and light was used.

Characters of the male postabdomen were utilized extensively, requiring further preparation of these structures. Preparation of the male postabdomen entailed removing the abdomen and treating it with a hot ten percent solution of sodium hydroxide for approximately one minute to remove extraneous tissue and rinsing the structures in tap water. The genitalia were then dissected and studied in glycerin. The abdominal structures including the dissected genitalia accompany the appropriate specimen in an attached plastic microvial containing a droplet of glycerin.

Illustrations were drawn using a Wild Mark 5 stereomicroscope equipped with a drawing tube. A doubling lens was attached to the microscope when illustrations of the genitalia were prepared to enlarge the initial drawings. The figures were drawn on grid paper and were later inked on mylar drafting film or velum. Unless otherwise indicated, the illustrations were drawn to the same scale.

Most measurements were taken using an American Optical filar micrometer attached to an American Optical Spencer stereomicroscope. Various magnifications were used depending on the structures being measured, 90X for head parts, 45X for thoracic and abdominal structures, and 15X for the total length. Wing measurements were taken from enlarged negative prints made using a print-producing microfilm reader. The wings and prints were prepared as follows: a wing was removed, placed in xylene for about one minute, and

slide-mounted using a synthetic Canadian balsam. After curing in a warm oven for approximately one week, the slide was taped over the bottom lens of a 3-M Filmac 400 microfilm reader-printer and a negative print was taken at the desired magnification. A millimeter ruler was then used for taking the appropriate measurements. Although time consuming, this procedure insures accurate and consistent measurement of a flat wing.

Species descriptions are composite and purposefully brief; for the most part they summarize specific differences or additions not found in the more detailed generic, subgeneric, or species-group descriptions. The diagnoses will differentiate the species from similar taxa. Polymorphic or polytypic variation plus any pertinent biological data are included in the discussion of each species.

Classification Methods and Comments

The classification presented below is the result of an attempt to combine a conventional-intuitive approach with a numerical assessment. I have not rigorously applied one approach to the total exclusion of the other, but have tried to correlate both in the final evaluation.

Delimitation of species is the combined result of conventional, comparative morphological studies, particularly of the male post-abdomen, and field experience. Confirmation of the morphological

species concepts through field work strengthened that basis for defining species, and in the absence of field work, greater confidence could be given to the morphological basis by extrapolation.

The quantitative taxonomic procedures used are outlined in Sokal and Sneath (1963) and Sneath and Sokal (1973). Forty-eight OTU's (operational taxonomic units) and 49 characters were selected, quantified, and numerically assessed. An exemplar was chosen to represent each OTU. Thirty-three quantitative and qualitative multi-state characters were standardized; 16 two-state characters were left as 0's or 1's. The effect of size was removed by expressing values of size characters as ratios of the total wing length. Wing length is the largest size character for most OTU's, making most ratios a value between unity and zero.

Estimates of resemblance were evaluated using Manhattan and Euclidean distance coefficients and the Pearson product-moment correlation coefficient. Several agglomerative, hierarchical clustering techniques were employed and the results were summarized graphically as phenograms.

Only agglomerative algorithms were used in clustering the data. Agglomerative clustering techniques are more frequently employed (usually the only algorithms available), although they are less reliable as larger groups of the original separate entities (OTU's) are formed. However, the initial species groupings, as clustered, should more

accurately reflect their phenetic relationships. Ideally, both agglomerative and divisive algorithms should be employed in the construction of a classification. Divisive techniques are better at delimiting larger groups, but tend to become less accurate as smaller subsets of the original group (all OTU's) are formed.

Most of the calculations were performed by a CDC-3300 computer at Oregon State University, Corvallis. The computer was programmed with *MINT, a program converted from an IBM system program developed by Dr. F. James Rohlf.

Most of the taxonomic decisions, including those necessary for the numerical analysis were resolved primarily from a subjective basis. Contrary to a stated aim of numerical taxonomy (Sneath and Sokal:11), I did not find the operational procedures of quantitative phenetics any more objective than the methodology of conventional taxonomy. The selection of OTU's, characters, character states, coding or scaling procedures, similarity estimates, clustering techniques, etc. are obviously subjectively chosen and the resulting conclusions can only mirror these choices (biases). The following quote from Sneath and Sokal (1973:146) is an example:

But when all is said and done, the validation of a similarity measure by the scientists working in a given field has so far been primarily empirical, a type of intuitive assessment of similarity based on complex phenomena of human sensory physiology.

DISCUSSION OF TAXONOMIC CHARACTERS

Characters considered in this study are from all body tagma and have been quantified where appropriate. Ratio values are based on an average of five specimens from different localities if available.

HEAD

Eye ratio. --This is the ratio of eye height to eye width; measurements are taken from the eye in lateral view (figure 8). This character is good for taxa at the species level and is more frequently used to distinguish species of the subgenus Notiphila.

Eye-to-cheek ratio. --This is the ratio of eye height to genal height. Measurements are taken from the head in profile (figure 8). Like the eye ratio, this character is only good at the species level and is diagnostic for more species in the subgenus Notiphila.

Postfrons ratio. --This ratio is calculated by dividing the frontal width into the frontal height. The width is measured as the distance across the frons between the median margins of the eyes immediately anterior to the anterior ocellus; the height is the distance from the anterior margin of the frons to the posterior pair of ocelli (figure 10). This character is particularly good for distinguishing the taxa belonging to the adusta species-group.

Prefrons ratio. --This is the ratio of the height to width of the face. The height is measured between the oral margin and the dorsum

of the frontal suture; the width is the narrowest distance between the eyes across the face (figure 9).

Postocular bristles.--The degree of development of the dorsal-most postocular bristles has been overlooked as a character, although it can be readily used to separate some species groups and species. A comparison of these bristles with the postocellar and/or genal bristles is convenient.

Fronto-orbitals.--This character is based on the number and degree of development of the small, proclinate, fronto-orbital setae located laterad and slightly anterior to the much larger reclinate bristle. Species of the subgenus Agrolimna generally have two well developed setae whereas the species of the subgenus Notiphila have one, two, or lack any small but distinguishable fronto-orbital setae.

Color of antennal segments.--This character is more frequently used in the subgenus Notiphila and is best used as a secondary diagnostic attribute due to considerable variation.

Aristal branches.--Cresson used this character extensively and in general it is useful for species recognition. Care should be taken, however, in attributing too much emphasis to this character because of variation and because poor preservation and mounting techniques too often result in damaged or broken aristal branches, making their use impractical.

Facial color.--The value of this character varies with the species, depending on the degree of variation exhibited. But for many species, the facial coloration is diagnostic, being relatively constant and consistent.

Facial setae.--This character is based on the number, degree of development, and relative length of the setal series. Difficulties are often encountered using this character because differences in character states are slight in many cases. I have only used facial setae as a key character when extremes are evident.

Color of palpi.--The maxillary palpi are generally pale orange to yellow or dark brown to black. This character is generally good at the subgeneric level with a few notable exceptions.

THORAX

Coloration of the mesonotum.--Usually the mesonotum is more darkly colored than the pleura and the degree of contrast is often a useful character. In addition, the color of the mesonotum is also a reliable character for a few species.

Mesonotal stripes.--This is actually a composite of several characters. Many species have a distinct to fairly distinct median stripe which bifurcates posteriorly. The adusta species-group and a few other species have other or additional paired stripes laterad to the median line. These darker stripes are used extensively in defining species belonging to both subgenera and especially the adusta species-group.

Scutellar margins.--The lateral margins of the scutellum of many species are dark brown to black and distinctly contrast with the coloration of the dorsum. The contrast in coloration is best seen from a posterior, oblique angle. Use of this character is presently limited to species of the subgenus Notiphila.

Mesopleural maculation.--The mesopleuron of several species has a darkened maculation area of various shapes that is distinct from the surrounding coloration. In a few species there is considerable variation in the degree of maculation development and in many species the mesopleuron is immaculate.

Mesotibial dorsal extensor bristles.--The number of mesotibial dorsal extensor bristles distinguishes Notiphila from most other shore fly genera (figure 7). The number of bristles also serves to distinguish the subgenera (three in Notiphila, four in Agrolimna). These bristles are often broken; on occasion, an aberrant specimen of the subgenus Notiphila is found with four bristles or of the subgenus Agrolimna with three.

Mesofemoral and mesotibial setal combs.--Most species of the subgenus Notiphila possess a comb-like row of closely set setae along the posteroventral margin of the mid femur (figures 4 and 5). Most of the same species also have a distinctive row of short setae along the ventral surface of the mesotibiae. This is a sexually dimorphic character, being restricted to males. The function of these structures is not known.

Coloration of tibiae and tarsi.--Although somewhat variable, the general coloration of the tibiae and tarsi are good characters for many species, especially in the subgenus Agrolimna. However, caution should be exercised in relying too heavily on these characters due to considerable variation in some species.

Setal fascicle of hind basitarsus.--The setal fascicle is a distinctive group of generally four to five closely set setae which generally project at an oblique angle from the ventral surface of the basitarsus near its base (figure 6). Often one to four of these setae are dark brown to black, contrasting with the surrounding setae. This character is more useful in the subgenus Agrolimna. Many species with dark colored basitarsi have a pale colored setal fascicle.

Wing ratio.--Several wing ratios are used although they are of limited value due to variation. All measurements are straight line distances. The wing ratio is calculated by dividing the wing length (distance between the base of the second basal cell and the wing tip) into the wing width (at widest point). The costal vein ratio is calculated by dividing the measured distance along the costal vein between R_1 and R_{2+3} into the distance between R_{2+3} and R_{4+5} . Finally, the M_{1+2} vein ratio is calculated by dividing the distance along vein M_{1+2} between the anterior and posterior crossveins into the distance between the posterior crossvein and where M_{1+2} terminates at the wing margin.

ABDOMEN

Maculation pattern. --Most species have a fairly constant maculation pattern that is darker in coloration than the surrounding background. Species of the subgenus Agrolimna most often are fasciated with a dark band across the anterior portion of the exposed tergites. The fascia are usually interrupted by a medial stripe that is lighter in color. Species of the subgenus Notiphila are more variable, having extensive guttate markings, fascia, small gemminate spots, or appearing immaculate.

Setation of fourth and fifth abdominal segments. --Two species of the subgenus Agrolimna that associate Notiphila with Dichaeta, N. furcata and N. bispinosa, have the last two exposed abdominal segments of the male developed with Dichaeta-like bristles and conformation. The fifth tergite projects posteriorly into a narrowed process which varies considerably in size with the species. Further, the posterior margin of the fourth tergite bears several large bristles and the process of the fifth tergite terminates with one to three stout bristles.

Abdomen ratio of males. --This is the ratio of abdominal length to width. Both distances are measured from a dorsal view and are the maximum distances.

Length of fourth to fifth tergite ratio in males. --This is the ratio of the length of the fourth tergite to the length of the fifth tergite.

The ratio is correlated with the fifth tergite ratio and is diagnostic of some species of the subgenus Notiphila.

Fifth tergite ratio in males. -- This is the ratio of the fifth tergite width to its length and like the above ratio, it is reliable for distinguishing some species of the subgenus Notiphila.

Male postabdomen. -- There are several useful characters of the male genitalia that are useful at all levels, species, species-groups, and so on. The characters I have used are the following: 1) the presence or absence of a ventral epandrial process and its conformation; 2) the shape of the basiphallus; 3) the degree of development of the surstyli and their shape; 4) the degree of development and shape of the hypandrial process; and 5) the type of hypandrial receptacle. See the subgeneric descriptions for a more detailed assessment of the male postabdomen morphology.

Female postabdomen. -- The characters I have used from the female genitalia are good at the subgeneric level and in some cases at the species-group level. The shape of the ventral receptacle and the extent of sclerotization of the postabdominal segments are the two main characters.

BIOLOGY

Species of the genus Notiphila are common inhabitants of aquatic environments where emergent vegetation is abundant. The larvae and pupae live in the submerged mud substrate where they attach to roots of various aquatic plants to obtain oxygen. Apparently most Notiphila species are innocuous, although Koizumi (1949) reported that the larvae of N. sekiyai Koizumi were a serious pest to rice roots in Japan.

Members of the genus are very poorly known biologically. In North America, only the larva and pupa of N. loewi Cresson have been figured (Berg, 1950). The Holarctic (?) species, N. riparia, has also been studied in Germany and England (Muller, 1922; Varley, 1937) and more recently in a detailed morphological study of the root-piercing and respiratory mechanisms of the larva and pupa (Houlihan, 1969). Studies on the immature stages of extralimital species are as follows:

1. N. brunnipes Robineau-Desvoidy--Torelli (1922); de Meijere (1940, 1941); Rousseau (1919); Hennig (1943). Palearctic.
2. N. nigricornis Stenhammar--Grunberg (1910). Palearctic.
3. N. phaea Hendel--Hennig (1943). Oriental.

Two early studies on N. flaveola (Goureau, 1851; Heeger, 1852) are apparently erroneous, being based on misidentified specimens of

Hydrellia and Scaptomyzetta respectively. Hennig (1952) and Wirth and Stone (1956) have partial keys to the larvae of many shore flies, including Notiphila.

Berg (1950) reported that the mature larvae and pupae of N. loewi were found attached to the roots of Potamogeton alpinus Balbis and P. richardsonii (Bennett) Rydb. The substrate mud had a high content of decaying organic matter and is nearly devoid of free oxygen. Berg was able to rear the pupae to adults by carefully removing the puparia from root tissue and placing them in moist sphagnum moss with the respiratory spines projecting into the air. Puparia left attached to roots floated in water became waterlogged and sank. Berg did not observe the eggs or young larvae of this species.

The studies of Muller (1922), Varley (1937), and Houlihan (1969) report that N. riparia larvae and pupae can be found attached to the roots of Glyceria maxima (Hartman) Holmberg, Typha latifolia L., and Juncus effusus (L.), although larger populations were found on Juncus and Glyceria. Adults lay eggs on the aerial leaves. Immediately after eclosion the immature larvae crawl down onto the roots. Houlihan's paper has many excellent figures of the spiracular and root-piercing systems and a discussion on the functional aspects of respiration. He suggests that the thickness of the plant epidermis is the limiting factor to respiration and is the reason why fewer

larvae and pupae of N. riparia were found on Typha roots whose epidermis is thicker than that of Glyceria or Juncus.

I have conducted biological studies on Notiphila quadrisetosa Thomson in both the field and laboratory. The field site was Dixon Creek, within the city limits of Corvallis, Benton County, Oregon. The bottom of the creek becomes choked with vegetation during the summer and provides a suitable habitat for this species.

Female adults of N. quadrisetosa oviposit in concealed sites. Eggs are most commonly laid in bunches of three to ten, but I have found small, broken, straw stems with single eggs and on one occasion a dried, bent leaf with 15 to 20 eggs. Maturation of eggs in the laboratory required two to four days at room temperature (approximately 21°C). Immediately after hatching, the first instar larva crawls down into the submerged mud substrate and attaches to a rootlet. In the laboratory, the first instar penetrated a fairly dense substrate of cotton, seeking the roots of various species of grasses which were allowed to germinate on the cotton. I was not successful in rearing the larvae past the second instar, which died, I suspect, from the lack of proper nutrient. Smashed lettuce was tried as food but soon became fetid, stunting the growth of the grass roots. Field collected third instar larvae and pupae were successfully reared. The third instar larva becomes noticeably yellow along the sides of the alimentary canal just prior to pupation (also observed in Dichaeta

caudata third instar larvae, Eastin and Foote, 1971) and pupation generally occurs within a day of this appearance. Pupal development required 7 to 14 days at 21^oC. A few days prior to eclosion of the pharate adult, a bright red eye spot becomes visible.

N. quadrisetosa is multivoltine and probably overwinters as a larva or possibly as an egg. I was not able to collect any stage during the winter. Pupae were collected as early as the last week of April, but were more common in May. Larvae and pupae were collected throughout the summer. Because the two genera are closely related, I suspect that the length of the life cycle of N. quadrisetosa is similar to that of Dichaeta caudata which lasts 19 to 44 days in northern Ohio (Eastin and Foote, 1971).

In the field, larvae and pupae of N. quadrisetosa were found attached to the roots of an Agrostis species (a feral lawn grass) and occasionally to the roots of Typha latifolia L. Neither the larvae nor the pupae were found on the roots of sedge that was abundant in this habitat. Usually the immature stages were found within the first one to two inches of the substrate and often were found in loose clusters of several larvae or pupae, all attached to the same root system. Apparently there is not too much active dispersal during the immature stages. The upper levels of the substrate at this site are very sandy and overlaid the more organic mud below. Larvae and pupae were more common in the sandy layers.

I have collected adults of N. quadrisetosa from a wide variety of habitats, from brackish water sedge meadows to sulfurous hot springs. The larvae and pupae seem to tolerate a wide range of environmental conditions, assuming that they also inhabit these situations.

Third instar larvae and pupae of N. aenigma were collected along the Pacific Coast from a stagnant pool on a landfill that extended into Newport Bay, Lincoln County, Oregon. The immatures were attached to the roots of Scirpus maritimus L. variety paludosus (A. Nels) Kuekenth, which were growing in a substrate of highly organic black ooze along the margins of the stagnant pool. The ooze is probably similar to the black humus where Berg collected the pupae of N. loewi. The mature third instars of N. aenigma also developed a yellowish band along the alimentary canal just prior to pupation. The pupae were reared to the adult stage.

The ecology and habitat of Notiphila adults has been studied by Dahl (1959) for northern European species, and by Deonier (1965) and Scheiring and Foote (1973) for Nearctic species. They have observed that most species are found in sedge-meadow or marsh-reed habitats, but a few species occur in floating-vegetation or limnic-wrack habitats. Dahl further reports that many Notiphila species are normally restricted to a particular habitat.

It is not uncommon to collect the adults of several Notiphila species from one locality and certain species are more often found together. While collecting along the banks of the Gallinas River in San Miguel County, New Mexico, I swept through an area approximately 50 meters long by 10 meters wide and found eight Notiphila species including one undescribed species. Seven of the species belonged to the subgenus Agrolimna (N. atripes, N. macrochaeta, N. decoris, N. sicca, N. aenigma, N. olivacea, and N. deserta) and one was a member of the subgenus Notiphila (N. erythrocerata). The dominant vegetation was sedges and grasses and did not appear any more diversified floristically than other collecting areas. How these species are partitioning the habitat is an interesting but still unanswered question.

Adult Notiphila flies are vagile and probably capable of considerable dispersal, although within a marsh or meadow where vegetation is abundant, flight is more often a short, almost hop-like movement to the next sedge. Adult flight behavior is not characterized by a great deal of activity. They often pause for extended periods on a Carex culm, for example. Glick (1939) collected specimens of a Dichaeta species (closely related to Notiphila and about the same size) in the air at altitudes of up to 2000 feet. Most of his collections were made during the day.

Males seem to spend most of their time trying to locate receptive females for mating. Flies of both sexes will often congregate on the white fabric of a collecting net that is laid against and among the emergent vegetation. In these situations, I have observed Notiphila males of various species attempting to mate with almost any small, moving fly that has momentarily stopped on the netting. The ratio of mating attempts to mating successes is considerably less than four to one.

The following mating behavior observations were made from laboratory caged flies of N. quadrisetosa.

Several virgin males and females were introduced into rearing chimneys and subsequent matings observed. Mating attempts occurred soon after both sexes were brought together. Before mounting was attempted, a male would approach a potential mate slowly. Males were observed attempting to mount both sexes, suggesting perhaps that the female is the discriminating sex. Many mounting attempts by males on females were rejected. Females reject males by quickly scraping across the dorsum and sides of her abdomen with her hind legs, breaking the mounting grasp of the male. Males grasped responsive females around the abdomen with the mid and hind legs. The male forelegs held the male over the female in a perch-like position. The claws of the male forelegs grasp the anterior margin of the female's wings near their base. A mounted female's wings are

parted slightly (at approximately a 45° angle) and upturned. When slight movements were made by the mounted female, the male responded by stroking (pawing) his forelegs across her mesonotum. The mid and hind legs also stroked the sides and venter of the female abdomen in intermittent bursts. Stroking of the female's abdomen by the mid and hind legs sometimes accompanied the stroking motions of the male forelegs but often the abdomen-stroking did not occur simultaneously. At times, the female would preen herself, especially her head and antennae, while in copula. After copulation is initiated, a second male would sometimes attempt to mount the same female. Often the second male would grasp the copulating pair and remain with them during most of the copulation period. A single female was observed to mate more than once. While in copula, a pair is not easily disturbed. Occasionally, the mounted female would lose her grasp of the substrate and fall to the bottom of the rearing chamber, but the pair would usually remain in copula while the female uprighted herself and regained her grasp of the substrate. Most matings lasted 10 minutes or less but a few were timed at over 15 minutes.

Gravid females are selective in choosing oviposition sites. Considerable time and care is spent probing, first with the mouthparts and then with the extended ovipositor. Before a site selection is made, a female will carefully examine an area such as a concealed split or break in a dried grass straw or any crevice where eggs would

be hidden when deposited. She will then repeatedly probe the area from many angles before final selection and oviposition is made. Eggs usually are laid in bunches, with each egg usually parallel to the others. In laboratory rearing chimneys, eggs are sometimes laid on the sides of the glass and frequently through the fabric mesh covering the open top.

The natural food of neither the adults nor of the larvae was determined. Deonier (1972) conducted gut dissections to determine the algal feeding habits of several shore flies including three species of Notiphila (N. macrochaeta, N. olivacea, and N. solita (= N. vittata)). His results show that the guts of all three species mostly contained algae other than diatoms although some diatoms were present in all examinations. I found that laboratory caged adults readily fed on a mixture of honey and brewer's yeast. Laboratory reared female adults live longer than males. Both sexes often live more than a month but I did not have any reared flies that lived longer than six weeks.

CLASSIFICATION AND PHYLOGENY

The classification presented here is based on species occurring in the Nearctic Region and lacking the purview of a worldwide study, it is reasonably valid only for that fauna. I have examined many extralimital species however, and have tried to extract pertinent information from available literature in the final collation. Cresson's publications (1917, 1946) and the more recent study of Cogan (1969) are especially important papers in this regard.

Notiphila is the nominate genus of the tribe Notiphilini, which is comprised of five other genera: Dichaeta Meigen, Paralimna Loew, Oedenops Becker, Karema Cresson, and Dryxo Robineau-Desvoidy. The tribe was first proposed by Cresson (1946) and was later expanded by Cogan (1969) to include the genera indicated above. Cogan's characterization of the tribe is accepted here and the keys provided in his paper and in Cresson's 1946 publication will adequately distinguish the genera (the inclusion of the genus Typopsilopa in Cresson's key is confusing but he corrected the error a few pages later by erecting a new tribe for that genus).

Within the tribe Notiphilini, Notiphila is most closely related to the genus Dichaeta and together, these genera are probably the sister-group of the genus Paralimna, through P. decipiens. Notiphila and Dichaeta are set apart from the latter genus by the reduced costal

vein, which only extends to the R_{4+5} vein. I consider this character state to be apomorphic for the tribe, where the generalized state for this character is an extension of the costal vein to vein M_{1+2} .

The validity of Dichaeta as a distinct genus from Notiphila was questioned by Cresson (1917, p. 28) because the usual distinguishing character, the presence of a terminal process on the male fifth abdominal segment that bears apical, stout bristles, was of doubtful value. The male fifth abdominal segment of Notiphila furcata and N. biseriata is produced into a Dichaeta-like process, which bears one to three stout bristles. Also like the genus Dichaeta, the above mentioned Notiphila species have a row of bristles along the posterior margin of the fourth abdominal segment that are clearly larger than comparable bristles on the preceding segments. Despite the invalidation of these characters as delimiting a monothetic genus, the distinguishing gap, biological as well as morphological, between Dichaeta and Notiphila warrants recognition of both as valid genera.

In subsequent papers, Cresson (1946) and more recent authors (see historical review) continued to treat Dichaeta as a separate genus. To consider Dichaeta as a subgenus of Notiphila would alter the subgeneric concepts as they now stand since the distinguishing gap between Dichaeta and Notiphila is decidedly greater than that between the present subgenera of Notiphila. Dichaeta is not a comparable taxon to the Notiphila subgenera and recognition of it as a subgenus of

Notiphila would distort the subgeneric and generic concepts beyond the limits imposed on other shore fly genera.

The close relationship of Dichaeta to Notiphila is primarily through the subgenus Agrolimna. Both Notiphila species described above with terminal abdominal processes similar to those of Dichaeta, are members of the subgenus Agrolimna and the male postabdomen of this subgenus also demonstrates a relationship more closely allied to Dichaeta species. The presence of large surstyli that are not fused to the ventral margin of the epandrium and the well-developed hypandrial process found in Dichaeta species are similarities found in Agrolimna but not in Notiphila s. str. The general conformation of the larvae and pupae of Dichaeta with a long breathing tube is also more similar to Agrolimna species than to those of Notiphila s. str.

Eastin and Foote (1971) recently published a detailed biological study on Dichaeta caudata (Fallén). Their study shows that the immature stages of this species apparently do not require attachment to the roots of aquatic plants in order to obtain oxygen. Both the larvae and pupae live near the surface of unsubmerged, organic substrates, and extend their long breathing tubes to the surface for respiration purposes. This is especially apparent in the puparium, which has the breathing tube oriented at almost a right angle to the body. The morphological differences between Dichaeta and Notiphila are further enumerated in the Notiphila generic diagnosis.

The basis for two subgenera of Notiphila is borne out by the numerical analysis and by the comparative morphology of the male and female postabdomens. Clustering of data from the distance coefficients had higher cophenetic values and also demonstrated the subgeneric split better than comparable clusterings based on the correlation coefficient matrix. Cophenetic values, however, were comparatively low in all cases, indicating considerable distortion by the clustering techniques. The highest cophenetic values were for unweighted pair-group method arithmetic averages clusterings of the Manhattan and Euclidean distance coefficient matrices. The phenograms of these clusterings are shown in Tables 2 and 3.

The external morphological evidence for the subgenera was noted by Cresson (1917), who proposed them originally. The subgenera, as then characterized, were polythetic, being recognizable only after evaluating several characters, none of which was entirely reliable. The presence of four versus three dorsal extensor bristles on the mesotibiae seems to be the best external, key character for recognizing Agrolimna or Notiphila s. str. respectively, but even this feature is prone to some variation as noted in the subgeneric descriptions. The male genitalia, however, reliably demonstrate the subgeneric dichotomy as well as that of the species-groups. For details, see the appropriate descriptions and their ensuing discussions.

Below the subgeneric level, clusters of similar species may also be recognized. These are arranged into species-groups following the precedent of Cresson's (1917) revision of the genus. The species-group is an especially appropriate category for groupings of this sort because it is informal, flexible, and the nomenclature is not burdened with available names that are likely to change when more information becomes available.

In many instances, a species included in one group also has affinities with species of other groups, and depending on the weighting system used, the clusters could vary considerably. Apparent ambiguities of this nature were usually resolved by emphasizing the weight given to characters of the male genitalia and in some cases by completely ignoring the clustering structure produced by the numerical analysis, which was based on overall phenetic resemblance. This procedure is convenient for delimiting easily defined groups; usually one or two morphological features are sufficient to characterize them. However, phylogenetic structure should not necessarily be implied from the resulting clusters.

The subgenus Notiphila has been divided into three species-groups in the present study. Cresson (1917) recognized two groups which he defined by the presence or absence of a ciliate row of small bristles on the ventral surface of the mid tibiae. His riparia-group is

essentially unchanged in this study but his cinerea-group has been divided into two groups.

The adusta group includes eight species. Three species of this group form a recognizable subgroup that is externally distinct from the others. N. bella, N. taenia, and N. nudipes have similar vittate markings on the mesonotum and the darkened sides of the scutellum distinctly contrast with the lighter dorsum. These three species also form a group in the numerical treatment when based on clustering analysis of Manhattan distance coefficients (tables 3 and 4). None of the other species of this group form subgroups that can be defined by a convenient character. However, all of the species belonging to this group have enlarged hypandrial processes that are clothed with spinules. This species-group is intermediate in many respects with the other two of this subgenus and many of the included species share similarities with the other groups.

The loewi group contains 12 species and is the largest group of the subgenus. Three subgroups are evident within the group if characters of the male genitalia are weighted. The numerical analysis did not result in any clusterings that could be characterized conveniently. N. solita and N. paurosoma are externally very similar to each other and together they resemble the species related to N. taenia of the adusta group. The darkened sides of the scutellum are a character that especially evidences this relation. A second element

of the species-group is N. floridensis, which bears many similarities with N. cognata of the adusta group and in the past, these species were considered synonyms of each other. The remaining species appear to be closely related, with the possible exception of N. orientalis, which is somewhat related to N. erythrocerata, a species of the next species-group.

The last species-group of this subgenus is composed of species that are similar to N. avia. This group is the equivalent of Cresson's riparia-group with some modification. This is a small group of five species in North America, however, its composition is as heterogeneous as the above two which are larger. In the numerical analysis, only N. avia and N. robusta consistently cluster together. N. pulchra and N. phaeopsis are externally quite similar as are N. avia and N. robusta, and all are somewhat related as evidenced by the overall similarity of the male genitalia. N. erythrocerata is conditionally placed here. This species will probably fit better in a group of as yet undefined Neotropical species.

Three species-groups are being recognized within the subgenus Agrolimna. Again, these groups are based primarily on the morphology of the male genitalia, although each species cluster is also definable by external characters as well. The numerical analysis also confirmed these groups in most instances. These groups

correspond to Cresson's groups in his 1917 revision although many species have been added since his proposals.

The pulchrifrons group includes three North American species. They are N. pulchrifrons, N. hamifera, and N. scoliochaeta. These species form an easily defined taxon in terms of their morphological characters and distribution. Both of these aspects are discussed in greater detail in the taxonomic section. Clusterings based on Manhattan distance coefficients show this species-group best (tables 3 and 7). It appears that one or possibly two African species may also belong to this group and there are probably undescribed Neotropical species that will also be placed here.

The second species-group is made up of two Nearctic species, N. furcata and N. bispinosa. The males of this group are particularly distinct and the morphology of the abdomen appears Dichaeta-like. The male genitalia of N. bispinosa however, are very similar to those of species belonging to the scalaris group. These two species consistently form a cluster using various clustering methods on the matrices of both Euclidean and Manhattan distance coefficients (tables 2, 3, 5-7). One species from Japan could also belong to this group.

The remaining species of Agrolimna are being lumped together into a third group composed of species similar to N. scalaris. Most of the included species are very similar to each other and despite the

large size of the group, it is very homogeneous. These species are the predominant element of the western North American fauna.

DISTRIBUTION AND ZOOGEOGRAPHY

Members of the genus Notiphila are found in most temperate and tropical regions of the world (table 1). Although the genus as a whole is widespread, most species are limited in distribution; few are known to occur in more than one zoogeographic region. In North America, 47 species are now recognized and of these, only four occur in other zoogeographic regions. N. uliginosa is Holarctic; N. furcata, N. pulchrifrons, and N. erythrocerata are in both the Nearctic and Neotropical Regions. Both subgenera are widely distributed throughout the world but the number of species in the subgenus Notiphila predominates over Agrolimna by approximately 2 to 1.

There are now 25 species in the subgenus Notiphila from North America. Although there are a few more species in this subgenus than in Agrolimna, members of the subgenus Notiphila are much less abundant on a specimen basis than those of the subgenus Agrolimna. The Nearctic species of the subgenus Notiphila occur primarily in eastern North America; below are the distributional data for each species-group of this subgenus.

The adusta group is distributed almost exclusively around the Great Lakes and westward along the Canadian-United States border. This pattern coincides with the southernmost extension of the ice covering during the last glacial period (based on maps compiled by

Table 1. Distribution of Notiphila species by faunal realm.

Faunal realm	Number of species	Subgenus <u>Notiphila</u>	Subgenus <u>Agrolimna</u>	Unrecognized species ¹	Source of information
Palaearctic	26	24	2	10	Becker, 1926; Dahl, 1959, 1972; Miyagi, 1966
Ethiopian	25	14	11		Cogan, 1968
Oriental and Australian	8	7	1	19	Cresson, 1948
Nearctic	47	25	22	1	Present study
Neotropical	9	6	3	5	Wirth, 1968

¹Previously described but presently unrecognizable species.

Dr. V.K. Prest, Geological Survey of Canada). N. pallicornis is the only species belonging to this group that is not found in this area.

This species occurs where a refugium existed during the same glacial period in northern Canada.

The loewi group is widely distributed in most of eastern North America from the Great Lakes area southward. Many of these species are known from only one locality.

The avia group is one of the least homogeneous assemblages of species of this subgenus and the distributions of the included species are also less uniformly grouped. N. avia is only found in the northern parts of North America. Within the southern limits of its range, it is usually found at higher elevations. N. avia is also found in western North America. The only other species of this subgenus that occurs in the West is N. erythrocera. However, the range of N. erythrocera does not generally overlap with that of N. avia in the West, being restricted to the southern half of North America (below the 45th parallel). N. erythrocera is also found in the East and extends into the Neotropical region as well. The other taxa of this species-group are all distributed in eastern North America, around the Great Lakes and southward. Most species are quite widely distributed.

The subgenus Agrolimna consists of 22 North American species. Most of these species are western in distribution although a few are also found in the East.

The pulchrifrons group includes only three Nearctic species and each is limited in distribution to the southern half of the continent (below the 40th parallel). Members of this group also occur in the Neotropics and possibly in Africa.

The furcata group is the smallest of this subgenus. Both species, N. furcata and N. bispinosa, are limited in distribution to the Atlantic and Gulf coasts. N. bispinosa extends northward into the maritime provinces of Canada whereas N. furcata is not normally found north of the mid-Atlantic states of the United States.

The scalaris group is the largest of the genus in North America. Most of the included species are distributed in the West, although a few are also found in the East or are exclusively eastern. N. uliginosa is Holarctic in distribution. In North America, this species is divided into three definable subspecific groups of populations that are geographically distinct although I have not elected to formally name them.

Until a revision of the Neotropical fauna is completed, further assessment of the biogeographic relationships between the North American fauna and that of other regions will be of little use. Most of the species from the Neotropical Region remain to be discovered and based on preliminary studies, I suspect that the Nearctic fauna has more ties with species of this region than with any other region.

TAXONOMY

Genus Notiphila Fallén

Notiphila Fallén, 1810, Specim, entomolog. nov. Dipt. disp. meth.

exh., p. 22; type-species, Notiphila cinerea Fallén, by subsequent designation (Westwood, 1840:153). Cresson, 1917, Trans. Amer. Ent. Soc. 43:27-66 (key to Western Hemisphere species). Cresson, 1946, Trans. Amer. Ent. Soc. 72:231-239 (revised key to North American species). Wirth, 1965, U.S.D.A. Agri. Handbk. No. 276, pp. 746-748 (catalog of North American species).

Keratocera Robineau-Desvoidy, 1830, Essai sur les Myod., p. 788.

This synonymy is according to Westwood, 1840:153.

Pegophila Rondani, 1856, Dipt. Ital. Prod., p. 129; type species,

Notiphila meridionalis Rondani. This synonymy is according to Becker, 1926:11.

Diagnosis. --Notiphila closely resembles the genus Dichaeta and both share many similarities. Notiphila may be distinguished from Dichaeta and other related genera in Notiphilinae as follows: costal vein reaching only to R_{4+5} vein; dorsal margin of mid tibiae usually with three to four dorsal extensor bristles; general coloration usually gray to light brown, pruinose, but often with considerable darkened

areas, especially on abdomen; fifth abdominal segment of males not generally produced apically into a slightly upturned, variously developed process with two to three terminal, stout bristles (N. furcata and N. bispinosa are exceptions); dorsalmost facial setae developed variously but their distance from the parafacial suture is nearly twice the width of the parafascia at the same level; lacking any well developed proclinate fronto-orbital bristles. The male genitalia of Notiphila are also similar to those of Dichaeta but differ as follows: the ventral margin of the epandrium and the epandrial process (if present) are in the same plane with the rest of the epandrium, they do not curve back at more than a 45° angle; the sides of the epandrium are not as sinuate; and the internal genitalia do not bear as many secondary structures.

Description. -- Small to large flies, length 2.50 to 5.60 mm, females larger than males by an average of 0.12 mm; general coloration dull, subdued, pollinose, light brown to dark brown but usually with darker colored markings, especially on abdomen.

Head. Head ratio 0.68 to 0.82; postfrons ratio 0.49 to 0.90; coloration of frons various, uniformly colored to distinctly marked with light and dark areas, some species with well defined, blackish vittae; ocelli forming an isosceles triangle, distance between posterior pair slightly longer; area surrounding ocellar triangle usually lighter in color,

often concolorous with lateral margins of frons, triangular shaped and often extending to anterior edge of frons; anterolateral edge of frons often slightly cinereous or at least lighter in color than remainder of lateral margin; chaetotaxy of frons as follows: one pair of proclinate ocellars; one pair of reclinate fronto-orbitals usually situated laterad and slightly anterior to larger reclinate bristle; one pair each of inner and outer verticals; two to four pairs of small, diverging postocellars. Antennae variously colored, black to yellowish-orange; second segment with several small bristles extending anteriorly from ventral and median surfaces; two larger bristles on dorsal surface; third antennal segment pubescent; arista pectinate on dorsal margin, number of branches varying from 6 to 15. Face generally grayish-yellow; pruinose but varying in color considerably from niveous to light brown; prefrons ratio 0.54 to 1.0; facial setae variously developed, small, hair-like to well developed bristles, numbering three to ten. Eye ratio 0.69 to 0.35, higher than wide; eye-to-cheek ratio 0.12 to 0.35. Gena usually concolorous with face anteriorly, becoming grayer posteriorly; one distinct genal bristle much larger than surrounding setae, approximately subequal to dorsalmost postoculars; genal and occipital areas clothed with small setae, often in seriated rows; a distinct row of slightly larger setae just posterior to compound eyes, terminating dorsally in one to two pairs of strong postocular bristles. Maxillary palpi prominent, dark

brown or black to yellowish-orange; anteclypeal and prementum sclerites of mouthparts grayish-black, pollinose; mouthparts usually withdrawn into oral cavity in preserved specimens.

Thorax. Mesonotum usually darker in coloration than pleura, especially the ventral pleura, usually grayer anteriorly often with some greenish to bluish coloration, becoming darker gray to light brown posteriorly; variously marked, immaculate to distinctly vittate, sometimes with dark maculation spots surrounding setal bases. Scutellum narrowly trapezoidal in shape, posterior edge truncate, concolorous with posterior half of mesonotum or slightly darker, lateral margins sometimes dark brown to black when viewed obliquely from posterior angle. Scutellum and mesonotum evenly covered with small setae. Pleura tending to become lighter, gray ventrally; mesopleuron, ventral portion of propleuron, and area surrounding large sternopleural bristle haired, other pleura bare. Chaetotaxy of thorax as follows: two pairs of dorsocentrals, one pair presutural, the other pair postsutural; one pair of prescutellars situated between line of dorsocentrals and acrostichals; one pair of prealars and a smaller pair of supra-alars to postalars; one pair of interalars; scutellum with one pair of laterals and one pair of apicals; one pair of humerals; two pairs of notopleurals; two pairs of mesopleurals near the posterior margin, ventral pair larger; one pair of sternopleurals. Wing ratio 0.36 to 0.47; costal vein ratio 0.32 to 0.60; M_{1+2} vein ratio 0.57 to

1.20. Femora generally dark, with considerable gray, pruinose areas; tibiae and tarsi various, often pale at "knees"; mid tibiae usually with three to four dorsal extensor bristles and often the posteroventral surface bears a row of setae in males. Setal fascicle of hind basitarsus pale or dark. Halteres pale, cream white to slightly yellowed.

Abdomen. Five abdominal segments normally exposed in both sexes. Abdominal ratio in males 0.50 to 0.85; length of fourth tergite to fifth tergite ratio in males 0.63 to 1.90; fifth tergite ratio in males 0.39 to 0.84. Length of female abdomen longer by an average of 0.12 mm. General background coloration concolorous with thorax but usually with darker markings although sometimes immaculate; markings various, fasciated to guttate to very reduced maculation areas. Tergites setulose, setae along posterior margin of tergite longer. Fifth tergite of two species produces into terminal process with elaborate setation similar to species of the genus Dichaeta. Female postabdomen consisting of abdominal segments six, seven, and eight plus cerci and possibly the ninth sternite; often segment seven very poorly sclerotized or not at all evident. First abdominal spiracle lies in membrane near venter of first tergite, spiracles two through six in ventral portion of respective tergites. One ventral receptacle present, helmet shaped variously but always with extending process, see figures. Male postabdomen symmetrical, reduced to fused ninth

and tenth tergites (epandrium), surstyli, ninth sternite (hypandrium), hypandrial process, aedeagal apodeme and aedeagus (sclerotized basiphallus and membranous distiphallus); see subgeneric descriptions for further details on male postabdomen.

Discussion. -- Notiphila is a worldwide genus of approximately 130 species and about twice as many available names. Nearly half of the known species are from the Western Hemisphere and two-thirds of these are Nearctic. Most faunas are very incompletely known, and no species are known from the Antarctic or Arctic.

Key to Subgenera of Notiphila Fallén

1. Mesotibiae with four dorsal erect extensor bristles;
facial setae reduced, hair-like; two pairs of small, proclinate fronto-orbital setae laterad to larger reclinate bristle; male mesofemora without posteroventral comb of setae Subgenus Agrolimna Cresson
- Mesotibiae with three dorsal erect extensor bristles;
facial setae often stronger, bristle-like; one pair of small, proclinate fronto-orbital setae laterad to larger reclinate bristle; mesofemora of male often with comb-like row of setae along posteroventral margin Subgenus Notiphila Fallén

Subgenus Notiphila Fallén

Notiphila (Notiphila) Fallén, Cresson, 1917, Trans. Amer. Ent.

Soc. 43:31.

See generic synonymy.

Diagnosis. --The nominate subgenus Notiphila may be distinguished from Agrolimna by the following combination of characters: there are three or fewer dorsal extensor bristles on the mesotibiae; the mesofemora and mesotibiae often have a comb-like row of setae along the posteroventral margins in most male specimens; generally there are fewer facial setae, three to four, and these are often more strongly developed, bristle-like; frequently the antennae (or at least one segment) are partially or entirely pale, usually yellowish-orange; the maxillary palpi are also pale; there is at most one pair of proclinate fronto-orbital setae laterad to the larger reclinate bristle; and the abdominal markings, although sometimes faciated, are often guttate, barely evident, or absent. The male postabdomen differs as follows: the ventral margin of the epinadrium is usually produced into a symmetrical process of various shapes; the surstyli are much smaller, trigonal; the hypandrial processes are smaller but are densely setulose or bear two or three apical setae. In addition, a small process is present that extends from the surstylus to the base of the basiphallus which is absent in Agrolimna. The hypandrial receptacle is

always divided into two thin strips that frequently are poorly sclerotized. The sclerotization of the female postabdomen is variable, but often the sixth and seventh segments are well sclerotized. The operculum of the female ventral receptacle is not higher than wide and the extending process bears lateral processes that are usually helically curved, some are rather straight. The larvae and pupae of Notiphila s. str. have short breathing tubes in comparison with the body length. The tube is much less than half the body length.

Description.--Small to large flies, length 2.45 to 5.60 mm, light gray to brown background coloration and darker brown markings.

Head. Head ratio 0.70 to 0.82 (mean of 0.75); postfrons ratio 0.60 to 0.90 (mean of 0.70); frons unicolorous or with lighter colored, narrow, mesotriangular area; at most with one pair of small, proclinate fronto-orbital setae laterad to the larger reclinate bristle; dorsalmost postocular bristles variable in length. One or more antennal segments partially or entirely pale, darkened portions dark brown, seldom black. Face niveous to light yellow, dusted; facial setae often large, bristle-like, usually numbering three to four and limited to ventral half of face; prefrons ratio 0.61 to 1.0 (mean of 0.79). Eye ratio 0.73 to 0.90 (mean of 0.77); eye-to-cheek ratio 0.14 to 0.35 (mean of 0.22). Maxillary palpi pale, yellow to orange.

Thorax. Mesonotum usually darker than pleura, immaculate, but

often with distinct, brown vittae. Lateral margins of scutellum in some specimens dark brown to black when viewed from posterior, oblique angle. Femora usually dark; tibiae and tarsi generally pale, if tibiae are dark then apical areas pale; mesotibiae with three dorsal extensor bristles or with larger bristles reduced or absent; mesofemora of male usually with dense row of comb-like setae along posteroventral margin; mesotibiae also with distinct row of shorter setae. Setal fascicle of hind basitarsus pale or dark, if dark then two to four setae are dark. Wing ratio 0.37 to 0.46 (mean of 0.42); costal vein ratio 0.36 to 0.60 (mean of 0.48); M_{1+2} vein ratio 0.80 to 1.20 (mean of 0.98).

Abdomen. Abdomen ratio in males 0.50 to 0.85 (mean of 0.74); length of fourth tergite to fifth tergite ratio in males 0.64 to 1.90 (mean of 1.07); fifth tergite ratio in males 0.39 to 0.84 (mean of 0.53). Markings usually guttate, infrequently fasciated, with two geminate spots, or immaculate. Fifth tergite never produced into extending, narrow process with elaborate setation as in Dichaeta species. Male postabdomen as in diagnosis and as follows: surstyli reduced but triangular in shape; a secondary process extends from surstyli to base of basiphallus; hypandrial process smaller lobe-like although in some species it is much longer than wide, with two to three apical setae or clothed with small spinules; sclerotized basiphallus often broadened apically; membraneous distiphallus with or without armed spinules. Female postabdomen as in diagnosis.

Discussion.--The subgenus Notiphila is presently represented by 25 known Nearctic species. Most are found east of the Mississippi River and based on collection numbers, they are not as abundant as Agro-
limna species are in the West. The subgenus seems to predominate in in the rest of the world, especially in the Palearctic Region.

Key to the Species of the Subgenus Notiphila

1. Lateral margins of scutellum dark, usually blackish when viewed from posterior oblique angle 2
- Lateral margins of scutellum generally concolorous with dorsum or but slightly darkened, not blackish when viewed from posterior oblique angle 7
- 2 (1). Setal fascicle of hind basitarsus with at least one darkened seta; postfrons ratio 1:0.85 or smaller 3
- Setal fascicle of hind basitarsus entirely pale; postfrons ratio 1:0.85 or larger 5
- 3(2). Dorsum of mesonotum immaculate except for small, darkened spot just anterior to presutural bristle; facial series of setae strongly developed, subequal to largest genal bristle; facial coloration generally gray and often with brown median stripe on lower two-thirds pulcra n. sp.
- Dorsum of mesonotum vittate; facial series of setae less strongly developed, hair-like; facial coloration grayish-yellow to light gray and without median stripe 4

- 4 (3). Fifth abdominal segment of male nearly as long as wide, distinctly turned down apically; mesonotum usually without median stripe subequal to lateral stripes solita Walker
- Fifth abdominal segment of male almost twice as wide as long, not distinctly turned down apically; mesonotum with median stripe subequal to lateral stripe pauroura n. sp.
- 5 (2). Fifth abdominal segment ratio in males 1:0.75 or larger and noticeably turned down apically; third antennal segment mostly pale . . . nudipes Cresson
- Fifth abdominal segment ratio in males 1:0.50 or less and not noticeably turned down apically; third antennal segment mostly dark 6
- 6 (5). Eye-to-cheek ratio 1:0.25 or larger; third antennal segment almost entirely dark; basiphallus enlarged apically bella Loew
- Eye-to-cheek ratio 1:0.20 or less; third antennal segment usually pale toward posteroventral angle; basiphallus lacking apical enlargement . . . taenia n. sp.
- 7 (1). General background coloration dark brown; face and frons concolorous, dark grayish-brown; mesonotum and mesopleura immaculate . . phaeopsis n. sp.
- General background coloration lighter, gray to light brown; face and frons not concolorous, dark grayish-brown; mesonotum or mesopleura often with some maculation pattern 8

- 8 (7). With the following combination of characters:
 eye ratio 1:0.85 or larger; eye-to-cheek ratio
 1:0.30 or larger; dorsum of abdomen mostly
 gray; tibiae and tarsi pale 9
 - Without the above combination of characters 10
- 9 (8). Setal fascicle entirely pale; mesopleura
 immaculate cognata Cresson
 - Setal fascicle dark, black; mesopleura often with
 maculation area on dorsal half which contrasts
 with grayer ventral half floridensis Cresson
- 10 (8). Prefrons ratio 1:0.88 or larger; facial setae
 bristle-like, subequal to genal bristle 11
 - Prefrons ratio 1:0.84 or smaller; facial setae
 hair-like, much smaller than genal bristle 13
- 11 (10). Length 4.0 to 5.2 mm; tibiae mostly dark 12
 - Length 3.0 to 4.25 mm; tibiae pale . . . erythrocerata Loew
- 12 (11). Third antennal segment often with some pallor;
 male genitalia as in figures 42 and 70; widely
 distributed avia Loew
 - Third antennal segment almost entirely dark;
 male genitalia as in figures 38 and 72;
 Quebec robusta n. sp.
- 13 (10). Lobe of hypandrial process enlarged, clothed
 with spinules 14
 - Lobe of hypandrial process not enlarged or clothed
 with spinules but often with two to three
 apical setae 17

- 14 (13). Antennal segments entirely pale; male genitalia
as in figures 23 and 54 pallicornis n. sp.
- First and second antennal segments usually dark;
male genitalia not as above 15
- 15 (14). Eye-to-cheek ratio 1:0.25 or larger; male genitalia
as in figures 22, 56, and 73 footei n. sp.
- Eye-to-cheek ratio 1:0.20 or smaller; male genitalia
not as above 16
- 16 (15). Mesopleura often with dark brown maculation spot;
gena very narrow; male genitalia as in figures
19 and 51 adusta n. sp.
- Mesopleura immaculate; gena moderately narrow;
male genitalia as in figures 21 and 49 . . biseriata Cresson
- 17 (13). Body coloration mostly gray; frons lacteous; third
antennal segment mostly pale poliosoma n. sp.
- Body coloration mostly light brown, not extensively
gray; frons at most brownish gray; third antennal
segment usually mostly dark 18
- 18 (17). Eye-to-cheek ratio 1:0.24 or larger 19
- Eye-to-cheek ratio 1:0.21 or smaller 21
- 19 (18). Ventral process of epandrium with diverging arms;
eye-to-cheek ratio 1:0.30 latigena n. sp.
- Ventral process of the epandrium with arms that
project straight; eye-to-cheek ratio less than above . . . 20
- 20 (19). Arms of epandrial process with preapical enlarge-
ments; pocket formed by arms notched basally;

- ventral margin of basiphallus with distinct
median bulge shewelli n. sp.
- Arms of epandrial process evenly tapering to point;
pocket formed by arms without basal notch;
ventral margin of basiphallus sinuate, not with
abrupt bulge paludicola new name
- 21 (18). Basiphallus much longer than wide, without
distinct apical enlargement 22
- Basiphallus about as wide as long, apically
enlarged 23
- 22 (21). Small flies, length 2.40 to 3.20 mm; eye-to-cheek
ratio 1:0.18 or less; pocket formed by arms of
ventral epandrial process more or less diamond
shaped cressoni new name
- Medium sized flies, length 3.0 to 4.0 mm; eye-to-
cheek ratio 1:0.20 or more; pocket formed by
arms of ventral epandrial process
V-shaped loewi Cresson
- 23 (21). Arms of ventral epandrial process diverging,
sinuate, but tapering evenly to tip orienta n. sp.
- Arms of ventral epandrial process projecting straight
and not tapering evenly 24
- 24 (23). Pocket formed by arms of ventral epandrial process
broadly U-shaped carinata Loew
- Pocket formed by arms of ventral epandrial process
as in figures 34 and 62 eleomyia n. sp.

Adusta Species-Group

This is the most homogeneous species-group of this subgenus and all of the included species may be easily recognized by the following characterization. The hypandrial process of the male genitalia is enlarged, usually considerably longer than wide, and the apical half is covered with short, stout spinules (see species figures for examples). Eight Nearctic species belong to this group and as a whole, the group is somewhat intermediate with respect to the other two species-groups. Many of the species included here share characteristics with species belonging to the other groups.

With the exception of N. pallicornis, all species in this group are distributed around the Great Lakes or directly east and west of the Lakes. This pattern coincides with the southernmost extension of the ice covering during the Wisconsin glaciation period which is the most recent.

Notiphila (Notiphila) adusta new species

(figures 19, 51, 75; map 11)

Diagnosis. -- This species closely resembles N. footei but may be distinguished from the latter by the following combination of characters. The gena of N. adusta is very narrow, making the eye to cheek ratio significantly less than that of N. footei. Further, the

mesopleuron bears a dark brown maculation area that contrasts distinctly with the lighter background color. The male genitalia of N. adusta are also diagnostic. Although similar to those of N. footei, especially in the joint possession of a well-developed, spine covered lobe of the hypandrial process, they differ consistently. The most obvious difference is in the shape of the ventral processes of the epandrium. Both arms of the ventral process of N. adusta are more slender and in relation to the size of the epandrium, they are also longer. See figures 19 and 22 for a comparison.

Description. --Medium sized flies, length 2.90 to 4.25 mm, with light brown, dusted background color and few darker brown markings.

Head. Head ratio 1:0.71; postfrons ratio 1:0.67; mesotriangular area and lateral margins of frons concolorous, lighter in color and grayer than remainder of frons which has some charcoal or dark green reflections. Dorsalmost postocular bristles medium sized, not too much larger than postocellars; at most with one pair of proclinate fronto-orbital setae. First and second antennal segments dark brown to black; third segment mostly pale, yellowish-orange but with anterodorsal margins darkened; arista with approximately ten aristal branches. Face yellow, lightly dusted; prefrons ratio 1:0.69; facial setae small, hair-like, numbering three to four. Eye ratio 1:0.82; eye-to-cheek ratio 1:0.165. Gena very narrow,

generally concolorous with face but becoming grayer posteriorly. Genal bristle subequal to dorsalmost postocular bristle. Maxillary palpi pale, yellow.

Thorax. Generally unicolorous, light brown, pruinose, although pleura are slightly lighter in color posteriorly. Mesonotum immaculate; mesopleuron with a dark brown maculation area. Femora mostly dark with gray dusted areas, apically pale; tibiae generally concolorous with femora but with more extensive pale areas on apices; fore tarsi usually darkened superficially, mid and hind tarsi pale, mostly yellowish-orange. Setal fascicle of hind basitarsus dark, Wing ratio 1:0.45; costal vein ratio 1:0.47; M_{1+2} vein ratio 1:0.82.

Abdomen. Abdomen ratio in males 1:0.75; length of fourth tergite to fifth tergite ratio in males 1:1.3; fifth tergite ratio in males 1:0.58. Abdominal maculation pattern as in most specimens of loewi species-group. Male postabdomen as in diagnosis and in figures 19, 51, and 75.

Type material. -- Male holotype: Hull, Quebec, 20 June 1956, J. R. Vockeroth; HOLOTYPE *Notiphila adusta* Mathis (red). Allotype and three paratypes (females) with the same label data as the type. Five paratypes (two males, three females): Ottawa, Canada, Mer Bleue, 2 July 1938, A. L. Melander (ANSP, USNM). The holotype will be deposited with the Canadian National Collection, Ottawa, type number

Other specimens examined. --Sixty-one specimens from the following localities: CANADA: Ontario: Marmora (CNC); Mer Bleue (ONC); One Sided Lake (CNC); Ottawa (CNC); Simcoe (CNC); Toronto (ANSP). Quebec: Hull (CNC); Kazubazua (CNC). UNITED STATES: Illinois: Lake Co., Waukegan (ANSP, INHS). Iowa: Hamilton Co., Little Wall Lake (ISU). Michigan: Iron Co (USNM); Keweenaw Co. (USNM); Monroe Co., Monroe (USNM); Wayne Co., Grosse Ile (USNM); Wexford Co., Woodward Lake (MSU). Minnesota: Chicago Co. (UMN); Clearwater Co. (UMN), Itasca State Park (UMN); Houston Co. (UMN); Lake Co., Basswood Lake (UMN); Wabasha Co., Wabasha (UMN). New York: Chautaugua Co., Ivory (USNM); Genesee Co., Bergen (USNM); Tompkins Co., Enfield (USNM), White Church (CU); Schuyler Co., Texas Hollow (CU). North Dakota: Trail Co. (ANSP). South Dakota: Minnehaha Co., Dell Rapids (ANSP). Wisconsin: Sauk Co., Devils Lake (ANSP).

Etymology. --The Latin adjective adusta, meaning "tanned" or "brown," refers to the tan body color.

Remarks. --The distribution of N. adusta is limited to the states or provinces surrounding the Great Lakes with the exception of one locality in Iowa (map 11). Collection dates are from 21 May to 27 October.

Apparently this species' habitat is limited to lentic water systems. The specimen from Iowa bore a label reading "on limnic wrack," which is a habitat type used by Deonier (1965) in his paper on the ecology of the shore flies of Iowa. Nothing more is known regarding the biology of this species.

Notiphila (Notiphila) bella Loew

(figures 20, 52, 77)

Notiphila bella Loew, 1862, Mono. Dipt. N. Amer. Pt. I. Smithsn.

Misc. Collect. 6:135.

Notiphila (Notiphila) nudipes Cresson (in part), 1917, Trans. Amer.

Ent. Soc. 43:43.

Notiphila (Notiphila) bella, Cresson, 1946, Trans. Amer. Ent. Soc.

72:234.

Type and type locality. --Male lectotype (here designated): Mittel St. (green); Loew Coll.; bella ♂ ; Type 11134; Notiphila bella Lw, det W. Wirth '61; LECTOTYPE Notiphila bella Loew by W.N. Mathis (red). The lectotype is presently deposited in the Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts, type number 11134. Loew's original description indicates that both male(s) and female(3) were in the type series and I did locate a male and female specimen of N. bella with Loew's locality data in the M. C. Z. These specimens also bare paratype labels as follows:

M.C.Z. Paratype 11134. These specimens are here designated as paralectotypes.

Diagnosis. --Although N. bella very closely resembles some members of the adusta species-group, it may be distinguished from them as follows. Unlike N. nudipes, the antennae are mostly black, but the extreme base of the third segment may be pale, yellowish. Further, the fifth abdominal segment is considerably wider than long. The male genitalia of N. bella are most similar to those of N. taenia, however they are distinctive and differ from the latter in the shape of the basiphallus, the hypandrial process, and the ventral process of the epandrium. These differences are readily seen by comparing figures 52 and 53.

Description. --Medium sized flies, length 3.03 to 3.64 mm, with bluish-gray to brownish-gray background coloration and few brown markings.

Head. Head ratio 1:0.78; postfrons ratio 1:0.89; frons subdued in coloration, mostly gray, mesotriangular area and lateral margins generally concolorous, remaining area of frons darker, slightly charcoal colored. Dorsalmost postocular bristles small, approximately one-half the length of the genal bristle. No proclinate fronto-orbital setae are evident. Antennal segments mostly dark, black, although the base of the third segment is slightly paler, orange; arista

with seven to eight aristal branches. Face very lightly colored, almost cinereous and nearly concolorous with frons; prefrons ratio 1:0.72; facial setae small, hair-like, only on ventral half. Eye ratio 1:0.81, eye-to-cheek ratio 1:0.26. Gena unicolorous, slightly darker in shade than face; genal bristle located posteriorly, approximately double the dorsalmost postocular bristle. Maxillary palpi pale, yellow.

Thorax. Mesonotum brownish-gray, darker than pleura; lateral margins with a brown stripe extending from anterior to presutural bristle to supra-alar bristle. Lateral margins of scutellum dark, blackish-brown when viewed from posterior, oblique angle. Mesonotum with prominent brown stripe along dorsal margin. Femora gray, apically pale; all tibiae and tarsi pale, yellow. Setal fascicle of hind basitarsus pale, yellow. Wing ratio 1:0.39; costal vein ratio 1:0.46; M_{1+2} vein ratio 1:0.96.

Abdomen. Abdomen ratio in males 1:77; length of fourth tergite to fifth tergite ratio in males 1:1; fifth tergite ratio in males 1:0.46. Fascia of tergites usually well defined, trigonal, sometimes reduced to a few spots. Male postabdomen as in diagnosis and figures 20, 52, and 77.

Specimens examined. --One specimen with the following label data:
Osten Sacken Coll. (ANSP).

Remarks.--Apparently, N. bella is known only from the type series and the single male specimen from Osten Sacken's collection. The distinctions between this species and N. taenia are subtle and will probably require dissection of the male genitalia. Because the genitalic structures are consistently different, N. taenia is recognized as distinct from this species.

Notiphila (Notiphila) biseriata Cresson

(figures 11, 21, 49, 74)

Notiphila (Notiphila) biseriata Cresson, 1917, Trans. Amer. Ent. Soc. 43:46.

Notiphila (Notiphila) loewi, Cresson (in part), 1946, Trans. Amer. Ent. Soc. 72:235.

Notiphila (Notiphila) loewi var. biseriata, Wirth, 1965, U.S.D.A. Agri. Handbk. No. 276, p. 747.

Type and type locality.--Male holotype: ♂ ; Sandusky, O.; HOLOTYPE, Notiphila biseriata, E.T. Cresson Jr.; Loan property of Ohio U. The unique holotype is presently deposited in the Ohio State University insect collection, Columbus, Ohio.

Diagnosis.--Externally, N. biseriata appears to be similar to N. loewi and for many years it was considered as a junior synonym or a variety of the latter. The male postabdomen of N. biseriata however,

is considerably different as shown by comparing figures 21, 49, and 74. The ventral process of the epandrium is proportionately narrower and the cleft formed by the arms of the process is deeply U-shaped. The ventral margin of the basiphallus is but slightly sinuate and the posterior portion of the aedeagal apodeme is not produced into a lobe. The hypandrial process is as long as wide and the lobe is greatly enlarged and clothed with short, stout setae. The maculation pattern on the dorsum of the abdomen is more pronounced and the geminate markings are broader than those of N. loewi. The eye-to-cheek ratio of most N. loewi specimens is also less than in N. biseriata.

Description. --Medium sized flies, length 4.04 mm, with subdued tan to gray coloration.

Head. Head ratio 1:0.77; mesofrons darker than lateral margins of postfrons, blackish-gray; small, brown triangle extending from anterior margin of postfrons; postfrons ratio 1:0.78. Dorsalmost postocular bristle much larger than postocellar bristles, subequal to ocellar bristles; proclinate fronto-orbital bristle small, hair-like. First and second antennal segments dark, blackish; basal half of third antennal segment light orange, apical half dark; concolorous with first and second segments; nine to ten arisal branches. Prefrons yellowish-gray, uniformly colored; prefrons ratio 1:0.80; facial setae with three to four primary setae, hair-like, approximately subequal to genal

bristle. Eye slightly higher than wide, ratio 1:0.75; eye to cheek ratio 1:0.195; gena concolorous with face anteriorly, becoming more grayish posteriorly. Maxillary palpi pale, yellow.

Thorax. Dorsum of mesonotum brownish-gray, with blue tinges toward anterior margin, some indications of a median stripe. Pleura more gray to bluish-gray. Femora all gray except for brown dorsum; fore tibiae and tarsi generally dark brown to black except for yellow joints; mid and hind tibiae yellow to black, tarsi lighter usually yellow. Setal fascicle of hind basitarsi with two to three dark brown setae. Wing ratio 1:0.41; costal vein ratio 1:0.32; M_{1+2} vein ratio 1:0.68.

Abdomen. Length of fourth to fifth tergite ratio in males 1:1; fifth tergite ratio in males 1:0.39. Dorsum generally gray to bluish-gray; segments two through five with geminate brown spots separated with gray median stripe. Male postabdomen as in diagnosis and in figures 21, 49, and 74.

Specimens examined.--This species is known only from the unique male holotype from Sandusky, Ohio.

Remarks.--Until the present study, this species was considered a junior synonym of N. loewi and externally they are very similar. However, the male genitalia of the type are very dissimilar and

because the type was collected sympatrically with N. loewi, N. biseriata is given species status.

Notiphila (Notiphila) cognata Cresson

(figures 12, 18, 50, 76)

Notiphila (Notiphila) cognata Cresson, 1917, Trans. Amer. Ent. Soc. 43:46.

Notiphila (Notiphila) floridensis Cresson (in part), 1946, Trans. Amer. Ent. Soc. 72:235.

Type and type locality. --Male holotype: Manahawkin, V-30-10, N. J.: Det. by Coquillett.; ♂; holoTYPE 6111; Holo-TYPE Notiphila cognata, E. T. Cresson Jr. The unique holotype is deposited in the Academy of Natural Sciences of Philadelphia, type number 6111.

Diagnosis. --Superficially, N. cognata very closely resembles N. floridensis but it may be differentiated from the latter by the following combination of characters. The mesopleuron is immaculate, without any trace of a darkened brown area that contrasts with the surrounding lighter gray color; the dorsum of the mesonotum is generally unicolorous although there is a faint indication of a median stripe; and the setal fascicle of the hind basitarsus is entirely pale, light yellow. The characters of the male postabdomen more clearly distinguish N. cognata from N. floridensis. The ventral processes of

the epandrium of N. cognata arise from a much broader base and project outward with a slightly convergent orientation. In addition, the processes distinctly taper, especially along the median surface but partially expand just before the apices. The dorsal margin of the aedeagal apodeme is slightly sinuate but not deeply concave and the ventral surface of the basiphallus is more or less straight before angling upward. The lobe of the hypandrial process is much longer than its base, is slightly spatulate apically, and is covered apically with stout bristles.

Description. --Medium sized fly, length 3.54 mm with subdued tan dorsum becoming gray ventrally.

Head. Head height to width ratio 1:0.77; postfrons gray generally unicolorous except for brownish colored triangle that extends anteriorly from ocellar bristles and for light colored areas along margins of eyes; postfrons ratio 1:0.65; postocellar and postocular bristles reduced, hair-like; one very small proclinate fronto-orbital seta. First and second antennal segments darkened, third segment orange basally, becoming darkened apically; arisal branches six to seven. Prefrons and gena generally concolorous, white although posteriorly, gena becomes slightly bluish; prefrons ratio 1:0.78; facial setae hair-like, smaller than genal bristle, extending to approximately one-half height of prefrons. Eye almost as wide as long, ratio 1:0.9; gena wide, eye-to-cheek ratio 1:0.3. Maxillary palpi yellow.

Thorax. Dorsum of mesonotum tan, generally unicolorous; from posterior margin of notopleuron and posteriorly becoming gray to whitish-gray. All femora gray; all tibiae and tarsi pale, grayish-yellow to yellow. Mesofemora with comb of closely set bristles along both anteroventral and posteroventral margins; mesotibia with row of small, closely set bristles on ventral surface, becoming indistinct apically. Setal fascicle of hind basitarsus pale, yellow. Wing ratios as follows: length to width ratio 1:0.43; costal vein ratio 1:0.41; M_{1+2} vein ratio 1:0.91.

Abdomen. Generally bluish-gray in coloration; without definite maculation pattern although second, third, and fourth segments with brown coloration, mostly along anterior margins. Fifth to fourth segment length ratio 1:0.95 in males; fifth segment ratio 1:0.46. Male postabdomen as in diagnosis and figures 18, 50, and 76.

Specimens examined.--N. cognata is known only from the unique male holotype from Manahawkin, New Jersey.

Remarks.--N. cognata was treated as a junior synonym of N. flori-densis in the most recent catalog (Wirth, 1965). However, the male genitalia are very dissimilar and are the basis for revising its status at the species level.

Notiphila (Notiphila) footei new species

(figures 22, 56, 73)

Diagnosis. -- N. footei appears to be closely allied to N. adusta, based upon their overall, external similarity and especially upon genitalic structures which closely resemble each other. The wide gena and reduced eye-to-cheek ratio however, are diagnostic. In addition, the mesopleuron is immaculate. The male genitalia of N. footei, although similar to N. adusta may be used to distinguish it from all related species. The arms of the ventral epandrial process are thick and proportionately shorter in relation to the length of the epandrium. These differences are best seen by comparing figures 19 and 22.

Description. -- Medium sized flies, length approximately 3.30 mm (the male abdomens were removed before measuring), with light brown to brown background coloration and some darker markings.

Head. Head ratio 1:0.73; postfrons ratio 1:0.68; frons mostly brown, pruinose with some charcoal or greenish coloration, mesotriangular area and margins usually lighter in color, concolorous. Dorsalmost postocular bristle slightly larger than postocellars; usually with one pair of proclinate fronto-orbital setae. First and second antennal segments generally dark brown, third segment with pale, orange posteroventral area otherwise darkened; arista with eight to ten aristal branches. Face unicolorous, yellow, lightly dusted with gray;

prefrons ratio 1:0.76; facial setae small, hair-like, numbering three to four. Eye ratio 1:0.84; eye-to-cheek ratio 1:0.26. Gena moderately wide, generally concolorous with face, especially anteriorly, becoming grayer posteriorly, genal bristle subequal to larger, dorsalmost postocular bristle. Maxillary palpi pale, yellow.

Thorax. Generally brown to tan, unicolorous although pleura tend to become lighter posteriorly. Mesonotum and mesopleuron usually immaculate, some specimens with faint indication of darker spot on mesopleuron. Femora dark, usually black with gray dusted area, apically pale; tibiae mostly dark, especially fore and mid tibiae, hind tibiae with more extensive pale areas; fore tarsi mostly dark brown to blackish-brown but with some pale coloration, mid and hind tarsi pale. Setal fascicle of hind basitarsus dark. Wing ratio 1:0.41; costal vein ratio 1:0.37; M_{1+2} vein ratio 1:0.74.

Abdomen. Length of fourth tergite to fifth tergite ratio in males 1:0.96; fifth tergite ratio in males 1:0.55. Maculation pattern not usually contrasting distinctly with background color, both dark, as in most species of loewi species-group. Male postabdomen structures as in diagnosis and in figures 22, 56, and 73.

Type material. --Male holotype: Montana, Lake Co., 1 mi S Swan Lake, 9 August 1972, Wayne N. Mathis; HOLOTYPE *Notiphila footei* W N Mathis (red). Paratypes as follows: one male: Montana, Lake

Co., 2.3 mi E Bigfork, 9 August 1972, Wayne N. Mathis (WNM); one male: 1 mi W Big Fork, Montana, 19 July 1973, J. Busacca collector (KSU); one male: St. Paul, Minn., Bussey's Pond, June 9, 1921, W.E. Hoffman (UMN); one male: Missisquoi Bay, Quebec, 11 July 1927, G.S. Walley (CNC); one male; Arenac Co., Michigan, 18 June 1950, R.R. Dreisbach (MSU). The holotype will be deposited in the National Museum of Natural History, Washington, D.C., type number 73549.

Etymology.--The genitive patronym, footei, honors my friend Dr. Benjamin A. Foote, for his contribution to the study of the shore flies.

Remarks.--The type and the paratype, which I collected, were taken in grass- to sedge-meadow habitats around the margins of lentic water systems in northwestern Montana. Other specimens of this species have been collected as far east as Quebec, Canada. Collection dates are from 9 June to 9 August.

Notiphila (Notiphila) nudipes Cresson

(figures 46-48)

Notiphila (Notiphila) nudipes Cresson, 1917, Trans. Amer. Ent.

Soc. 43:43.

Types and type locality.--Male holotype: Woodbury, 6-27-'96, N.J.:

; Holo TYPE 6110; *Notiphila vittata* Lw (folded); Holo-TYPE *Notiphila nudipes* E.T. Cresson Jr. The holotype is deposited in the Academy of Natural Sciences of Philadelphia, type number 6110. The original description by Cresson also indicates two male paratopotypes and that C.W. Johnson was the collector of the type series.

Diagnosis. --The similarities between *N. nudipes*, *N. bella*, and *N. taenia* are obvious and indicate close relationships. However, *N. nudipes* may be distinguished from its similar congeners by the following. The first and second antennal segments are dark, mostly black but the third segment is mostly pale, yellow except for the anterodorsal margin which is darkened, concolorous with the basal segments. The maculation pattern of the abdominal segments of *N. nudipes* is more extensive and the fifth abdominal segment is almost as long as it is wide. The male genitalia of *N. nudipes* are very distinctive. The epandrium is very large and the ventral half is flexed at approximately a right angle to the remaining portion. The shape of the hypandrial process, basiphallus, and aedeagal apodeme is also characteristic. See figures 46, 47, and 48.

Description. --Medium sized flies, length 3.1 to 4.37 mm, with gray to brownish-gray coloration and a few brown markings.

Head. Head ratio 1:0.78; postfrons ratio 1:0.86; frons mostly subdued gray although mesotriangular area and lateral margins

generally lighter, concolorous. The dorsalmost postocular bristles small, only slightly larger than postocellars. No proclinate fronto-orbital setae are present. Antennal segment one and two generally dark, third segment mostly pale except for anterodorsal margins which are darkened; arista with eight to ten aristal branches. Face very pale, whitish-yellow; prefrons ratio 1:0.81; facial setae small, hair-like, numbering two to four, on ventral half only. Eye ratio 1:0.81; eye-to-cheek ratio 1:0.21. Genae unicolorous throughout, slightly darker than facial color; genal bristle approximately twice the length of dorsalmost postocular bristles. Maxillary palpi pale, yellow.

Thorax. Mesonotum mostly gray although with some brownish coloration, slightly darker than pleura; lateral margins with distinct stripe extending from anterior to presutural bristle to supra-alar bristle area, brown. Lateral margins of scutellum blackish-brown when viewed from posterior, oblique angle. Femora concolorous, gray, apically pale; all tibiae and tarsi yellow. Setal fascicle of hind basitarsus pale, yellow. Wing ratio 1:0.45; costal vein ratio 1:0.52; M_{1+2} vein ratio 1:0.81.

Abdomen. Abdomen ratio in males 1:0.85; length of fourth tergite to fifth tergite ratio in males 1:1.9; fifth tergite ratio in males 1:0.78. Abdominal fascia brown, usually well marked and extensive, trigonal,

sometimes reduced to fewer spots. Male postabdomen as in diagnosis and in figures 46, 47, and 48.

Specimens examined.--Fifty-six specimens from the following localities: CANADA: Ontario: Point Pelee (CNC). UNITED STATES: Alabama: Lauderdale Co., Wilson Dam (USNM). Florida: Paradise Key (ANSP). Michigan: Kalamazoo Co., Gull Lake Biological Station (MSU). Ohio: Summit Co., Akron (ANSP, OHSU).

Remarks.--Apparently, this species occurs throughout eastern North America although collecting records are few. Nothing is known of the biology of this species. Collection dates are from 21 February to 5 July.

Notiphila (Notiphila) pallicornis new species

(figures 23, 54)

Diagnosis.--In most respects, N. pallicornis appears similar to species of the adusta group but it also resembles taxa of the avia group. Of the species of the adusta group, it is similar to N. adusta, N. biseriata, and N. footei. Like N. pallicornis, these species all possess an enlarged hypandrial process that is apically covered with spinules. The general shape of the process varies from species to species. In N. pallicornis, this process is more slender and not as heavily clothed with spinules. The conformation of the ventral

epandrial process is also similar to that of N. adusta but differs in having the apices of the arms turned inward. The shape of the basiphallus of N. pallicornis is close to that found in the avia group, being much longer than wide. See figures 23 and 54. Externally, the entirely pale antennal segments are diagnostic.

Description. --Medium sized flies as based on the length of the thorax with grayish-tan background coloration and a general absence of darker markings.

Head. Head ratio 1:0.71; postfrons ratio 1:0.55, frons generally unicolorous but with darker appearing broad stripes at lateral margins of mesofrons when viewed from some angles; dorsalmost postocular bristles only slightly larger than postocellars, much smaller than genal bristle; at most with one pair of small proclinate fronto-orbital setae. Antennal segments entirely pale, bright yellow; arista with approximately eight to nine branches. Face nearly concolorous with frons, yellow but not appearing velvety from some angles; facial setae not strongly developed, more hair-like; prefrons ratio 1:0.63. Eye ratio 1:0.75; eye-to-cheek ratio 1:0.26. Gena moderately wide, concolorous with face anteriorly, becoming grayer posteriorly; genal bristle prominent, larger than dorsalmost postoculars. Maxillary palpi pale, bright yellow.

Thorax. Generally grayish-tan and immaculate; dorsum concolorous with pleura. Femora dark except at apices, gray dusted; tibiae mostly dark, hind pair with considerable pallor at apices; tarsi mostly pale, yellowish-orange. Setal fascicle of hind basitarsus dark. Wing ratio 1:0.43; costal vein ratio 1:0.45; M_{1+2} vein ratio 1:0.77.

Abdomen. Concolorous with thorax in general but with darker areas toward the anterior margin of each segment. The abdomen was removed before measurements were taken. Male genitalia as in diagnosis and in figures 23 and 54.

Type material.--Male holotype: Reindeer Depot, Mackenzie Delta, 17-VIII-1948, J.R. Vockeroth; HOLOTYPE *Notiphila pallicornis* Mathis (red). Reindeer Depot is in the Northwest Territories, Canada. The type will be deposited with the Canadian National Collection, Ottawa, type number

Etymology.--The word pallicornis is a combination of the Latin adjective pallidus meaning "pale" or "dim" and the Latin noun cornu meaning "horn" in reference to the distinctive pale antennae.

Remarks.--This species is only known from the unique male holotype. Nothing is known of its biology.

Notiphila (Notiphila) taenia new species

(figures 24, 53)

Diagnosis. --N. taenia is a member of the adusta group and is most similar to N. bella although it could also be easily confused with N. nudipes. N. taenia may be distinguished from either congener however, by the following combination of characters. The antennal segments are mostly black except for the basal third of the apical segment which tends to become pale, usually orange. The fifth abdominal segment is much wider than it is long and the male genitalia are not as large or as angulate as N. nudipes. The genitalic structures most closely resemble those of N. bella and care should be taken in distinguishing between them. The ventral process of the epandrium in N. taenia projects further and is narrower, the basiphallus is much longer and angulate, and the hypandrial process is longer in length and not symmetrical. See figures 24 and 53 for a comparison.

Description. --Medium sized flies, length 3.0 to 3.65 mm, with gray to slightly brownish-gray background coloration and a few brown markings.

Head. Head ratio 1:0.78; postfrons ratio 1:0.90; frons generally light brown, subdued, slightly pruinose; mesotriangular area and lateral margins lighter, more grayed in color. Dorsalmost postocular bristles small, only slightly larger than postocellars; no proclinate

fronto-orbital setae present. Antennal segments mostly dark, black, except for basal third of third segment which tends to become pale toward the base. Arista with approximately nine aristal branches. Face unicolorous, pale yellow; prefrons ratio 1:0.74; facial setae very weak, on ventral portion only. Eye ratio 1:0.88; eye-to-cheek ratio 1:0.18. Gena narrow; genal bristle about twice as long as dorsalmost postoculars; gena generally concolorous with face although becoming slightly darker posteriorly. Maxillary palpi pale, yellow.

Thorax. Mesonotum generally unicolorous, lightly brownish-gray, darker than pleura; lateral margins with distinct stripes extending from anterior to presutural bristles, across the dorsum of notopleuron to area around supra-alar bristles. Scutellum with darkened lateral margins which are extensions of a mesonotal stripe beginning just anterior to posterior interalar bristle, best viewed from postero-dorsal angle. Mesopleuron with brown stripe along dorsal margin. Femora mostly gray, apically pale; tibiae and tarsi yellow. Setal fascicle of hind basitarsus entirely pale; yellow. Wing ratio 1:0.37; costal vein ratio 1:0.48; M_{1+2} vein ratio 1:0.65.

Abdomen. Abdomen ratio in males 1:0.74; length of fourth tergite to fifth tergite ratio in males 1:0.64; fifth tergite ratio in males 1:0.40. Segments with gray background color and with brown fascia which are usually distinct, trigonal in shape. Male genitalia as in diagnosis and in figures 24 and 53.

Type material.--Male holotype: Gull Lake Biol. Sta., Kalamazoo Co., MICH, 23 June 1959, R.A. Scheibner; HOLOTYPE *Notiphila taenia* Mathis (red). The allotype and six paratypes (four males and two females) have the same label data as the type. Additional paratypes are as follows: three males: Flushing, N.Y., 30 V 1932, collector, C.H. Curran (AMNH); one male and three females; Manahawkin, V-30-10 NJ (New Jersey) (AMNH). The holotype will be deposited with the Michigan State University insect collection, East Lansing, Michigan.

Other specimens examined.--Eighteen specimens from the following localities: CANADA: Ontario: London (CNC); Point Pelee (CNC). UNITED STATES: Michigan: Livingston Co., G. Res. (USNM). New Jersey: Morris Co., Madison (USNM). New York: North Beach, Long Island (ANSP). Ohio: Carroll Co., Specht Marsh (KSU, USNM).

Etymology.--The Latin noun taenia refers to the lateral mesonotal stripes.

Remarks.--N. taenia occurs around the Great Lakes and eastward into New York and New Jersey. Collection dates are from 21 June to 4 July.

This species is often found sympatrically with N. nudipes but can be readily distinguished by the characters mentioned in the

diagnosis and key. It is most similar to N. bella, however the genitalia are consistently different, which is the primary evidence for recognizing it as a new species. The biology of this species is unknown.

Avia Species-Group

This is the smallest species-group of the subgenus Notiphila in North America. With few exceptions, the species included here are the same as those placed in Cresson's riparia-group. Riparia is not retained as the species-group name because it is unlikely that this species occurs in North America.

The species of this group may be characterized as follows. The facial setation is usually strong, bristle-like; the setation of the mid legs is generally weak, especially the ciliate row of setae along the ventral surface of the tibiae; most of the species are large; and the hypandrial process of the male postabdomen is short but wide (see species figures).

Although small, this species assemblage is as heterogeneous as the other two of this subgenus. N. avia and N. robusta are quite similar to each other and in addition to their affinities with other species of this species-group, they are both quite similar to N. pallicornis of the adusta group. N. pulcra and N. phaeopsis are also very similar to each other and also evidence some resemblance with

Notiphila species from the Orient and Africa. N. erythrocera is the outlier of this group and it may be more similar to a group of Neotropical species, however, the latter group has not been defined.

N. avia and N. erythrocera of this species-group are the only two species of the subgenus that occur in western North America. They also are found in the East where most of the other species of this group occur.

Notiphila (Notiphila) avia Loew

(figures 42, 70, 184-185; map 1)

Notiphila avia Loew, 1878, Ztschr. f. die Gesam. Naturw. 51:193.

Notiphila (Notiphila) avia, Cresson 1946, Trans. Amer. Ent.

Soc. 72:236.

Type and type locality. --Female holotype: H. B. T. (Hudson Bay Territory); Loew Coll.; avidm.; Type 11135; Notiphila avia Lw, det W. Wirth '61. The holotype is deposited in the Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts, type number 11135.

Diagnosis. --N. avia is very similar to N. robusta and is best distinguished from the latter only after comparing differences in the male genitalia. See figures 42 and 70. Externally, the third antennal

segment of N. avia is often mostly pale, yellowish-orange, and in many specimens it is entirely so.

Description. -- Large flies, 4.0 to 5.60 mm in length, with grayish-brown to light brown background coloration and few darker markings.

Head. Head ratio 1:0.73; postfrons ratio 1:0.61; frons generally unicolorous or mesotriangular area slightly lighter in color, pruinose, area immediately laterad to mesotriangle often tinged with some charcoal coloration. Dorsalmost postocular bristles large, approximately twice the length of the postocellars; usually there are no distinguishable proclinate fronto-orbital setae or at most there is one pair. First and second antennal segments dark, usually black; third antennal segment variable, mostly pale but darkened apically and dorsally; arista with eight to ten aristal branches. Face little differentiating from frons in color, lighter; facial setae strong, bristle-like, numbering three to four; prefrons ratio 1:0.95. Eye ratio 1:0.77; eye-to-cheek ratio 1:0.28. Gena wide; genal bristle distinct, subequal to dorsalmost postocular bristles. Maxillary palpi pale.

Thorax. Generally unicolorous, some specimens with slight indication of median mesonotal stripe or with maculation area on mesopleura. Femora, tibiae, and fore tarsi dark, black but pale apically; mid and hind tarsi pale. Setal fascicle of hind basitarsus dark. Wing ratio 1:0.42; costal vein ratio 1:0.35; M_{1+2} vein ratio 1:0.72.

Abdomen. Abdomen ratio in males 1:0.74; length of fourth tergite to fifth tergite ratio in males 1:0.80; fifth tergite ratio in males 1:0.57. Abdominal tergites fasciated although weakly with darker, blackish-brown coloration. Female postabdomen composed of well sclerotized segments six, seven, and eight. Male postabdomen as in diagnosis and in figures 42 and 70.

Specimens examined. -- Two hundred seventy-three specimens from the following localities: CANADA: Alberta: Banff (CNC); Lesser Slave Lake (USNM); McMurray (CNC); Nordegg (ANSP). British Columbia: Ledum-Kalmia bog (CNC); Port Rupert (CNC). Manitoba: Assiniboine River-treesbank (CNC); Brandon (CNC); Churchill (CNC); Eastern Creek near Churchill (CNC); Farnsworth Lake near Churchill (CNC); Gillam (CNC); 5 mi SW Shilo (CNC); Warkworth Creek near Churchill (CNC). Northwest Territories: Aklavik (USNM); Exmouth Lake - $65^{\circ}0.2'$, $115^{\circ}54'W$ (CNC); Fort McPherson (CNC); Fort Smith (CNC); Norman Wells (CNC). Ontario: Ottawa (CNC); Mer Bleue (CNC). Quebec: Berthierville (AMNH); Kazubazua (CNC); Montebello (AMNH); Rupert House (CNC). Saskatchewan: Waskesiu River (USNM); Willows - $49^{\circ}37'$, $105^{\circ}52'$ (CNC). Yukon Territory: Otter Lake - $130^{\circ}25'$, $62^{\circ}30'$ (CNC); Swim Lakes - 133° , $63'$ (CNC). UNITED STATES: Alaska: Anchorage - 30 mi NE (USNM); 20 mi W Glenallen (KSU); King Salmon-Naknek River (CNC); Matanuska Valley

(CU, USNM); McKinley National Park near Teklanika Campground (KU). California: Nevada Co., 1 mi NW Hobart Mills (WNM); 2 1/2 mi NW Hobart Mills (WNM). Colorado: Boulder Co., Nederland (CSU); Mineral Co., Creede (KSU). Idaho: Latah Co., Potlatch (ANSP). Illinois: Du Page Co., Glen Ellyn (USNM). Iowa: Hamilton Co., Little Wall Lake (USNM). Michigan: Livingston Co., Game Reserve (MSU, USNM); Muskegon Co. (USNM). Minnesota: Eaglenest (USNM); Cook Co., Grand Marais (UMN). Montana: Flathead Co., 1 mi W Bigfork (KSU, USNM), 6 mi NW Bigfork (KSU), 10 mi NW Bigfork (KSU), 33 mi N West Glacier (KSU), 5 mi ENE Kalispel (KSU); Glacier Co., 2 mi E Babb (USNM), Glacier National Park-Avalanche Campground (USNM); Lake Co., 2.3 mi E Polson (WNM), 3 mi E Polson (KSU), 15 mi NE Polson (KSU), 3 mi S Ronan (KSU, USNM), 3.2 mi S Ronan (WNM), 1 mi S Swan Lake (KSU), 5 mi S Swan Lake (KSU), 3 mi S Swan Lake (USNM), University of Montana Biological Station (MSU). Oregon: Linn Co., 21 mi SE Idanha (WNM), 26 mi SE Idanha (WNM). South Dakota: Tripp Co., Winner (ANSP). Utah: Duchesne Co., Ashley National Forest-Lime Kiln Spring (WNM). Washington: Ferry Co., 15 mi W Kettle Falls (UN).

Remarks. --N. avia is widely distributed throughout the northern half of North America (map 1). This is one of the few species of the subgenus Notiphila that occurs in the West, as far south as California,

although usually at higher elevations. It has been collected from 28 May to 24 August.

In western North America, the third antennal segment of this species is mostly dark, often entirely black, whereas specimens from the East have considerably more pallor. Often the posteroventral portion is pale orange and in some specimens, most of the segment is pale.

This species has been collected from grass-meadow habitats near lotic water systems in mountainous areas. Collecting was particularly productive around beaver ponds.

Notiphila (Notiphila) erythrocera Loew

(figures 4-7, 41, 69, 183, 186; map 2)

Notiphila erythrocera Loew, 1878, Ztschr. f. die Gesam. Naturw. 51:194.

Notiphila varia Jones, 1906, Calif. Univ., Pubs., Ent. 1:153.

Notiphila (Notiphila) erythrocera, Cresson, 1917, Trans. Amer. Ent. Soc. 43:36.

Types and type locality. --Female lectotype (here designated); a small square (silver colored); Loew Coll.; erythrocer a m.; Type 11132 (red); LECTOTYPE Notiphila erythrocera Loew by W.N. Mathis. Loew's original description states that Cuba is the type locality although a

locality label does not accompany the type specimen. The lectotype is deposited in the Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts, type number 11132. I have also examined the lectotype of the junior synonym, N. varia (designated by Mathis, 1974) which bears the following label data: Riverside, Riverside Co., V-30-98, Cal.; Cresson's determination label dated 1915; Wirth's determination label with no date; a blue paratype label written by Cresson; 1134; ♂; LECTOTYPE *Notiphila varia* Jones, Wayne N. Mathis, 1848. The lectotype of the junior synonym is deposited with the California Academy of Sciences, San Francisco, type number 1848.

Diagnosis. --N. erythrocera is one of the most variable species of Notiphila and could be easily confused with similar congeners. However, it may be distinguished from all others by the following combination of characters. All of the antennal segments are usually pale, light orange, although the first and second segments often have some darkened areas. Usually there are 10 to 12 arisal branches. The facial setae are well developed, bristle-like, but they are few in number, three to four. The overall color and maculation pattern of this species vary considerably but in general it is cinereous to ochraceous in color and there are some dark brown maculation markings on the abdomen. The structures of the male genitalia are the most distinctive and reliable characters. The arms of the ventral

process of the epandrium are setulose and project forward from the epandrium without any basal development. The arms form a broad, deep, U-shaped structure. See figures 41 and 69.

Description. --Mostly medium sized flies, length 3.00 to 4.25 mm, with cinereous to ochraceous coloration and a few darker brown markings.

Head. Head ratio 1:0.72; postfrons ratio 1:0.61; frons generally light brown, pruinose, mesotriangular area and lateral margins lighter in color, concolorous. Dorsalmost postocular bristles large, nearly twice the size of postocellars; one pair of proclinate fronto-orbital setae generally present. Antennal segments mostly pale, yellowish-orange, but often with some darkened areas on basal segments; arista with 10 to 12 aristal branches. Face yellowish-gray to almost whitish-gray; facial setae strong, bristle-like, numbering three to four; prefrons ratio 1:0.88. Eye ratio 1:0.79; eye-to-cheek ratio 1:0.25. Gena moderately narrow, mostly concolorous with face becoming grayer and slightly darker posteriorly; genal bristle subequal to dorsalmost postocular. Maxillary palpi pale, yellow.

Thorax. Mostly light brown, cinereous to ochraceous, mesonotum usually darker than pleura. Both mesonotum and mesopleuron generally without any maculation areas but sometimes there are faint indications. Femora mostly gray, with some darkened areas,

apically pale; tibiae and tarsi pale, yellow, fore tibiae sometimes slightly darkened. Setal fascicle of hind basitarsus dark. Wing ratio 1:0.41; costal vein ratio 1:0.48; M_{1+2} vein ratio 1:0.83.

Abdomen. Abdomen ratio in males 1:0.79; length of fourth tergite to fifth tergite ratio in males 1:0.78; fifth tergite ratio in males 1:0.43. Usually with some maculation pattern of darker brown areas, guttate, but often nearly immaculate. Male postabdomen as in figures 41 and 69.

Specimens examined. --Five hundred thirteen specimens from the following localities: UNITED STATES: Alabama: Kushla (USNM); Mobile Co., Coden (USNM), Mobile (USNM). Arizona: St. Xavier Mtn. (CAS); Apache Co. (KU); Cochise Co., Huachuca Mountains-Sunnyside Canyon (KU, USNM); Pima Co., Lowell Ranger Station (AMNH, USNM); Santa Cruz Co., Patagonia (USNM), 6 mi E Patagonia-Sonoita Creek (KSU); Tonto Co., E Verde River - 5 mi N Payson (WNM). California: Colusa Co., Maxwell (UCD); Inyo Co. (UCR); Kern Co., Rosamond (KU); Los Angeles Co., Los Angeles River (ANSP), Sangus (ANSP, WSU); Mono Co., Mono Lake (USNM), 2 mi N Mono Lake (WNM); Orange Co., Anaheim (ANSP); Riverside Co., Lake Hemet (USNM), Riverside (UCB, ANSP, USNM), Temecula (UCB); San Bernardino Co., Chino (USNM), Redlands (USNM); San Diego Co., Jacumba (KU), Lake Henshaw (USNM); Sutter Co., Live

Oak Park (USNM). Colorado: Chaffee Co. (ANSP, CSU); El Paso Co., Monument (ANSP); Fremont Co. (KNSU); Jefferson Co., Golden (USNM); Larimer Co., Fort Collins (ANSP, CSU), La Porte (CSU); Weld Co., Roggen (CSU). Delaware: Sussex Co., Rehoboth (ANSP, USNM). Florida: Hibernia (KU); Little River (ANSP); Alachua Co. (FSCA), Gainesville (KU, USNM); Dade Co., Biscayne Bay (ANSP), Miami (CNC); DeSoto Co., Fort Ogden (CNC); Duval Co., Jacksonville (CU); Franklin Co., 2 mi W Apaloachicola (UMI); Glades Co., Palmdale-Fisheating Creek (CU); Gulf Co., Beach at McNeil's (UMI); Highlands Co., Archbold Biological Station - 10 mi S Lake Placid (CU, UN, PSU), Highlands Hammock State Park (CU), Sebring (FSCA, MCZ); Hillsborough Co., Tampa (USNM); Levy Co. (FSCA, USNM); Marion Co., Silver Springs (USNM); Okaloosa Co. (FSCA); Orange Co., Orlando (ANSP, USNM); Osceola Co., Kissimmee (USNM); Palm Beach Co., Lake Worth (AMNH, USNM); Pasco Co., Hudson (KU); Pinellas Co., Saint Petersburg (CU); Polk Co., Lakeland (ANSP, CU); Saint Johns Co., 0.4 mi N Marineland (CU), Saint Augustine (ANSP, MCZ); Sarasota Co., Myakka River State Park (FSCA, USNM); Volusia Co. (FSCA), Ormond (AMNH). Georgia: Glynn Co., Thalmann (ANSP, CU); Liberty Co., North Newport River-Riceboro (ISU), Saint Catherines Island (AMNH). Louisiana: Cameron Parish, Cameron (ANSP, OHSU, WSU), 15 mi E Creole (KU); Iberville Parish, Sunshine (FSCA); Jefferson Parish, Harahan (MCZ); Orleans Parish,

New Orleans (ANSP); Saint Charles Parish, W. Bonnet Carre Spillway (CU); Saint Tammany Parish, Manderville (KU), Slidell (ANSP, OHSU). Maryland: Calvert Co., Chesapeake Beach (USNM).

Nebraska: Box Butte Co., Alliance (UN); Chase Co., Champion (UN); Cherry Co., Snake Falls (USNM). Nevada: Washoe Co., Sparks (USNM), Steamboat (USNM). New Jersey: Cape May Co., Cape May (ANSP). New Mexico: Catron Co., Apache Creek (WNM); Eddy (KU); Grant Co., Mangus Springs - 11 mi S Cliff (WNM); San Juan Co., 1 mi S Bloomfield (WNM); San Miguel Co., 1/2 mi NE Montezuma (WNM).

Oregon: Harney Co., Crane Hot Springs (WNM), Harney Lake (USNM); Lake Co., Ana Reservoir (WNM), Summer Lake (WNM), 4.8 mi N Summer Lake (WNM), Warner Canyon (WNM). South Carolina: Charleston Co., Wedge Plantation - 7 mi NE McClellanville (CU); Horry Co., Myrtle Beach (USNM). Texas: Victoria (USNM); Bexar Co., San Antonio (USNM); Cameron Co., Harlingen (USNM), Laguna Madre - 25 mi SE Harlingen (ISU, USNM); Galveston Co., Dickinson (ANSP), Galveston (ANSP, USNM); Hidalgo Co., McAllen (USNM); Kenedy Co., Sarita (INHS); Lubbock Co., Buffalo Spring Lake (USNM); Travis Co., Austin (USNM). Utah: Box Elder Co., Brigham (USU), Syracuse (USU); Davis Co., Farmington (USNM); San Juan Co., 2 mi S Blanding (WNM); Utah Co., Elberta (ANSP), Goshen Pond (WNM). Wyoming: Platte Co., Chugwater (ANSP, USNM).

Remarks.--N. erythrocera occurs throughout most of the southern half of North America below the 45th parallel. In the West, it is found as far north as Oregon and Wyoming (map 2). Collection dates are from 1 January to 24 October.

This is a variable species although the male genitalia are consistently similar throughout its distribution. There are a few populations from the Southeast that are almost white in background coloration and have very light maculation areas. These populations could represent a distinct subspecies or species when more evidence is accumulated. Most specimens are light tan with darker brown, guttate markings on the abdomen.

N. erythrocera has been collected from sedge-meadow and reed-marsh habitats.

Notiphila (Notiphila) phaeopsis new species

(figures 43-44, 64, 82)

Diagnosis.--Although similar to N. pulcra, N. phaeopsis may be distinguished by the following combination of characters. In general, N. phaeopsis is darker brown and more uniformly colored than N. pulcra and the pre- and postfrons are nearly concolorous. The prefrons of N. pulcra is considerably lighter than its postfrons. The first and second antennal segments of N. phaeopsis are always dark brown and the third segment is mostly dark although its base is often

lighter, generally orange. The maculation pattern on the thorax of N. phaeopsis is not as evident, especially the darkened spot on the mesopleuron and as a whole, the thorax is uniformly colored. The darkened fascia on the abdominal segments extend to the lateral margins without being interrupted by lighter areas as in N. pulcra; they also continue on the ventral surface. All femora and tibiae of N. phaeopsis are dark brown and the lightened apical and basal areas are not nearly as extensive as in N. pulcra. In N. phaeopsis the epandrial process of the male postabdomen is bluntly rounded, short, and does not diverge apically. Also, the lobe of the hypandrial process is apically rounded, contrasting with the more angulate process of N. pulcra.

Description. --Medium sized flies, length 3.54 to 3.90 mm, uniformly dark colored, brown.

Head. Head ratio 1:0.70; post- and prefrons uniformly concolorous, dark brown, lightly pruinose; postfrons ratio 1:0.77; postocular bristles large, subequal to proclinate, anterior ocellar bristles. First and second antennal segments dark brown to blackish-brown; third segment orange basally, becoming dark apically; arisal branches 10 to 14. Facial setae hair-like, subequal to postocellars; prefrons ratio 1:0.78. Eye ratio 1:0.78; eye-to-cheek ratio 1:0.16; genal bristle subequal to facial setae, gena lighter than prefrons, becoming

gray posteriorly. Maxillary palpi pale apically, yellow, basally darkened.

Thorax. Uniformly dark brown, concolorous with head. Propleural area grayed, posterior area of mesothorax also gray. All femora and tibiae dark brown although not pruinose; joints usually lightened, yellowish. Tarsi mostly yellow but with darkened brown colored areas, especially on dorsal surfaces. Setal fascicle of hind basitarsus black. Wing ratio 1:0.40; costal vein ratio 1:0.39; M_{1+2} vein ratio 1:0.68.

Abdomen. Darkened fascia occupying most of tergites except for posterior margins which are bluish-gray. Male postabdomen as in diagnosis and figures 43-44, 64, and 82.

Type material. --Male holotype: Iowa, Hamilton Co., Goose Lake, VII-14-1960, D. L. Deonier; HOLOTYPE *Notiphila phaeopsis* Mathis (red). Allotype: Iowa, Hancock Co., Pilot Knob St. Park, June 24, 1966, H. Borchers (USNM). One female paratype from each of the following localities: Michigan, Detroit, Aug 4, 1939, Geo. Steyskal (ANSP); New York, Oswego Co., St. Mary's Pond, July 16, 1968, K. W. Simpson coll. (CU); Long Island Orient, Sept. 15, 1948, Roy Latham (USNM); Ontario Beach, N. Fairhaven, July 7, 1922, L. S. West (CU). The holotype will be deposited with the National Museum of Natural History, Washington, D. C., type number 73553.

Etymology. -- From phaios (Greek meaning "dusky" or "brown") plus opsis (Greek meaning "appearance" or "countenance") in allusion to the general dark brown color of this species.

Remarks. -- From the few locality records available, N. phaeopsis occurs in the Midwest and Northeast of the United States. Its biology is not known. Collection dates are from 24 June to 15 September.

Notiphila (Notiphila) pulcra new species

(figures 45, 71; map 3)

Notiphila (Notiphila) riparia, of North American authors, nec.

Meigen, 1830, Syst. Besch. . . Zweifl. Insek. 6:65.

Diagnosis. -- This species is not likely to be confused with any other except possibly for N. phaeopsis. N. pulcra is distinguishable from N. phaeopsis and all other species by the following combination of characters. The antennal segments are entirely pale or at most the first segment is darkened and the arista bears up to 15 aristal branches. The facial series of setae are very well developed, bristle-like. The mesonotum does not have a median stripe but there is a small spot just anterior to the presutural bristle and the mesopleuron also bears a darker maculation area. The characteristic setal comb along the posteroventral margin of the mid femora is very weakly developed and there is no distinguishable row of setae on the

mid tibiae. N. pulcra is grayer in background coloration than N. phaeopsis and the male genitalia of the former species are also very diagnostic. See figures 45 and 71.

Description. --Medium to large flies, length 3.65 to 4.82 mm, with dark gray to brownish gray background coloration and dark brown markings.

Head. Head ratio 1:0.70; postfrons ratio 1:0.61; frons mostly gray but mesotriangular area lighter and brown, lateral margins sometimes concolorous with mesotriangular area but often dark, like the rest of the frons. Dorsalmost postocular bristles very large, in some specimens equaling ocellars in size; one pair of proclinate fronto-orbitals usually present but never strongly developed. Antennal segments mostly pale, yellowish-orange, occasionally the basal segment is darkened; arista with 10 to 15 aristal branches. Face gray and often with median stripe on lower two-thirds that is brown; facial setae strongly developed, numbering three to four, restricted to lower half of face; prefrons ratio 1:0.73. Eye ratio 1:0.73; eye-to-cheek ratio 1:0.16. Gena narrow, generally concolorous with face; genal bristle strong, almost equal to dorsalmost postoculars. Maxillary palpi pale, yellowish-orange to yellow.

Thorax. Mesonotum mostly gray to brownish-gray and immaculate except for a small, darker brown spot just anterior to presutural

bristle. Disc of scutellum usually slightly lighter in color. Mesopleura often with darker maculation area. Femora and tibiae dark, usually black but both pale apically; tarsi mostly pale; setal comb along posteroventral margin of mid femora weakly developed or absent; no evidence of a distinct row of setae along the mid tibiae. Setal fascicle of hind basitarsus black. Wing ratio 1:0.48; costal vein ratio 1:0.51; M_{1+2} vein ratio 1:0.57.

Abdomen. Abdomen ratio in males 1:0.72; length of fourth tergite to fifth tergite ratio in males 1:0.74; fifth tergite ratio in males 1:0.49. Abdomen generally dark gray but with darker brown-gray guttate markings of large size. Male postabdomen as in figures 45 and 71.

Type material. --Male holotype: Goose Lake, Hamilton Co., Iowa, VIII-14-1960; D.L. Deonier; HOLOTYPE *Notiphila pulcra* Mathis (red). Allotype and six paratypes (five males, one female) with the same locality data as the type (ISU, USNM, WNM). The type will be deposited with the National Museum of Natural History, Washington, D.C., type number 73551.

Other specimens examined. --Sixty-nine specimens from the following localities: CANADA: Ontario: Dundas Marsh (CNC); Marmora (CNC). UNITED STATES: Florida: Royal Palm Park (USNM); Alachua Co., Gainesville (CNC, FSCA); DeSoto Co., Brownville (USNM); Franklin Co., Beach - 2 mi W Apalachicola (UMI); Highlands Co., Archbold

Biological Station (PSU); Polk Co., Lakeland (ANSP). Georgia: Billy's Island - Okefenokee Swamp (CU); Honey Island-Okefonokee Swamp (CU); Okefenokee Swamp (UG); Glynn Co., Thalman (CU). Illinois: Johnson Co., Goreville (MSU). Kansas: Stafford Co. (ANSP). Louisiana: East Baton Rouge Parish, Baton Rouge (USNM). Massachusetts: Middlesex Co., Concord (USNM); Nantucket Co., Nantucket (ANSP). Michigan: Bay Co. (USNM); Monroe Co., Monroe (ANSP, USNM). Missouri: Saint Louis Co., Webster Groves (USNM). New Jersey: Essex Co., Newark (ANSP). New York: Cayuga Co., Auburn (USNM); Niagra Co., Olcott (USNM); Queens Co., Flushing (AMNH); Tompkins Co., Ithaca (ANSP, CU). Ohio: Carroll Co., Specht Marsh (KSU); Erie Co., Sandusky-Cedar Point (ANSP, OHSU); Hamilton Co., Cincinnati (OHSU); Portage Co., Kent (OHSU), 3 mi E Kent (KSU), Mogodore Reserve (KSU); Wayne Co., 1/2 mi S Rittman (KSU, USNM). Tennessee: Knox Co., Knoxville-University Farm (CNC). Texas: Val Verde Co., Del Rio-Devil's River (CNC).

Etymology.--The Latin adjective pulcra, meaning "noble, fine, or fair," refers to the handsome appearance of this fly.

Remarks.--N. pulcra is distributed throughout most of eastern North America. It extends northward into Ontario, Canada and southward into Florida (map 3). Collection dates are from 25 March to 8 October.

This species has gone under the name of N. riparia Meigen since it was first discovered. After examining some European specimens that were labeled N. riparia, after comparing figures of the ventral epandrial process of Nearctic material with illustrations or photographs of the same by Dahl (1964, 1971), and after Dr. Lorìc Matile, Paris Museum of Natural History, compared Nearctic specimens, which I had sent him, with the two extant syntypes of N. riparia, I have concluded that the North American species is distinct from N. riparia. There is no other available name for this species, so it is being named here.

Dr. Lorìc Matile pointed out several differences between the syntypes and the specimens I sent from Michigan. He also mentioned that one of the syntypes had four dorsal extensor bristles on the mid tibiae, which is a key character for the subgenus Agrolimna. Both specimens are damaged and the true identity of N. riparia still needs to be worked out and will depend on a thorough revision of the European fauna of Notiphila.

Notiphila (Notiphila) robusta new species

(figures 38, 72, 87)

Diagnosis.--This species belongs to the avia group where it is closely allied to N. avia. Externally, the differences between N. robusta and N. avia are slight and reference to characters of the male genitalia

will usually be necessary to distinguish one from the other. Except for a very thin basal edge of light coloration, the third antennal segment is almost entirely dark. Many N. avia specimens have darkened third antennal segments, especially in the West, but this is not the usual character state for that species from near the type locality of N. robusta. Several structures of the male genitalia are diagnostic. The shapes of the ventral apendrial process, hypandrial process, and basiphallus are all characteristic to this species. See figures 38, 72, and 87.

Description. -- Large sized flies as based on the length of the thorax, with grayish-tan coloration and few contrasting, darker areas.

Head. Head ratio 1:0.74; postfrons ratio 1:0.63; frons mostly unicolorous, brown with some gray pollinosity, except for lighter brown mesotriangular areas surrounding ocellar triangle; dorsalmost postocular bristle subequal with genal bristle. Antennal segments mostly dark brown to black, base of third segment with narrow margin of contrasting lightened area; arista with eight aristal branches. Face lighter than frons, yellow; prefrons ratio 1:0.89; facial setae strong, subequal to genal bristle, numbering two to three. Eye ratio 1:0.74; eye-to-cheek ratio 1:0.25; gena moderately wide, uniformly unicolorous, slightly grayer than face, genal bristle distinct but not more strongly developed than facial setae. Maxillary palpi pale, yellow.

Thorax. Coloration grayish-brown with some faint tinges of darker coloration, generally immaculate; pleura not distinctly contrasting in color with mesonotum, immaculate. Femora dark, gray dusted, apically pale; tibiae dark except at apices; fore tarsi dark, concolorous with fore tibiae, mid and hind tarsi appearing somewhat dark on anterior surface, otherwise with considerable pallor. Setal fascicle of hind basitarsus dark, black. Wing ratio 1:0.36; costal vein ratio 1:0.33; M_{1+2} vein ratio 1:0.71.

Abdomen. Generally concolorous with thorax but with some darkened areas dorsally although these are not distinct, blending marginally. The abdomen was removed before measurements were taken. Male genitalia as in diagnosis and figures 38, 72, and 87.

Type material. --Male holotype: Mi 61 Rte. 58, La Verendrye, Prov. Pk. Que., 26 VI 1965, D.M. Wood; HOLOTYPE *Notiphila robusta* Mathis (red). The type will be deposited with the Canadian National Collection, Ottawa, type number 13774.

Etymology. --Robusta is a Latin adjective meaning "strong" or "robust" referring to the large size of this species.

Remarks. --This species is only known from the unique male holotype. Its biology has not been studied.

Loewi Species-Group

This species-group is comprised of 12 North American species and is the largest of this subgenus. The included species may be further divided into three subelements that demonstrate affinities with each other but also with species of the adusta species-group. The species-group as a whole may be characterized by the short and narrow hypandrial process that usually bears two or three apical bristles and by the weak facial setation.

All of the species in this group occur in eastern North America, mostly east of the Mississippi River.

Notiphila (Notiphila) carinata Loew

(figures 33, 58; map 11)

Notiphila carinata Loew, 1862, Mono. Dipt. N. Amer. Pt. I.

Smithsn. Misc. Collect. 6:137.

Notiphila (Notiphila) carinata, Cresson, 1946, Trans. Amer. Ent.

Soc. 72:235.

Type and type locality. --Female holotype: Mittel St. (green); Loew Coll.; carinata ♀; Type 11133 (red). The holotype is in the possession of the Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts, type number 11133.

Diagnosis.--This species is a member of the loewi group but it is not likely to be confused with most of the included species because of its small size. N. carinata does resemble N. cressoni and N. orientalis but it may be distinguished from either of the latter species as follows. The mesopleuron has a rather well defined darkened area, the mesonotum is immaculate, and the male genitalia are very diagnostic. The ventral process of the epandrium is widely U-shaped and does not curve apically. The arms of the ventral process are not sinuate. The basiphallus is short, with an expanded apex. See figures 33 and 58 for a comparison.

Description.--Small sized flies, length 2.58 to 3.56 mm, with grayish-brown to light brown background coloration and a few brown markings.

Head. Head ratio 1:0.78; postfrons ratio 1:0.64; most of frons light brown, pruinose, mesotriangular area and lateral marking lighter, concolorous. Dorsalmost postocular bristles large, approximately double postocellars in size; at most with one proclinate fronto-orbital seta. Antennae mostly darkened, dark brown, third segment with basal half, especially posteroventral portion, pale, yellow; arista with eight to nine aristal branches. Face unicolorous, light yellow, lightly dusted; prefrons ratio 1:0.69; facial setae small, hair-like. Eye ratio 1:0.83; eye-to-cheek ratio 1:0.155. Gena narrow, generally

concolorous with face, especially anteriorly, becoming grayer posteriorly; genal bristle approximately subequal to dorsalmost postocular bristle. Maxillary palpi pale, yellowish-orange.

Thorax. Mesonotum light brown, darker than pleura, generally immaculate. Mesopleuron with darkened brown spot. Femora gray with some darkened areas along dorsum; tibiae generally concolorous although fore pair are slightly darkened, often with darkened preapical spot to ring; tarsi all pale, yellow. Setal fascicle of hind basitarsus dark. Wing ratio 1:0.45; costal vein ratio 1:0.55; M_{1+2} vein ratio 1:0.97.

Abdomen. Abdomen ratio in males 1:0.84; length of fourth tergite to fifth tergite ratio in males 1:1.1; fifth tergite ratio in males 1:0.48. Maculation pattern variable but generally as most species of loewi species-group. Male postabdomen as in diagnosis and in figures 33 and 58.

Specimens examined. --Forty-five specimens from the following localities: UNITED STATES: Delaware: Kent Co., Bombay Hook National Wildlife Refuge (CU). Indiana: Montgomery Co., Crawfordsville (USNM); Tippecanoe Co., La Fayette (ANSP, USNM).

Maryland: Plummers Island (USNM). New York: Genesee Co., Bergen (WNM). North Carolina: Macon Co., Highlands (CNC). Ohio: Wayne Co., 1/2 mi S Rittman (KSU). Virginia: Fairfax Co.,

Potomac River at Scott Run (USNM). Washington, D. C. (ANSP, USNM).

Remarks. -- This species is limited in distribution to the mid Atlantic states and westward into Ohio and Indiana (map 11). Loew's locality label "Mittel St." is being interpreted as the mid Atlantic states area. Collection dates are from 7 June to 18 September.

Loew apparently described this species from a single female specimen, which made later use of the name difficult because most subsequent species were based on male specimens. I have interpreted this species on the distinctions made in the diagnosis which were associated with reliable characters of the male genitalia in associated male specimens.

Notiphila (Notiphila) cressoni new name

(figures 13, 28-29, 59, 80; map 6)

Notiphila (Notiphila) bicolor Cresson, 1917, Trans. Amer. Ent. Soc. 43:35. [preoccupied, Waltl, 1837, Isis (von Oken) 4:281].

Notiphila (Notiphila) carinata, Cresson (in part), 1943, Trans. Amer. Ent. Soc. 72:235.

Type and type locality. -- Male holotype; Columbia, Mo., May 26-June 8, '06, C. R. Crosby Coll.; Holo-TYPE Notiphila bicolor, E. T. Cresson Jr, (red); property of C U, Loaned (pink); Holotype Cornell

No. 4519. The holotype is deposited in the Cornell University insect collection, type number 4519. The type is in relatively good condition although the right third antennal segment is missing and a number of the head bristles have been broken off.

Diagnosis.--This species belongs in the loewi group as evidenced by the male genitalia, but it may be distinguished from any of the species of that group by the following combination of characters. Specimens of N. cressoni are small, length 2.38 to 3.23 mm, with very narrow genae. The ventral margin of the epandrium is the most reliable character for species determination being produced into two processes, which from a lateral view, curve anteriorly. See figures 28 and 29. The basiphallus is long, gently sinuate and the aedeagal apodeme is very narrowly produced where it attaches to the basiphallus but it is enlarged posteriorly becoming almost subquadrate. See figures 59 and 80.

Description.--Small sized flies, length 2.38 to 3.23 mm, with light brown to brownish-gray coloration and some brown markings.

Head. Head ratio 1:0.72; postfrons ratio 1:0.66; frons generally brown, pruinose, lateral margin and mesotriangular area lighter brown, concolorous. Dorsalmost postocular bristles weak, only slightly larger than postocellar bristles; at most with one very small proclinate fronto-orbital seta. First and second antennal segments

mostly dark brown but with some paler areas dorsally; third segment pale posteroventrally, otherwise dark; arista with approximately ten aristal branches. Face yellowish-gray; prefrons ratio 1:0.79; two to three facial setae toward ventral margin. Eye ratio 1:0.78; eye-to-cheek ratio 1:0.18. Gena narrow; genal bristle distinct, usually larger than dorsalmost postoculars. Maxillary palpi pale, yellow.

Thorax. Mesonotum slightly darker than pleura, immaculate, generally uniformly colored; dorsum of scutellum sometimes lighter than mesonotum in color. Mesopleuron often with undefined darker area toward dorsal margin but usually immaculate. Femora mostly gray with some grayish-black areas, pale apically; fore tibiae mostly dark, mid tibiae pale, hind tibiae pale with preapical darkened ring. Tarsi pale although fore tarsi are darker. Setal fascicle of hind basitarsus dark. Wing ratio 1:0.42; costal vein ratio 1:0.50; M_{1+2} vein ratio 1:0.90.

Abdomen. Abdomen ratio in males 1:0.75; length of fourth tergite to fifth tergite ratio in males 1:1.3; fifth tergite ratio in males 1:0.41. Maculation pattern variable, usually with paired darkened areas toward anterior margin on both sides of mid line, more evident on segments three and four. Male genitalia as in figures 28-29, 59, and 80 and in diagnosis.

Specimens examined. --Twenty specimens from the following localities:

CANADA: Ontario: Simcoe (CNC). UNITED STATES: Arkansas:

Washington Co. (USNM). Iowa: Allamakee Co., 3 mi ESE Waterville

(ISU); Hamilton Co., Little Wall Lake (ISU). Kansas: Riley Co.,

Manhattan (ANSP); Wyandotte Co., 1 1/2 mi S Bonner Springs (ISU).

Maryland: Baltimore Co., Towson-minebk (ANSP). Missouri:

Lawrence Co., 4 mi NE La Russell (ISU, WNM); Saint Louis Co.,

Creve Coeur (USNM). Ohio: Franklin Co. (OHSU), Columbus (ANSP).

Pennsylvania: Philadelphia Co., Philadelphia (ANSP). Virginia:

Fairfax Co., Herndon (CSU).

Remarks. --The new name N. cressoni is a genitive patronym honoring E. T. Cresson, Jr., who contributed so much to the study of shore flies. The new name is proposed to replace N. bicolor Cresson which was preoccupied (Watl, 1837). Collection dates are from 23 May to 22 September.

N. cressoni has a Midwestern to Middle Atlantic distribution in North America. It extends northward as far as Ontario, Canada (map 6).

Notiphila (Notiphila) eleomyia new species

(figures 34, 62, 83)

Diagnosis. --N. eleomyia is very similar to N. shewelli but it can be

differentiated by the narrower gena and more reliably by differences in the male genitalia. The arms of the ventral epandrial process are narrower and the general conformation of the process, although similar to N. shewelli, is more sharply formed. The epandrium is larger and the lateral margins are sinuate. See figures 34, 62, and 83.

Description. --A medium sized fly with light brown coloration and a few darker brown maculation areas.

Head. Head ratio 1:0.82; postfrons ratio 1:0.71; frons generally brown with some charcoal reflections but with mesotriangular area and lateral margins lighter in color. Dorsalmost postocular bristles large, subequal to genal bristles, much larger than postocellar bristles; at most with one pair of small, proclinate fronto-orbital setae. First and second antennal segments dark brown, third segment pale orange basally and along posteroventral margin, becoming darker, concolorous with first and second segments along anterodorsal edges; arista with approximately eight arisal branches. Face dusted yellow; prefrons ratio 1:0.79; facial setae weak, numbering approximately four to five. Eye ratio 1:0.74; eye-to-cheek ratio 1:0.21. Gena narrow, concolorous with face anteriorly, becoming grayer posteriorly; genal bristle distinct, approximately equal in length to dorsalmost postoculars. Maxillary palpi pale, yellow.

Thorax. Mesonotum mostly dusted brown, more or less uniformly colored. Scutellum lighter in color than mesonotum, yellowish-gray. Pleura generally lighter in color than mesonotum but not distinctly contrasting, lighter areas gradually becoming so. Femora concolorous, dark, gray dusted. Fore tibiae mostly dark; mid and hind tibiae mostly pale; all tarsi more or less pale, fore tarsi slightly darker. Setal fascicle of hind basitarsus dark. Wing ratio 1:0.42; costal vein ratio 1:0.41; M_{1+2} vein ratio 1:0.76.

Abdomen. Male postabdomen as in diagnosis and in figures 34, 63, and 83.

Type material.--Male holotype: Ohio, Carroll Co., Specht Marsh, 21 June 1953; E. J. Allen collector; HOLOTYPE *Notiphila eleomyia* Mathis (red). The holotype will be deposited in the National Museum of Natural History, Washington, D.C., type number 73548.

Etymology.--Eleo (Greek meaning "marsh") plus myia (Greek meaning "fly"), referring to the habitat of the species.

Remarks.--This species is only known from the male holotype which was collected in Ohio. Because the male genitalia are distinct from any known Notiphila species, I feel justified in recognizing this specimen as a new species. Nothing is known of its biology.

Notiphila (Notiphila) floridensis Cresson

(figures 39-40, 67, 85)

Notiphila (Notiphila) floridensis Cresson, 1917, Trans. Amer. Ent.

Soc. 43:46.

Types and type locality. -- Male holotype: S. Fla, Robertson; ♂;

Type No. 20723, U.S.N.M.; Holo-TYPE Notiphila floridensis, E.T.

Cresson Jr. The holotype is deposited with the United States Museum of Natural History, Washington, D.C. Cresson also listed a female paratopotype in the original description which I examined and found to be a male.

Diagnosis. -- N. floridensis is apparently closely allied to N. cognata and externally they are very similar to each other. However, N. floridensis may be distinguished from N. cognata by the following combination of characters. The dorsal half of the mesopleuron often has a darker brown maculation area which contrasts with the gray background color and the setal fascicle of the hind basitarsus is black. The male genitalia of N. floridensis are very diagnostic and do not appear to be closely related to any others. The ventral process of the epandrium is narrow and apically bifurcates forming a U-shaped structure that is laterally setulose midway up both arms. The basiphallus is uniquely shaped, very narrow and resembling a fish in

profile. The hypandrial processes are not well developed. See figures 39-40, 67, and 85.

Description. --Medium sized flies, length 3.0 to 3.98 mm, with gray to light brown background coloration and brown markings.

Head. Head ratio 1:0.76; postfrons ratio 1:0.69; frons with antero-lateral margins cinereous, mesotriangular area indicated by being slightly lighter but not contrasting greatly with remainder of frons. Dorsalmost postocular bristles large, subequal to genal bristle; at most with one pair of proclinate, small, fronto-orbital setae laterad to larger reclinate bristle. First and second antennal segments dark, dark brown to black; third segment with extensive pale areas toward posteroventral corner, otherwise dark brown; arista with approximately eight aristal branches. Face cinereous to niveous; facial setae well developed, restricted to lower half of face, numbering three to four; prefrons ratio 1:0.79. Eye ratio 1:0.89; eye-to-cheek ratio 1:0.35. Gena very wide; genal bristle distinct and slightly larger than largest facial bristles; gena concolorous with face. Maxillary palpi pale, yellowish-orange.

Thorax. Mseonotum light brown, gray anteriorly and on extreme lateral margins; scutellum mostly gray. Mesopleura with brown maculation area toward dorsal margin, indistinct and often covering most of the dorsal half. Pleura mostly gray but with some brownish

coloration. Femora dark, gray, pruinose over extensive areas; tibiae and tarsi pale, yellowish-orange but with some darker coloration. Setal fascicle of hind basitarsus dark, black. Wing ratio 1:0.44; costal vein ratio 1:0.62; M_{1+2} vein ratio 1:0.83.

Abdomen. Abdomen ratio in males 1:0.82; length of fourth tergite to fifth tergite ratio in males 1:0.89; fifth tergite ratio in males 1:0.40. Abdomen mostly gray but usually with geminate brown spots on either side of midline and toward anterior margin on third and fourth tergites, some females with four spots per tergite. Female postabdomen consisting of segments six and eight well sclerotized and the seventh mostly membranous. Male postabdomen as in diagnosis and in figures 39-40, 67, and 85.

Specimens examined.--Thirty-eight specimens from the following localities: UNITED STATES: Florida: Citrus Co., Inverness (ANSP); Putnam Co., Drayton Island (ANSP). Georgia: Charlton Co., Okefenokee Swamp (USNM). Illinois: Macoupin Co., Carlinville (INHS, WNM).

Remarks.--Apparently, this species is mainly distributed in the Southeast of the United States although most specimens were collected just north of St. Louis in Carlinville, Illinois. As indicated above, very few collection records are known. Collection dates are from 8 August to 5 September.

Nothing is known regarding the biology of this species.

Notiphila latigena new species

(figures 36, 60, 78)

Diagnosis.--N. latigena belongs to the loewi group and is closely allied to N. cressoni and N. loewi. The general facies of the head are also similar to N. floridensis. N. latigena differs from all similar congeners by the following combination of characters. The wide gena and resulting eye-to-cheek ratio are large, the total body length is approximately 3.50 mm, and the male genitalia, especially the shape of the ventral epandrial process are distinctive. The arms of the ventral epandrial process are short, arise from a narrow base, and diverge from each other to form a wide V-shaped process. The internal structures of the genitalia are very similar to those of N. loewi and N. cressoni and evidence a close relationship with both. See figures 36, 60, and 78.

Description.--A medium sized fly, length of holotype 3.43 mm, with light dusted brown to gray coloration and a few very faint brown markings.

Head. Head ratio 1:0.78; postfrons ratio 1:0.69; frons mostly light brown to brown with distinguishable mesotriangular area that is lighter in color, anterior angle of mesotriangle with brown spot concolorous with lateral margins of mesofrons, extreme lateral margins of frons considerably lighter than remainder of frons, concolorous

with face. At most with one proclinate, small, fronto-orbital seta. First and second antennal segments dark brown, third segment pale, yellowish-orange basally but concolorous with first and second segments along anterodorsal margins; arista with seven to eight aristal branches. Face grayish-yellow, pruinose; prefrons ratio 1:0.80; facial setae weak, numbering four to five and restricted to lower half of face. Eye-to-cheek ratio 1:0.29; eye ratio 1:0.83. Gena wide, anterior portion concolorous with face, becoming grayer posteriorly; genal bristle very distinct. Maxillary palpi pale, yellow.

Thorax. Mesonotum light brown, appearing dusted, mostly uniformly colored but with some darker areas. Scutellar disc lighter in color than mesonotum, grayer. Pleura distinctly lighter in color than mesonotum, tending to become lighter ventrally, gray, mesopleura with faint brown maculation areas. Femora gray, dusted, apically pale; tibiae and tarsi all pale. Setal fascicle of hind basitarsus dark. Wing ratio 1:0.41; costal vein ratio 1:0.43; M_{1+2} vein ratio 1:0.82.

Abdomen. Abdomen ratio of males 1:0.66; length of fourth tergite to fifth tergite of males 1:1.2; fifth tergite ratio of males 1:0.57.

Abdomen mostly unicolorous, but with a few darker maculation areas, mostly faint bigeminate toward anterior edge. Male postabdomen as in diagnosis and in figures 36, 60, and 78.

Type material.--Male holotype: Florida, Highlands Co., Archbold Biological Station, 15 March 1964, S.W. Frost; HOLOTYPE *Notiphila latigena* Mathis (red). One male paratype: Florida, Silver Springs, 2 April 1932, A.L. Melander (ANSP). The holotype will be deposited with the National Museum of Natural History, Washington, D.C., type number 73550.

Etymology.--Lati, a Latin adjective meaning "wide," plus gena, a Latin noun meaning "cheek," referring to the wide gena.

Remarks.--This species has only been collected in Florida although I suspect that it will eventually be found to occur more widely in the Southeast. The biology of this species is unknown.

Notiphila (Notiphila) loewi Cresson

(figures 30, 61, 84; map 4)

Notiphila (Notiphila) loewi Cresson, 1917, Trans. Amer. Ent.

Soc. 43:44.

Type and type locality.--Male holotype: Sandusky, Cedar Pt, O.; 16 July 1902. Cresson's original description further lists one male and nine female paratopotypes. The holotype is presently deposited in the Ohio State University insect collection, Columbus, Ohio.

Diagnosis.--N. loewi belongs to the loewi group and is very similar to most of the included species. However, this species may be distinguished from related congeners by the following combination of characters. Specimens of N. loewi are generally larger than those of N. cressoni and N. carinata but approximately the same size as N. shewelli, but the eye-to-cheek ratio of N. shewelli is significantly larger than that of N. loewi. The mesopleuron bears only a faint, indefinite indication of a darkened spot and usually a median mesonotal stripe is lacking or is very poorly developed. The maculation pattern on the abdomen is variable but is usually more extensive than N. poliosoma. The male genitalia of N. loewi are distinctive and are the most reliable characters for distinguishing this species. The shape of the ventral epandrial process is especially diagnostic. Also, the aedeagal apodeme, the basiphallus, and the hypandrial process are useful. See figures 30, 61, and 84.

Description.--Medium sized flies, length 2.98 to 4.07 mm, with light brownish-gray to brown coloration and a few darker brown markings.

Head. Head ratio 1:0.72; postfrons ratio 1:0.68; frons mostly light brown, pruinose, often with some charcoal or greenish coloration; mesotriangular area and lateral margins usually concolorous and lighter than remainder of frons. Dorsalmost postocular bristles large, usually larger than genal bristle. At most with one proclinate

fronto-orbital seta. Antennal segments one and two dark, blackish-brown; third segment pale, orange, especially toward posteroventral margin and base, otherwise darkened; arista with seven to nine aristal branches. Face light yellow to grayish-yellow; prefrons ratio 1:0.82; facial setae numbering three to four on ventral portion only, larger than postocellars setae. Eye ratio 1:0.81; eye-to-cheek ratio 1:0.21. Gena moderately narrow and generally concolorous with face although becoming grayer posteriorly; genal bristle strong but usually smaller than dorsalmost postocular bristles. Maxillary palpi pale, yellow.

Thorax. Mesonotum light brown, dusted, slightly darker than pleura, usually without median stripe or with only a faint indication. Mesopleuron with indefinite, faint darkened area toward dorsal margin. Femora mostly gray usually darkened dorsally; fore tibiae and tarsi concolorous, superficially darkened but apically pale; mid and hind tibiae mostly pale, sometimes with darkened preapical ring; mid and hind tarsi pale. Setal fascicle of hind basitarsus dark. Wing ratio 1:0.47; costal vein ratio 1:0.48; M_{1+2} vein ratio 1:0.87.

Abdomen. Background color often somewhat grayer than thorax. Abdomen ratio in males 1:0.71; length of fourth tergite to fifth tergite ratio in males 1:1.1; fifth tergite ratio in males 1:0.67. Maculation pattern variable, best developed on segments three and four, usually with two oblong spots on either side of median line, sometimes with

darkened area connecting spots anteriorly. Male postabdomen as in diagnosis and in figures 30, 61, and 84.

Specimens examined.--One hundred twenty-four specimens from the following localities: CANADA: British Columbia: Agassiz (CNC); Vancouver Island-Elk Lake (ANSP, USNM). Ontario: Dundas Marsh (CNC); Grand Bend (CNC); Kingston (USNM); London (USNM); Lyndhurst (CNC); Pembroke (ANSP). Quebec: Lac Bernard (CNC); Norway Bay (CNC); Saint Chresostome (CNC). UNITED STATES: Florida: Alachua Co., Gainesville (USNM). Illinois: Pistakee Bay (ANSP, USNM); Mason Co., Havana (ANSP, INHS); McHenry Co., McHenry (USNM). Indiana: Tippecanoe Co., La Fayette (USNM). Iowa: Dickinson Co., Milford Woods-Okoboji Twp. (ISU); Monona Co., Lewis and Clark State Park (ISU). Maryland: Cecil Co., Egypt Road (CU). Michigan: Arenac Co. (USNM); Houghton Co. (USNM); Midland Co. (USNM); Monroe Co., Monroe (ANSP, USNM). Minnesota: Clearwater Co., Itasca State Park (ISU), Lake Itasca - W side across from Biological Station (ISU); Ramsey Co., Saint Paul-Bussey's Pond (UMN). Montana: Lake Co., 2.3 mi E Polson (KSU). New York: Dutchess Co., Stanfordville (ANSP); Warren Co., Adirondack-Connery Pond (ANSP, USNM). Ohio: Carroll Co., Specht Marsh (KSU); Erie Co., Sandusky-Cedar Point (ANSP, KU, OHSU); Portage Co., 1 mi E Kent (KSU). Pennsylvania: Luzerne Co., Ashley

(USNM). South Dakota: Custer Co., 8 mi N Pringle-Flynn Creek

(CNC). Texas: Val Verde Co., Del Rio-Devil's River (CNC).

Remarks. --N. loewi is widespread in eastern North America, extending westward through South Dakota into Montana and British Columbia (map 4). I have not examined any specimens from the Southeast between Texas and Florida. Collection dates are from 27 April to 9 September.

Walker described a new fly species as N. unicolor in 1860. Two years later, Loew (1862) described a new North American species with the same name, N. unicolor; that name thus became a primary homonym of N. unicolor Walker. In 1917, Cresson proposed the name N. loewi as a "new name" under which N. unicolor Loew was listed as a questionable, preoccupied, synonym. Although N. loewi was given as a new name, Cresson designated a new holotype and mentioned in his discussion that "being uncertain as to the correct identification of unicolor, I am supplying a new species for my series" (p. 45, italics mine).

N. unicolor Loew was and has been considered a junior, preoccupied synonym of N. loewi (Wirth, 1965). After studying the type of N. unicolor Loew and comparing it with N. loewi, I have concluded that N. unicolor Loew is a distinct and separate species. Dissections

of the male genitalia were made and compared. The problem now is what is the type of N. loewi?

The problem was referred to Dr. Curtis W. Sabrosky, a member of the International Commission of Zoological Nomenclature, U.S. D.A. - U.S.N.M., for his opinion. Dr. Sabrosky (personal communication) suggested that N. loewi Cresson be treated as a new species with its own type. This was suggested in view of the substance of Cresson's article in which he listed N. unicolor Loew only questionably as a synonym, designated a new holotype, and treated N. loewi as a new species in his discussion. N. unicolor Loew will be given a new name below; its type will be that of N. unicolor Loew.

Notiphila (Notiphila) orienta new species

(figures 37, 68, 88)

Diagnosis. -- N. orienta appears to be very similar to N. erythrocera but it may be distinguished from the latter species by the following combination of characters. The facial setae of N. orienta are weaker, hair-like, and the second and third antennal segments are mostly dark although with some pale areas. The structures of the male genitalia are very diagnostic and are the most reliable characters for distinguishing this species. The arms of the ventral process of the epandrium are shorter than those of N. erythrocera and they are also

thicker and sinuate. For a comparison of this and other genitalic characters, see figures 37, 68, and 88.

Description. --Small sized flies, length approximately 2.88 m, with light brown to grayish-brown coloration and some darker brown markings.

Head. Head ratio 1:0.75; postfrons ratio 1:0.67; frons mostly brown but with some darker, charcoal tinged areas, mesotriangular area and lateral margins usually lighter in color. Dorsalmost postocular bristle approximately equal to genal bristle, larger than postocellars; with at most one developed proclinate fronto-orbital seta. First and second antennal segments mostly dark brown, second segment sometimes with extensive pale areas; third segment mostly pale although anterodorsal margin is often darkened; arista with approximately nine aristal branches. Face unicolorous, light yellow, appearing dusted, facial setae small, hair-like, numbering three to four; prefrons ratio 1:0.67. Eye ratio 1:0.80; eye-to-cheek ratio 1:0.18. Gena narrow, mostly concolorous with face, becoming grayer posteriorly; genal bristle subequal to dorsalmost postocular bristle. Maxillary palpi pale, yellow.

Thorax. Mesonotum mostly brown to dusted grayish-brown, darker than pleura, generally immaculate but sometimes with some faint darkened areas. Mesopleuron usually with a small, dark brown

maculation spot toward dorsal edge. Femora dark, brownish-black to black, with some dusted gray areas; tibiae generally concolorous with femora, apically pale; tarsi pale although fore tarsi somewhat darkened. Setal fascicle of hind basitarsus dark, black. Wing ratio 1:0.37; costal vein ratio 1:0.54; M_{1+2} vein ratio 1:0.84.

Abdomen. Abdomen ratio in males 1:0.82; length of fourth tergite to fifth tergite ratio in males 1:1.2; fifth tergite ratio in males 1:0.49. Maculation pattern as in most species of loewi species-group. Male genitalia as in diagnosis and in figures 37, 68, and 88.

Type material. --Male holotype: USA, Georgia: Liberty Co., St. Catherines Island, April 24-28, 1972, Thompson and Picchi; HOLOTYPE *Notiphila orientalis* Mathis (red). One male paratype: Manahawkin, 5 September 1910, NJ (New Jersey), 763 (ANSP). One male paratype: DC (Washington, D. C.), 19 August 1899 (OHSU). The male holotype will be deposited with the American Museum of Natural History, New York.

Etymology. --Orientalis is formed from the Latin noun oriens meaning "east," in allusion to the distribution of this species along the eastern coast of North America.

Remarks. --N. orientalis is only known from the southeastern coast of North America, from New Jersey to Georgia. Its biology is unknown.

Notiphila (Notiphila) paludicola new name

(figures 35, 66, 86)

Notiphila unicolor Loew, 1862, Mono. Dipt. N. Amer. Pt. I.

Smithsn. Misc. Coll. 6:137 (preoccupied, Walker, 1860).

Notiphila (Notiphila) loewi, Cresson, 1917, Trans. Amer. Ent.

Soc. 43:44.

Type and type locality. --Male holotype: Mittel St. (green); Loew Coll.; unicolor ♂ ; Type 11128 (red). The holotype is in the possession of the Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts. While dissecting the abdomen, the hind legs and part of the right side of the thorax also came off; these structures have been placed in a microvial with the abdomen.

Diagnosis. --N. paludicola is superficially very similar to N. cressoni, N. loewi, and N. shewelli. These relationships are borne out by the close resemblances in male genitalia, especially the shapes of the internal structures. However, the ventral process of the epandrium of paludicola is distinctive and will serve to distinguish it from the related species. See figures 35, 66, and 86.

Description. --Medium sized fly, length 2.91 mm, with subdued light brownish-gray coloration and few brown markings.

Head. Head ratio 1:0.75; postfrons ratio 1:0.70; frons tan with

mesotriangular area and lateral margins concolorous, lighter, yellowish-gray. Dorsalmost postocular bristle two to three times length of postocellars; one proclinate fronto-orbital seta. First and second antennal segments dark brown although second segment with some pale coloration along dorsal surface; arista with nine arista branches. Face mostly gray with some light yellowish tinges; facial setae weak, two to three on lower portion. Eye ratio 1:0.79; eye-to-cheek ratio 1:0.24. Gena concolorous, light yellowish-gray; genal bristle subequal to dorsalmost postocular. Maxillary palpi pale, yellow.

Thorax. Mesonotum only slightly darker than pleura, both generally immaculate, gray to brownish-gray. Femora gray; all tibiae and tarsi pale yellow. Setal fascicle of hind basitarsus dark, dark brown to black. Wing ratio 1:0.39; costal vein ratio 1:0.40; M_{1+2} vein ratio 1:0.95.

Abdomen. Generally gray with some light greenish-blue coloration along anterior margins of segments. Dorsum of third and fourth segments with two brown spots near the middle, maculation spots much better developed on fourth segment. Male postabdomen as in figures 35, 66, and 86.

Specimens examined. -- N. paludicola is only known from the unique male holotype.

Remarks.-- The new name, N. paludicola, is a replacement for N. unicolor Loew, which is preoccupied (Walker, 1860). The male genitalia of the unique male holotype are distinct from those of N. loewi and are the basis for taking this species out of synonymy. A discussion of the nomenclature of this species and of N. loewi is found in the remarks section under N. loewi.

Notiphila (Notiphila) pauroura new species

(figures 14, 16, 27, 57, 81)

Diagnosis.--N. pauroura appears to be very similar to N. solita but it may be distinguished from the latter by the following combination of characters. The median stripe on the mesonotum is as strongly developed as the lateral vittate markings and throughout its length it is equally evident. Posteriorly, the stripe bifurcates. The other vittate markings on both the mesonotum and mesopleuron are better developed and are more extensive. The dorsum of the scutellum is immaculate and appears to be slightly lighter in color than the mesonotum. The lateral margins of the scutellum are darkened like N. solita. The abdominal dimensions of the males are more similar to most Notiphila species. The fifth abdominal segment is much wider than it is long but the maculation pattern of the abdominal segments resembles that of N. solita although there is considerable variation. The male postabdomen of N. pauroura differs markedly

from that of N. solita. This is especially evident by comparing the shapes of the epandrium and basiphallus. The epandrium of N. pauroura is more rectangular and the basiphallus expands apically. See figures 26 and 27 for a comparison.

Description. --Small to medium sized flies, length 2.80 to 3.55 mm, with yellowish-brown to tannish-gray coloration and brown markings.

Head. Head ratio 1:0.75; postfrons ratio 1:0.66; frons generally unicolorous, brown, pruinose, except for extreme lateral margins and part of the mesotriangular area, especially toward vertex which is much lighter, more gray. Dorsalmost postocular bristles strong, much larger than postocellars; at most with one proclinate fronto-orbital seta. First and second antennal segments dark brown; third segment often mostly pale but usually darkened along anterior and dorsal surfaces; arista with 11 to 13 aristal branches. Face yellow; prefrons ratio 1:0.70; setae of face consisting of three to four small hairs. Eye ratio 1:0.75; eye-to-cheek ratio 1:0.14. Gena very narrow; genal bristle subequal to dorsalmost postocular. Maxillary palpi yellow.

Thorax. Mesonotum darker than pleura, vittate; median stripe strong, bifurcating posteriorly; vittate markings also at level of posterior intra-alar bristle and at presutural bristle level. Lateral margins of scutellum brownish-black as viewed from posterior angle. Meso-pleuron with two vittate markings, one near dorsal edge, other along

ventral edge. Femora grayish-black, pale apically; fore tibiae generally concolorous with femora; other tibiae pale except for dark pre-apical ring on hind tibiae; all tarsi light, yellow. Setal fascicle of hind basitarsus dark. Wing ratio 1:0.47; costal vein ratio 1:0.46; M_{1+2} vein ratio 1:0.85.

Abdomen. Abdomen ratio in males 1:0.82; length of fourth tergite to fifth tergite ratio in males 1:1; fifth tergite ratio in males 1:0.49. Maculation markings on abdomen as in solita, see figures 14 and 16. Male postabdomen as in diagnosis and in figures 27, 57, and 81.

Type material. --Male holotype: Bronx, N. Y., VI-1940-23; Collector S. C. Harriot; HOLOTYPE *Notiphila pauroura* Mathis (red). Allotype, and four female paratypes with the same label data as the type. Other paratypes as follows: one male: Sta. Study Insects, Tuxedo, N. Y., Lily VI-29-1928, Collector, C. H. Curran (AMNH); one male: Snake Hill, New Jersey (AMNH); one male: Fishers, N. Y., 6-VIII '33 (USNM); one male: Ottawa, Ont., 4-VII-1956, J. R. Vockeroth (CNC); one male: Archbold Biol. Station, Highlands Co. Fla., S. W. Frost, 4-7-64 (USNM); one female and two males: Gainesville, Fla., R. P. Esser, coll. 29 IC 63, coll. at light, (FSCA, USNM); two females: Highlands Hamm., St. Pk., Fla., H. V. Weems, Jr., coll. 26 III 63 (FSCA, USNM). The holotype will be deposited with the American Museum of Natural History, New York.

Etymology.--Pauros (Greek meaning "little") plus oura (Greek meaning "tail") in allusion to the small fifth abdominal segment.

Other specimens examined.--Eighteen specimens from the following localities: UNITED STATES: Florida: Lake Co., 2 mi S Tavaves, St. 448 (FSCA); Osceola Co., Kissimmee (ANSP); Polk Co., Lakeland (ANSP). Missouri: Boone Co., Columbia (CU). New York: Tompkins Co., Dryden-Dryden Lake outlet (CU).

Remarks.--N. paoura occurs sympatrically with N. solita throughout most of eastern North America. The biology of this species is unknown. Collection dates are from 1 February to 15 August.

Notiphila (Notiphila) poliosoma new species

(figures 31, 65, 89)

Diagnosis.--N. poliosoma is one of the most distinctive members of the loewi group. Externally, this species is generally characterized by its extensive gray coloration, by its lacteous, pruinose postfrons, and by its almost entirely pale third antennal segment. The male genitalia are also diagnostic. The ventral process of the epandrium is proportionately very long in relation to the rest of the epandrium and the shape of the arms is distinctive to this species. See figures 31, 65, and 89.

Description. --Medium sized flies, length 2.96 to 3.76 mm, with gray to slightly brownish-gray coloration and very few light brown markings.

Head. Head ratio 1:0.75; postfrons ratio 1:0.70; frons mostly lacteous in coloration, mesotriangular area and lateral margins slightly lighter. Dorsalmost postocular bristle approximately equal to genal bristle, larger than postocellars; at most with one fronto-orbital seta. First and second antennal segments mostly dark brown, anterodorsal area of second segment with some pale coloration; third antennal segment mostly pale, yellow, sometimes with some dark tinges along anterodorsal margin; arista with approximately eight aristal branches. Face unicolorous, light yellow; prefrons ratio 1:0.79. Eye ratio 1:0.84; eye-to-cheek ratio 1:0.24. Gena moderately narrow, mostly concolorous with face anteriorly, becoming gray posteriorly; gena bristle subequal to dorsalmost postocular. Maxillary palpi pale, yellow.

Thorax. Mesonotum mostly gray but with some light brown dusted areas, especially posteriorly; scutellum usually lighter gray in coloration than mesonotum. Pleura mostly gray, lighter in color than mesonotum; mesopleuron often with a faint light brown maculation area toward dorsal margin. Femora almost entirely gray but with some darker, charcoal areas, apically pale; tibiae and tarsi entirely pale. Setal fascicle of hind basitarsus dark brown to black. Wing ratio 1:0.43; costal vein ratio 1:0.45; M_{1+2} vein ratio 1:0.81.

Abdomen. Abdomen ratio in males 1:0.67; length of fourth tergite to fifth tergite in males 1:1; fifth tergite ratio in males 1:0.53. Coloration mostly gray, pruinose; third and fourth tergites with two small geminate, light brown maculation spots on anterior margin. Male genitalia as in diagnosis and in figures 31, 65, and 89.

Type material. --Male holotype: Franklin Co., 16 June 1936, Ohio; A. Peterson, collector; HOLOTYPE *Notiphila poliosoma* Mathis (red). Allotype and three paratypes (one male, two females): Carlinville, Illinois, Charles Robertson Collection (collection numbers 6396 to 6399, INHS). Three paratypes (two males, one female): Marais des Cygnes Wildlife Refuge area, Linn Co., Kansas, 5 September 1961, D. L. Deonier, on floating leaf of Potamogeton sp. (ISU, WNM). One female paratype: Kansas University Natural History Reserve, Douglas Co., Kansas, 7 June 1963, D. L. Deonier (ISU). Five males and two female paratypes: Wisconsin, La Crosse Co., 2-3 August 1975, D. F. Sefton (WNM). The holotype will be deposited with the Ohio State University insect collection.

Etymology. --Polios (Greek meaning "gray") plus soma (Greek meaning "body") in reference to the general body color.

Remarks. --This species is distributed in the Midwest of the United States. Collection dates are from 7 June to 5 September.

One of the paratypes from Kansas bore a label reading "on floating leaf of Potamogeton sp." This could be the primary plant to which this species attaches during the larval and pupal stages.

Notiphila (Notiphila) shewelli new species

(figures 32, 63, 79, 183; map 2)

Diagnosis. --N. shewelli belongs to the loewi group and is very similar to N. loewi. However, it may be distinguished from loewi and related species by the following combination of characters. The gena is very wide, eye-to-cheek ratio approximately 1:0.27, and the mesopleuron has an undefined maculation area toward the dorsal margin or it is immaculate. The maculation pattern on the abdomen is variable but it is generally reduced, consisting of light brown geminate spots. The maculation pattern is more pronounced on segments three and four. The male genitalia are distinctive, particularly the ventral extension of the epandrium as shown in figure 32. From a lateral view, the ventral extension projects straight outward without curving dorsally. The ventral margin of the basiphallus also has a very prominent enlargement near the middle. See figures 63 and 79.

Description. --Medium sized flies, length 3.0 to 4.2 mm, with brown to gray-brown coloration and some darker brown markings.

Head. Head ratio 1:0.75; postfrons ratio 1:0.67; frons with lateral

margins and mesotriangular area concolorous, lighter than remainder of frons which is generally light brown, pruinose; dorsalmost postocular bristles larger than postocellar bristles; at most with one proclinate fronto-orbital seta. Antennal segments mostly dark brown except for posteroventral surface of third segment which is orange to brownish-orange; arista with approximately eight aristal branches. Face wide, prefrons ratio 1:0.84, light yellow in color; facial setae numbering two to three, subequal to postocellar bristles. Eye ratio 1:0.82; eye-to-cheek ratio 1:0.27. Gena wide; genal bristle equal or slightly smaller than dorsalmost postoculars. Maxillary palpi pale, yellow.

Thorax. More or less unicolorous although mesonotum is often slightly darker. Mesonotum with very weak medium stripe, some specimens immaculate; mesopleuron usually with maculation spot toward dorsal edge that is undefined, blending with surrounding color, often immaculate. Femora mostly gray, pale apically; tibiae usually concolorous with femora except hind tibiae which has darkened dorsal surface at middle; fore tarsi with blackish brown tinges, mid and hind tarsi mostly pale, yellowish. Setal fascicle of hind basitarsus dark. Wing ratio 1:0.45; costal vein ratio 1:0.45; M_{1+2} vein ratio 1:0.83.

Abdomen. Abdomen ratio in males 1:0.66; length of fourth tergite to fifth tergite ratio in males 1:1.1; fifth tergite ratio in males 1:0.54. Abdomen generally concolorous with thorax; maculation pattern on

dorsum variable, from two very reduced geminate spots on segments three and four to four spots on three and four plus some markings on segments two and five. Male postabdomen as in figures 32, 63, and 79.

Type material. --Male holotype: Ottawa, Ont., 2-VII-1947, G.E. Shewell; Rockcliffe; Associated with *Nymphae advena*; HOLOTYPE *Notiphila shewelli* Mathis (red.). Allotype and 47 paratypes (27 males and 20 females) with the same label data as the type (CNC, USNM, WNM). The male holotype will be deposited with the Canadian National Collection, Ottawa, type number 13775.

Other specimens examined. --Seventy-six specimens from the following localities: CANADA: Ontario: Algonquin Park (ANSP, CNC); Marmora (CNC); Ottawa (CNC); Pembroke (USNM); Perth Road (CNC); Point Pelee (CNC). Quebec: Abbotsford (CNC); Lac Mondor-Ste. Flore (CNC). UNITED STATES: Connecticut: Hartford Co., Avon-Avon Old Farms (FSCA). Maine: Hancock Co., Mount Desert Island (ANSP, WSU). Massachusetts: Nantucket Co., Nantucket (ANSP). Michigan: Cheboyan Co., Douglas Lake (USNM). Minnesota: Lake Co., Basswood Lake (UMN); Roseau Co., Warroad (UMN). Montana: Lake Co., 1 mi S Swan Lake (WNM). New Hampshire: Graffon Co., Franconia Notch (ANSP). New York: Dutchess Co., Stanfordville (CU); Franklin Co., Franklinton (ANSP, NYSM); Orange

Co., Tuxedo-Lily (USNM), Tuxedo-Station Study Insect (AMNH, FSCA). Washington: San Juan Co., Orcas Island, Mount Constitution (ANSP).

Etymology. --The genitive patronym shewelli honors Guy E. Shewell, a distinguished dipterist and friend. Mr. Shewell also collected the type series.

Remarks. --The type series was collected from Nuphar advena (Ait.), a water lily that is widely distributed in eastern North America. This habitat is similar to that reported for the European species N. brunnipes. In the case of N. brunnipes, the eggs were laid on the flower of the water lily but the larvae and pupae developed, attached to the roots of a Typha species.

This species occurs in northern United States and southern Canada (map 2). Collection dates are from 3 June to 9 September.

Notiphila (Notiphila) solita Walker

(figures 15, 17, 25-26, 55; map 1)

Notiphila solita Walker, 1852, Dipt. Saund. p. 406.

Notiphila vittata Loew, 1862, Mono. N. Amer. Dipt. Pt. I.

Smithsn. Misc. Coll. 6:136, NEW SYNONYMY.

Notiphila (Agrolimna) solita, Wirth, 1965, U.S.D.A. Agri. Handbk.

No. 276, p. 748.

Type and type locality. --Male lectotype (here designated): 68·4; US (United States); *solita*; United States, W.W. Saunders. B.M. 1868 - 4; LECTOTYPE *Notiphila solita* Walker by W.N. Mathis (red). The lectotype is in the possession of the British Museum (Natural History). The female holotype of the junior synonym bears the following label data: Dista-Columb. (green); Loew Coll.; *vittata*. ♀ ; Type 11127 (red); *Notiphila vittata* Lw. det W. Wirth '61. This specimen is deposited in the Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts, type number 11127.

Diagnosis. --This species very closely resembles *N. pauroura* and has often been confused with the latter. Like *N. pauroura*, the sides of the scutellum are blackish-brown when viewed from a posterior, oblique angle. *N. solita*, however, may be distinguished from *N. pauroura* by the following combination of characters. The median stripe on the mesonotum is not as evident and in most specimens it is considerably weaker than the lateral mesonotal markings. Usually the stripe is also weakly produced posteriorly. The male fifth abdominal segment of *N. solita* is almost as long as it is wide and the male genitalia are very distinct. The epandrium is broadly produced toward the middle but markedly tapers toward both ends and the venter of the epandrium projects forward, terminating as a broadly U-shaped process. From a lateral view, this process projects upward at an obtuse angle. The

basiphallus of the aedeagus is subelliptical and the lobe of the hypandrial process is as long as the base.

Description. --Medium sized flies, length 2.81 to 4.25 mm, olive gray to light tannish-gray in coloration with brown markings.

Head. Head ratio 1:0.71; postfrons ratio 1:0.70; frons with extreme lateral margins concolorous with face; mesotriangle and surrounding area of frons nearly concolorous, brownish-gray, pruinose although the triangular area is slightly lighter. Dorsalmost postocular bristles much larger than postocellars, approximately twice their size; often without proclinate fronto-orbital setae or if present, very small. First and second antennal segments dark brown except for anterodorsal surface of second which is yellowish; third antennal segment mostly yellowish-orange, darkened apically and dorsally; arista with 10 to 12 aristal branches. Face light grayish-yellow; prefrons ratio 1:0.61; facial setae with three to four hairs which are subequal to postocellar bristles. Eye ratio 1:0.75; eye-to-cheek ratio 1:0.14. Gena very narrow, concolorous with face anteriorly, becoming gray posteriorly; genal bristle subequal to dorsalmost postocellar. Maxillary palpi yellow.

Thorax. Mesonotum darker than pleura; median stripe of mesonotum weakly developed, especially posteriorly; mesonotum with vittate markings extending from anterior to presutural bristle, posterior

through anterior supra-alar bristle area, across dorsum of notopleuron weakly developed. Lateral margins of scutellum appearing blackish-brown as viewed from posterior angle. Mesopleuron with distinct vittate markings toward dorsal surface, extending from prospiracle to larger bristles along posterior margin and along the posteroventral edge. Femora unicolorous, grayish-black, apically pale; tibiae various, fore tibiae mostly dark, hind tibiae with only darkened preapical ring. All tarsi pale, yellow. Setal fascicle of hind basitarsus with three dark setae. Wing ratio 1:0.41; costal vein ratio 1:0.44; M_{1+2} vein ratio 1:0.67.

Abdomen. Abdomen ratio in males 1:0.50; length of fourth tergite to fifth tergite ratio in males 1:1.4; fifth tergite ratio in males 1:0.84. Tergites with maculation pattern as in figures 15 and 17. Male postabdomen as in diagnosis and in figures 25-26 and 55.

Specimens examined. --One hundred eleven specimens from the following localities: CANADA: Manitoba: International Peace Gardens-Turtle Mountain Forest Reserve (CNC). Ontario: Grand Bend (CNC); Kingston (ANSP); Marmora (CNC); Ottawa (CNC); Point Pelee (CNC). Quebec: Abbotsford (CNC); Fairy Lake (CNC); Kazubazua (CNC); Norway Bay (CNC). UNITED STATES: Florida: Alachua Co., Gainesville (CNC); Dade Co., near Mahogany-Everglades National Park (FSCA), Highlands Hammock State Park (FSCA), Flamingo to

Mahogany--Hammock in Everglades National Park (FSCA); De Soto Co., Fort Ogden (CNC); Duval Co., Jacksonville (ANSP). Illinois: Cook Co., River Forest (USNM); Lake Co., Waukegan (ANSP, INHS); McHenry Co., Fox River Grove (USNM), McHenry (USNM); Winnebago Co., Rockford (AMNH). Indiana: Tippecanoe Co., LaFayette (USNM). Iowa: Dickinson Co., Iowa Lakeside Laboratory (ISU); Hamilton Co., Goose Lake (USNM). Maryland: Calvert Co., Chesapeake Beach (USNM); Charles Co., Popes Creek (ANSP, MCZ). Michigan: Manistee Co., Pierport (MSU); Monroe Co., Monroe (ANSP, USNM); Shiawassee Co., Owosso (USNM); Wayne Co., Detroit (USNM); Grosse Ile (USNM). Nebraska: Cherry Co., Sanek Falls (USNM). New Jersey: Forest Hill (ANSP); Burlington Co., Riverton (MCZ); Essex Co., Newark (AMNH, ANSP, FSCA), W. Orange (USNM); Gloucester Co., Westville (MCZ). Ohio: Erie Co., Sandusky (ANSP, OHSU); Franklin Co. (OHSU); Fulton Co., Wauseon (ANSP, OHSU); Portage Co., 1 mi E Kent (KSU), 3 mi E Kent (WNM), 4 1/2 mi E Kent (KSU), 6 mi S Kent (KSU), Mogodore Reserve (KSU); Wayne Co., 1/2 mi S Rittman (KSU, USNM). Pennsylvania: Crawford Co., Hartstown (USNM); Philadelphia Co., Philadelphia (MCZ). Texas: Galveston Co., Dickinson (ANSP). Virginia: Independent City Co., Alexandria (ANSP, USNM).

Remarks.--N. solita is distributed throughout eastern North America, although collecting records from the Southeast are few (map 1).

Collection dates are from 9 April to 18 September.

Until the present study, the nomenclature of the senior synonym has been confused. Most recently Wirth (1965) tentatively placed this name under the subgenus Agrolimna. Through the kindness of Dr. Brian H. Cogan of the British Museum (Natural History) I was permitted to examine Walker's type and although it is a female specimen, I am confident that it is this species.

This species occurs sympatrically with N. pauroura, its most closely related congener. Its biology is unknown.

Subgenus Agrolimna Cresson

Notiphila (Agrolimna) Cresson, 1917, Trans. Amer. Ent. Soc.

43:48; type-species, Notiphila scalaris Loew, by original designation.

Diagnosis.--The subgenus Agrolimna is distinguishable from the nominate subgenus Notiphila by the following characters: usually there are four dorsal extensor bristles on the mesotibiae although occasional specimens are encountered with three or five bristles; the mesotibiae and mesofemora never have a comb-like row of setae along the posteroventral margins; the facial setae are more numerous,

numbering up to eight, and they are generally smaller, hair-like; there are two pairs of proclinate, fronto-orbital setae laterad to the larger reclinate bristle; the antennae and maxillary palpi are usually black; and the darker abdominal markings are often fasciated or occupy most of the dorsum of the tergites, particularly abdominal tergites three and four. The male postabdomen is diagnostic and further supports the subgeneric status. The epandrium usually does not bear any processes on the ventral margin; the surstyli are large, trigonal but sometimes with a secondary lobe; the hypandrial process is large, often with preapical enlargements. The hypandrial receptacle is either cup-shaped or is divided with each half broadly shaped like a half circle or a parallelogram. The operculum and extending process of the female ventral receptacle are plain, without ornate processes, and the operculum is considerably longer than wide. The sixth and seventh abdominal segments of the female postabdomen usually are not well sclerotized and frequently little remains except for setae and small sclerotized spots around the setal bases. The larvae and pupae of Agrolimna can be separated easily from those of the subgenus Notiphila by comparing the length of the breathing tube with the length of the main body. The breathing tube of Agrolimna species is well over half the body length.

Description. --Small to medium sized flies, length 2.56 to 4.58 mm, background coloration grayish-brown to brown with darker brown to black markings.

Head. Head ratio 0.68 to 0.79 (mean of 0.74); postfrons ratio 0.49 to 0.75 (mean of 0.60); frons generally with mesotriangular area concolorous with lateral margins, lighter than remainder of mesofrons; darker areas often tinged with charcoal, sometimes appearing velvety and distinctly contrasting; some specimens with scattered green reflections or with anterior margin colored with gray; frons usually lightly pruinose. Two pairs of small proclinate fronto-orbital setae laterad to the larger reclinate bristle. Antennal segments usually entirely black although many exceptions exist. Face niveous to light yellow, usually appearing dusted; facial setae small, hair-like, usually extending for more than half face height; prefrons ratio 0.54 to 0.75 (mean of 0.68). Eye ratio 0.69 to 0.83 (mean of 0.77); eye-to-cheek ratio 0.12 to 0.23 (mean of 0.19). Maxillary palpi usually dark brown or black, pale in a few species.

Thorax. Mesonotum usually immaculate but often vittate, darker than pleura; scutellum never appearing dark brown to black on lateral margins when viewed obliquely from posterior angle. Legs usually dark except for tarsi which are generally pale; mesofemora and mesotibiae without dense row of comb-like setae on posteroventral margins; mesotibiae with four prominent dorsal extensor bristles. Setal

fascicle of hind basitarsus usually pale, if dark then only one seta appearing so. Wing ratio 0.37 to 0.46 (mean of 0.42); costal vein ratio 0.36 to 0.60 (mean of 0.48); M_{1+2} vein ratio 0.80 to 1.20 (mean of 0.98).

Abdomen. Abdomen ratio in males 0.61 to 0.82 (mean of 0.73); length of fourth tergite to fifth tergite ratio in males 0.63 to 1.40 (mean of 0.92); fifth tergite ratio in males 0.45 to 0.70 (mean of 0.58). Darker markings usually fasciated, contrasting with lighter colored posterior margins and median stripes; sometimes occupying entire dorsum of tergite; fascia appearing most strongly on tergites three and four, fifth tergite often entirely dark. Male postabdomen as follows: epandrium usually with truncate ventral margin except for species of pulchrifrons group, often with small median indentation; surstyli large, attached basally to epandrium and small process above hypandrial process, usually subtriangular in shape but often with secondary lobe which bears three or four small setae; hypandrial process large, much longer than wide, with preapical enlargement, appearing sinuate above; sclerotized basiphallus tapering apically; membranous distiphallus plain or with numerous small, black spinules; and hypandrial receptacle as one lightly sclerotized cup-shaped structure or rather flat and with a median division. See diagnosis for discussion of female postabdomen.

Discussion. -- This is primarily a New World taxon although a few species occur in most of the faunal realms. In western North America, the species of Agrolimna predominate both in number of species and especially in abundance. Only four species of this subgenus occur exclusively in eastern North America, N. scalaris, N. elophila, N. furcata, and N. bispinosa. The latter two species are restricted to costal salt marshes.

Frequently, several Agrolimna species are found occurring together. This seems to be particularly true of N. decoris, N. macrochaeta, and N. olivacea. All three species are widespread and abundant. The sympatric occurrence of two or more species has facilitated species recognition and is the prime source of evidence supporting the morphological integrity and limits of the included species.

Agrolimna species from North America may be conveniently divided into three species-groups. These groups are recognized primarily from a morphological basis. A more detailed account of these groups is found below.

Key to Nearctic Species of the Subgenus Agrolimna

- | | | |
|----|---|---|
| 1. | Palpi pale, yellow to brownish-orange, at least | |
| | apically | 2 |
| - | Palpi entirely dark, usually black | 7 |

- 2 (1). Primary setae along posterior margin of fourth tergite very long in males, approximately twice the length of fourth tergite; fifth abdominal segment of males with two stout, closely appressed apical bristles; setal fascicle of hind basitarsi entirely pale 3
- Marginal setae of fourth tergite not as long in males, subequal to length of fourth tergite; fifth abdominal segment of males without apical stout bristles; setal fascicle of hind basitarsi various 4
- 3 (2). Antennal segments entirely pale, yellow; arista usually with ten or fewer branching hairs; fifth abdominal segment of males subconical, not produced posteriorly into long, slender process bispinosa Cresson
- Antennal segments mostly dark, basal portion of third segment often reddish-yellow; arista usually with ten or more branching hairs; fifth abdominal segment of male produced posteriorly into slender process as long as apical setae furcata (Coquillett)
- 4 (2). Setal fascicle of hind basitarsi with at least one brown or black seta; hind tibiae of male with prominent crooked seta arising from apical anterior surface 6
- Setal fascicle of hind basitarsi entirely pale; hind tibiae of male without crooked seta 5
- 5 (4). Antennal segments entirely dark; dorsum of mesothorax and scutellum immaculate; frons not

- conspicuously vittate, lateral margins never
velvety black pallidipalpis Cresson
- Third antennal segment at least partially pale;
second segment sometimes pale; dorsum of meso-
notum and usually scutellum with brown stripe;
frons vittate, lateral margins often velvety black,
distinctly contrasting with mesofrons . . . pulchrifrons Loew
- 6 (4). Dark fascia of abdominal segments three and four
conspicuous with inner portion reaching posterior
margin of segment, trigonal hamifera Wheeler
- Dark fascia of abdominal segments three and four
weakly developed, inner portion not attaining
posterior margin of segment scoliochaeta n. sp.
- 7 (1). Setal fascicle of hind basitarsi with at least one
dark brown or black seta 8
- Setal fascicle of hind basitarsi entirely pale regard-
less of tarsal color 10
- 8 (7). Fore tarsi yellow; mesopleura with brown
spot deserta n. sp.
- Fore tarsi dark brown to black; mesopleura usually
lacking well defined brown spot 9
- 9 (8). Black seta of hind basitarsi long, at least one-
third length of basitarsus in males; fifth tergite of
females with mesal apical membraneous
area macrochaeta Loew
- Black seta of both sexes short, subequal to pale
setae; fifth tergite of female without membraneous
areas decoris Williston

- 10 (7). Dark fascia of fourth abdominal segment scarcely attaining lateral margin, not generally continuing on ventral surface 11
- Dark fascia of fourth abdominal segment broadly attaining lateral margin, continuing on ventral surface 18
- 11 (10). All tarsi dark brown to black uliginosa Haliday (melanic form)
- Mid and hind tarsi generally pale, yellow to orange 12
- 12 (11). Mesopleura with brown maculation area distinct from lighter background color; mesonotum vittate aenigma Cresson
- Mesopleura without definite brown maculation area; mesonotum not vittate 13
- 13 (12). Dark fascia of fourth abdominal tergite subdued, not contrasting greatly with lighter areas toward posterior margin 14
- Dark fascia of fourth abdominal tergite distinct, decidedly contrasting with lighter areas 15
- 14 (13). Preapical enlargement of hypandrial process with apical margin angulate, not rounded or straight, see figures 119 and 171 uliginosa Haliday (Great Lakes form)
- Preapical enlargement of hypandrial process with apical margin evenly rounded or straight, not angulate, see figures 120 and 170 uliginosa Haliday (pale form)

- 15 (13). Eight or fewer aristal branches; dark fascia of fourth abdominal tergite subquadrate to triangular; aedeagal apodeme triangular (Long Island, New York) elophila n. sp.
- Usually ten or more aristal branches; dark fascia of fourth abdominal tergite rectangular to angulate; aedeagal apodeme subquadrate 16
- 16 (15). Ventral margin of aedeagal apodeme scalloped; hypandrial process as in figure 115 paludia n. sp.
- Ventral margin generally straight; hypandrial process not as above 17
- 17 (16). Preapical enlargement of hypandrial process preceded by a distinct depression, apical surface less angulate and apices projecting, see figure 113 olivacea Cresson
- Preapical enlargement of hypandrial process preceded by a more gently formed depression, apical surface or enlargement more angulate to overall plane of process deonieri n. sp.
- 18 (10). All tarsi generally dark brown to black 21
- At least mid and hind tarsi yellow 19
- 19 (18). Fore tarsi entirely dark, black or dark brown minima Cresson
- Fore tarsi generally pale, slightly darkened in some specimens 20
- 20 (19). Mesopleura with definite brown spot; antennal segments entirely black scalaris Loew

- Mesopleura lacking definite spot; base of third antennal segment usually reddish-yellow . . . sicca Cresson
- 21 (18). Mesonotum with median stripe which bifurcates posteriorly 22
- Mesonotum generally immaculate 23
- 22 (21). Mesopleura with distinguishable brown maculation spot near middle; dark abdominal fascia on third, fourth, and fifth tergites extending to posterior margin; male genitalia as in figures 103 and 123. . atrata n. sp.
- Mesopleura generally lacking distinguishable brown maculation spot near middle; dark abdominal fascia terminating before posterior margin; male genitalia as in figures 118 and 133-134 quadrisetosa Thomson
- 23 (21). Larger species, length up to 4.1 mm; male genitalia as in figure 105 atripes Cresson
- Generally smaller species, length seldom over 3.45 mm; male genitalia as in figures 112 and 166. nanosoma n. sp.

Pulchrifrons Species-Group

Only three Nearctic species are included in this group. Characters distinguishing the group are as follows. The maxillary palpi are pale; usually one or more of the antennal segments has some pale areas; the hypandrial process of the male postabdomen is very long and slender; and the ventral margin of the epandrium is somewhat produced into a symmetrical process (see species figures).

An Ethiopian species, N. bipunctata Loew, apparently shares many of the characters that define this group and it may prove to belong here when specimens are available for comparison. That species, like N. pulchrifrons, also has velvety black patches on the lateral margins of the frons.

The Nearctic species of this group are limited in distribution to the southern half of this region but extend well into the Neotropics.

Notiphila (Agrolimna) pulchrifrons Loew

(figures 100, 139-145, 155; map 7)

Notiphila pulchrifrons Loew, 1872, Berlin. Ent. Ztschr. 16:102.

Notiphila (Agrolimna) pulchrifrons, Cresson, 1917, Trans. Amer. Ent. Soc. 43:55.

Notiphila (Agrolimna) frontalis var. signata Cresson, 1917, Trans. Amer. Ent. Soc. 43:57.

Notiphila (Agrolimna) signata, Wirth, 1965, U.S.D.A. Agri. Handbk.

No. 276, p. 748.

Types and type locality. --Male holotype: Texas Left. (?) (green); Loew Coll.; pulchrifrons Lw. Cent. X.: Type 11130 (red). The holotype is deposited with the Museum of Comparative Zoology, Cambridge, Massachusetts, type number 11130. Loew's original description also cited Belfrage as the collector. The label data of the male holotype of N. signata are as follows: Thalman, April 28, 11 (1911) Ga.; Holo-TYPE ♂, *Notiphila signata*, E.T. Cresson Jr (red); HOLOTYPE Cornell U., No. 1663.1 (red). The type of N. signata is in the possession of the Cornell University insect collection, Ithaca, New York, type number 1663.1. Cresson's original description of N. signata also listed two male and four female paratopotypes.

Diagnosis. --This species is one of the most distinctive members of the subgenus Agrolimna and it is not likely to be confused with any other species. It may be distinguished from all other species by its small size, its conspicuously vittate mesonotum, its pale maxillary palpi and antennal segments, and by its velvety black parafrenal stripes. The male genitalia are also diagnostic. See figures 100, 139-145, and 155.

Description. -- Small sized flies, length 2.49 to 3.12 mm, with light brown to grayish-brown background coloration and brown markings.

Head. Head ratio 1:0.77; postfrons ratio 1:0.53; frons with two conspicuously marked, velvety black parafrontal stripes; remainder of frons whitish-gray, but often with a mesofrontal stripe also. Dorsalmost postocular bristles small, only slightly larger than postocellars; usually with two pairs of proclinate fronto-orbital setae. Antennal segments one and two mostly pale but with some darker brown coloration; third antennal segment mostly yellowish-orange but usually darkened on anterodorsal margin; arista with approximately 11 aristal branches. Face yellow, subcarinate; prefrons ratio 1:0.61; facial setae very small, hair-like, numbering six to seven. Eye ratio 1:0.77; eye-to-cheek ratio 1:0.19. Gena narrow, concolorous with face anteriorly, becoming grayer posteriorly; genal bristle nearly twice the size of dorsalmost postocular bristles. Maxillary palpi pale, yellowish-orange.

Thorax. Mesonotum darker than pleura, slightly lighter in coloration anteriorly, conspicuously vittate with a median, bifurcating stripe and two stripes on either side. Scutellum also vittate. Mesopleuron usually with a darker maculation area, otherwise pleura mostly grayish-brown. Femora and tibiae mostly dark brown to black but with considerable gray dusted areas, apically pale; tarsi pale. Setal

fascicle of hind basitarsus pale. Wing ratio 1:0.43; costal vein ratio 1:0.56; M_{1+2} vein ratio 1:0.94.

Abdomen. Abdomen ratio in males 1:0.81; length of fourth tergite to fifth tergite ratio in males 1:0.71; fifth tergite ratio in males 1:0.45. Markings on abdomen variable, fascia-like to guttate. Male genitalia as in figures 100, 139-145, and 155.

Specimens examined. -- One thousand four hundred thirty-nine specimens from the following localities: UNITED STATES: Arizona: Catalina Mountains (UA, USNM); Granite Dell (KU); Cochise Co., Chiricahua Mountains (USNM); Herb Martyr Dam (FSCA, USNM); Sunnyside Canyon-Huachuca Mountains (ANSP, KU, USNM); Coconino Co., Bill Williams Forest (ANSP, KU), Oak Creek Canyon-Sedona (KU, MSU, USNM); Maricopa Co., Wickenburg-Hassayampa River (USNM), Santa Cruz River (UA); Santa Cruz Co., Ruby (KU), Sonoita Creek - 6 mi E Patagonia (KSU); Gila Co., E Verde River - 5 mi N Payson (WNM); Yavapi Co., Prescott (USNM). California: Mojave Desert (USNM); Ortega Highway (USNM); Alameda Co., Sunol Valley Park (CAS); Butte Co., Oroville (CAS); Inyo Co., 3 mi N Lone Pine (UCB), Shoshone (CAS), Warm Sulphur Springs (UCR); Kern Co., Bakersfield (ANSP, CAS), Kernville (KU, USNM), Onyx (KU, USNM), Rosamond (KU); Los Angeles Co., Angeles Bay Gulf (ANSP, CAS), Azusa (USNM), Los Angeles (CAS), Los Angeles River (ANSP, CAS);

Mendocino Co., Echo (KU); Monterey Co., Pleyto (CAS); Orange Co., Atwood (USNM), Buena Park (USNM), Capistrano Hot Springs (USNM), San Juan Hot Springs (USNM); Riverside Co., Anza (KU), Deep Canyon (UCR, USNM), Lake Hemet (UCR), Palm Canyon-Palm Springs (CNC), Riverside (USNM); Sacramento Co. (KU); San Bernardino Co., Cajon (USNM), Cajon Pass (USNM), Chino (USNM), Morongo (USNM), Victorville (CU, USNM); San Diego Co. (KU), Borego (UCB), Descanso (ANSP), Desert edge (ANSP, CAS), 25 mi N Ensenada (USNM), Jacumba Springs (KU, USNM), Lake Henshaw Dam (UCR, USNM), Mount Buckman (CAS), Warner Spring (UCD); San Luis Obispo Co., Alamo Creek (UCB, USNM); Santa Clara Co., San Antonio Valley (UCB); Sonoma Co., Cloverdale (CU); Sutter Co., Live Oak Park (USNM); Tulare Co., Terminus Reservoir (UCR), Three Rivers (ANSP, USNM), Visalia (USNM); Ventura Co., Piru (UCB, USNM). Colorado: Regnier (AMNH). Georgia: Glynn Co., Thalman (ANSP, CU); Liberty Co., Saint Catherines Island (AMNH). Indiana: Vanderburgh Co., Evansville (ANSP, USNM). Kansas: Hamilton Co., (KNSU); Kingman Co. (ANSP, KU); Mitchell Co. (KNSU); Pottawatomie Co. (KNSU); Riley Co., Manhattan (KNSU). Maryland: Cecil Co., Chesapeake Beach (USNM). Mississippi: Noxubee Co., Shuqualak (KU). Missouri: Lawrence Co. (WNM); Saint Louis Co., Saint Louis (USNM). Nebraska: Chase Co., 10 mi SW Imperial (UN); Hamilton Co., Hordville (UN, USNM). Nevada: Washoe Co., Sparks (CAS).

New Mexico: Colfax Co., Springer (USNM); Grant Co., Mangus Springs - 11 mi S Cliff (WNM); Hidalgo Co., 20 mi S Rodeo (UCR); Sandoval Co., Jemez Mountains (ANSP); San Miguel Co., 1/2 mi NE Montezuma (WNM). Ohio: Champaign Co., Cedar Swamp (KSU); Franklin Co. (OHSU). Oklahoma: Platt National Park (ANSP).

Texas: Weser (KU); Brewster Co., Big Bend National Park (USNM), Marathon (KU), 5 mi s Marathon (USNM); Brooks Co. (KU); Comal Co., New Braunfels (ANSP); Galveston Co., Dickinson (ANSP), Galveston (USNM); Gissespie Co., Pedernales River (USNM); Hays Co., San Marcos (USNM); Jackson Co. (KU); Jim Wells Co. (KU, USNM); Kerr Co., Hunt-Guadalupe River (USNM), Kerrville (ANSP), 10 mi NE Kerrville (UMN), Henke Pond-Kerrville (USNM); Kimble Co., Roosevelt (USNM); Llano Co., Enchanted Rock (USNM); Sutton Co. (KU); Travis Co., Austin (USNM); Uvalde Co., Garner State Park (USNM); Val Verde Co., 20 mi E Del Rio (USNM), Devils River-Juno (CNC, USNM), Garner State Park (USNM); Walker Co., Sam Houston National Forest-Stubblefield Lake Camp (USNM). Utah: Emery Co., Green River (UMN, USU); Grand Co., Moab (ISU, UMN); Kane Co., Kanab River (USU); Sanpete Co., Fairview (USU); San Juan Co., 6 1/2 mi N LaSal Junction (WNM); Washington Co., Leeds (UMN, USNM, USU); Wayne Co., Capital Reef (USU).

Remarks.--N. pulchrifrons is one of the most variable Notiphila species. The variation tends to be geographically limited and some of the varying populations have been given subspecific and/or specific status. I prefer not to recognize these categories until a more thorough study is made and more Nearctic material becomes available. Most of the variation is limited to the development of the mesonotal stripes and to the degree of velvet pruinosity expressed on the lateral margins of the frons. The conformation of the ventral margin of the epandrium also varies from population to population.

This species, together with N. hamifera and N. scoliochaeta form a fairly distinct group which I suspect is primarily tropical in origin. N. pulchrifrons occurs throughout the tropics under the name of N. frontalis.

N. pulchrifrons is distributed from California to Georgia, as far north as Nebraska and Indiana, and southward into the tropics of Central America (map 7). Collection dates are from 15 March to 16 November.

Notiphila (Agrolimna) hamifera Wheeler

(figures 94, 102, 146, 469)

Notiphila (Agrolimna) hamifera Wheeler, 1961, Southwest Nat. 6:87.

Types and type locality.--Male holotype: Oak Creek Cany Ariz, 6·21·51; M. R. Wheeler Collectors; Holotype Notiphila hamifera

Wheeler. The holotype and allotype are deposited with the National Museum of Natural History, Washington, D.C.; no type number is indicated on the specimen or in the description. Wheeler also listed two male paratopotypes and one male paratype from Deckers, Colorado, August 25, 1950.

Diagnosis.--N. hamifera resembles N. scoliochaeta very closely but may be distinguished with the following combination of characters. The maculation pattern on the abdomen of N. hamifera is more extensively developed; the fascia reach the lateral and posteromedial margins and are much darker in color. Generally the base of the third antennal segment is yellowish and specimens of N. hamifera are usually larger in size. The long hypandrial process of the male genitalia is slightly sinuate dorsally and apically, and the enlarged prebasal section is more extensive. See figures 101 and 102 for a comparison.

Description.--Small to medium sized flies, length 3.40 to 4.30 mm, with grayish-brown coloration and dark brown markings.

Head. Head ratio 1:0.78; postfrons ratio 1:0.60; two pairs of proclinate fronto-orbital setae; postocular bristles small, slightly larger than facial setae; large, light-colored triangular area surrounding ocellar triangle and extending to anterior margin of frons, unicolorous with extreme lateral margins of frons; remainder of frons

subdued, charcoal black in color. Antennae generally black except for base of third antennal segment which is yellowish; 10 to 12 aristal branches. Face whitish-yellow; prefrons ratio 1:0.63; facial setae hair-like. Eye ratio 1:0.77; eye-to-cheek ratio 1:0.25; genal bristle distinct. Maxillary palpi yellowish-orange.

Thorax. Mesonotum vittate; mesopleuron with brown maculation toward dorsal border. Ground color of thorax generally unicolorous although pleura are usually lighter, more gray. Femora grayish-black; fore tibia partially darkened apically, otherwise yellow; other tibiae light, yellowish-orange except for darkened ring on hind tibia; hind tibia with apical process as in figure 94; all tarsi yellow. Setal fascicle of hind basitarsus light, yellow. Wing ratio 1:0.41; costal vein ratio 1:0.48; M_{1+2} vein ratio 1:0.91.

Abdomen. Abdominal ratio 1:0.81; length of fourth tergite to fifth tergite ratio in males 1:0.96; fifth tergite ratio in males 1:0.64. Fascia of abdominal tergites dark brown, extensive, attaining lateral and posteromedial margins. Male postabdomen as in diagnosis and figures 102, 146, and 149.

Specimens examined. -- Eleven specimens from the following locality:
UNITED STATES: Arizona: Coconino Co., Oak Creek Canyon
(USNM).

Remarks.--This species could only be confused with N. scoliochaeta but it is distinguishable from the latter by the characters given in the diagnosis and key. Although I did not examine the male paratype from Decker, Colorado, I suspect that it is a specimen of N. scoliochaeta since all specimens that look like N. hamifera or N. scoliochaeta other than those from the type locality of N. hamifera are of that species.

Notiphila (Agrolimna) scoliochaeta new species

(figures 101, 147, 150-151)

Diagnosis.--Specimens of N. scoliochaeta are very similar to specimens of N. hamifera, however, N. scoliochaeta may be distinguished from the latter as follows. N. scoliochaeta is generally smaller, although some specimens are nearly as large as N. hamifera. The maculation pattern of the abdominal fascia is much less developed in N. scoliochaeta, contrasting only slightly with the background coloration, and the median extensions never reach the posterior margins of the tergites. The base of the third antennal segment is usually black or if it is lighter in color, the lightened area is not as extensive. The male postabdomen of N. scoliochaeta is also quite similar to that of N. hamifera but the long hypandrial process is evenly arched apically and not sinuate above and the prebasal swelling is not as extensive. Compare figures 101 and 102.

Description. --Small to medium sized flies, length 3.4 to 4.2 mm, with grayish-brown to gray coloration.

Head. Head ratio 1:0.71; extreme lateral margins of frons whitish-gray, concolorous with median triangle; in between areas of frons dull black; anterior to front ocellus is a brown spot; postfrons ratio 1:0.57; postocular bristle small, subequal to facial setae; two pairs of subequal proclinate fronto-orbital setae. Antennal segments black, sometimes base of third segment lightened in color; 10 to 12 aristal branches; face subdued, golden yellow; parafacials usually lighter; prefrons ratio 1:0.71; facial hairs small, hair-like. Eye ratio 1:0.71; eye-to-cheek ratio 1:0.25; genal bristle approximately subequal to posterior ocellar bristles; gena whitish-gray. Maxillary palpi light, orangish-yellow.

Thorax. Mesonotum brownish-gray with rather subdued median stripe which bifurcates posteriorly; mesopleuron with only a slightly brownish area, otherwise gray, concolorous with other pleura. Femora blackish-gray; fore tibiae basally yellow, apically darkened, black; other tibiae yellow; all tarsi yellow, although some with darkened ring near middle; hind tibiae with apical processes as in N. hamifera (figure 94). Setal fascicle of hind basitarsus light, yellow. Wing ratio 1:0.44; costal vein ratio 1:0.48; M_{1+2} vein ratio 1:0.93.

Abdomen. Abdominal ratio in males 1:0.76; length of fourth tergite to fifth tergite ratio in males 1:1; fifth tergite ratio in males 1:0.65.

Maculation pattern on dorsum of abdominal segments weakly developed, fascia generally does not reach the lateral or posterior margins.

Male postabdomen as in diagnosis and in figures 101, 147, and 150-151.

Type material. --Male holotype: UTAH San Juan Co, 6 1/2 mi N LaSal Junc, 22 June 1973, Wayne N. Mathis; HOLOTYPE, *Notiphila scoliochaeta* Mathis (red). Allotype and 26 paratypes (12 males and 14 females) with the same label data as the type. One male paratype: Arizona, Patagonia, Sonoita Crk, X-2-70; B.A. Foote, Collector.

The type, allotype, and two paratypes will be deposited in the National Museum of Natural History, Washington, D.C., type number 73547.

Etymology. --Scoli (Greek meaning "curved" or "crooked") plus chaeta (Greek meaning "bristle") in allusion to the distinct, crooked bristle on the apex of the hind tibia.

Remarks. --This species was collected in southern Utah along the banks of a small fresh water creek. The only emergent vegetation was a Carex species. The adults of this species, N. pulchrifrons, and a Chrysops species (Tabanidae) were abundant at this locality. B.A. Foote also collected a male specimen from the Patagonia Mountains in southern Arizona.

Like N. hamifera, this species has a prominent, crooked seta on the apices of the hind tibiae in the male. I suspect that other species related to this species-group will be found in Mexico when the Notiphila fauna from that area is better known.

Collection dates are from 22 June to 2 October.

Furcata Species-Group

N. bispinosa and N. furcata are the only North American species belonging to this group, which is characterized by the Dichaeta-like development of the male abdomen. The male genitalia, however, are similar to those of the scalaris group to which the furcata group is closely related. This is particularly true of N. bispinosa.

The distribution of both species is along the Atlantic and Gulf coasts of North America.

A Japanese species, N. sekiyai Koizumi, may also belong to this species-group. Miyagi (1966) redescribed that species and mentioned that the fifth segment of the male abdomen is produced into a cylindrical tubercle with two stout, upcurved bristles apically. I have not examined any specimens of this species.

Notiphila (Agrolimna) bispinosa Cresson

(figures 92, 96, 98, 153; map 8)

Notiphila (Agrolimna) bispinosa Cresson, 1917, Trans. Amer.

Ent. Soc. 43:58.

Type and type locality.--Male holotype: Barnegat Cty Ju (nction), VIII-11-10, N. J.: ♂; TYPE Notiphila BISPINOSA, E. T. Cresson, Jr. 6114. The holotype is in the Academy of Natural Sciences of Philadelphia. Cresson's original description gives H.S. Harbeck as the collector of the type although the type specimen does not presently have any indication of a collector. Cresson also listed a male paratopotype.

Diagnosis.--This species is very distinctive and is not likely to be confused with any others of the subgenus Agrolimna. It is similar to N. furcata in the development of the secondary male sex structures of the fourth and fifth abdominal tergites although they are not as elaborate or Dichaeta-like. The posterior end of the fifth tergite does not project backward into a slender process but it does bear two or three terminal bristles. Further, the large bristles along the posterior margin of the fourth tergite are not as strongly developed nor as numerous as those of N. furcata. The antennal segments of N. bispinosa are entirely yellow and generally there are fewer arista

branches. The hypandrial process of N. bispinosa differs in several details from that of N. furcata. For a comparison, see figures 98 and 99.

Description. --Small to medium sized flies, length 2.86 to 4.15 mm, with olive brown to grayish-brown coloration and brown markings.

Head. Head ratio 1:0.75; postfrons ratio 1:0.59; lateral margins and median triangular area of frons concolorous, light brown, pruinose; remaining area of frons blackish-gray with some metallic green reflections. Dorsalmost postocular bristles large, much larger than postocellar bristles; two pairs of proclinate, fronto-orbital setae. Antennae entirely pale, yellow but sometimes with darker discoloration on third segment; usually eight to ten arisal branches. Face cinereous to niveous; prefrons ratio 1:0.67; facial setae small, hair-like. Eye ratio 1:0.81; eye-to-cheek ratio 1:0.16. Genal bristle subequal to dorsalmost postocular; gena not sharply contrasting with facial color. Maxillary palpi pale, yellow.

Thorax. Mesonotum immaculate, olive gray anteriorly becoming light brown posteriorly. Mesopleuron with a brown maculation spot; pleura in general lighter in coloration than mesonotum, becoming more grayed ventrally. Femora grayish-black; fore tibiae darkened, black though the apices are pale, yellow; mid and hind tibiae and all tarsi pale, yellow. Setal fascicle of hind basitarsus entirely pale.

Wing ratio 1:0.40; costal vein ratio 1:0.53; M_{1+2} vein ratio 1:0.95.

Abdomen. Abdomen ratio 1:0.71; length of fourth tergite to fifth tergite ratio in males 1:0.95; fifth tergite ratio in males 1:0.60.

Fascia of abdominal tergites light brown but contrasting with gray ground color; fascia extending to lateral margins and on ventral surfaces. Posterior margin of fourth tergite with seven to nine large bristles, almost twice the length of fourth tergite; fifth tergite with dorsum generally dark brown, terminating with two to three stout bristles, see figure 96. Male postabdomen as in figures 98 and 153.

Specimens examined. -- Four hundred three specimens from the follow-

ing localities: CANADA: Nova Scotia: Backman's Beach (CNC), Lockeport (CNC), Petete Riviere (CNC), Petpeswick (CNC), Smith's Cove (CNC, USNM). Prince Edward Island: Alberton (CNC).

UNITED STATES: Connecticut: Fairfield Co., Westport (ANSP); Middlesex Co., Plum Bank Beach (CU); New Haven Co., Guilford (CU); New London Co., Mystic (KU). Delaware: Bombay Hook (CU); (CU); Saint Jones River (CU); Woodland Beach (CU); Sussex Co., Lewes (KSU). Florida: Levy Co. (FSCA); Manatee Co., Bradentown (CAS); Saint Johns Co., Crescent Beach (CU), Saint Augustine (ANSP, MCZ). Georgia: Barn Co., Espelo I. (USNM); Chatham Co., Savannah (WSU); Glynn Co., Brunswick-Torras Causeway (CU), 0.2 mi W Jekyll Island (CU); Liberty Co., Saint Catherines Island

(AMNH); McIntosh Co., Sapelo Island (UG, USNM). Louisiana: Cameron Parrish, Cameron (ANSP, OHSU), 6 mi S Hackberry (WNM); Saint Tammany Parish, 6.5 mi W Rigolets River (CU). Maine: Trenton (USNM, ANSP); Hancock Co., Mount Desert (MCZ, USNM); Lincoln Co. (OHSU, USNM), Medomak (OHSU); Washington Co., Machias (ANSP, MCZ). Maryland: Seaside (ANSP, USNM); Calvert Co., Chesapeake Beach (ANSP, USNM); Dorchester Co., Lloyds (USNM); Saint Marys Co., Piney Point (USHM), Saint George Island (USNM). Massachusetts: Naushon Island (USNM); Pasque Island (USNM); Welflee (USNM); Woebecker Island (USNM); Barnstable Co., Falmouth (USNM); Eastham (ANSP, CNC, CU), North Falmouth (USNM), Mashpee (USNM), Pocasset (USNM), South Yarmouth (USNM), Woods Hole (ANSP, USNM); Bristol Co., New Bedford (MCZ, USNM); Essex Co., Ipswich (CAS, MCZ, USNM), Lynn (ANSP); Nantucket Co., Nantucket (MCZ). New Jersey: Anglesea (ANSP); Ducan Island (AMNH); Cape May Co., Cape May (ANSP, MCZ), Stone Harbor (ANSP), Wildwood (ANSP); Mercer Co., Trenton (USNM); Monmouth Co., Morganville (AMNH); Ocean Co., Barnegat City Junction (ANSP), 3 mi S Tuckerton (USNM). New York: Jamaica Co., Howard Beach (UMN); Nassau Co., Jones Beach State Park (MSU), Long Beach (USNM); Richmond Co., Staten Island (USNM); Suffolk Co., Babylon (CU), Cold Springs Harbor (AMNH, ANSP, CU, FSCA, USNM).

Texas: Galveston Co., Dickinson (ANSP). Virginia: Assateague Island (WNM, CU); Accomack Co., Chincoteague Island (CU), Eel Creek Marsh - E of Chincoteague (CU); York Co., York River (ANSP).

Remarks.--N. bispinosa occurs along the Atlantic and Gulf coasts of North America (map 8). Collection dates are from 27 March to 8 September.

This species and N. furcata are the obvious links between the genus Dichaeta and Notiphila because of the unusual development of the fourth and fifth abdominal segments of male specimens. The male genitalia clearly associate N. bispinosa with the subgenus Agrolimna where it is similar to the species related to N. scalaris.

Denno (1975, personal communication) reported that this species is commonly collected in salt marshes in New Jersey.

Notiphila (Agrolimna) furcata (Coquillett)

(figures 95, 99, 148, 152; map 5)

Dichaeta furcata Coquillett, 1902, Jour, N.Y. Ent. Soc. 10:182.

Notiphila (Agrolimna) furcata, Cresson, 1917, Trans. Amer.

Ent. Soc. 43:59.

Type and type locality.--Male holotype: Bisc. Bay, Fla.; Collector Mrs. Slosson; Type No. 6640 U.S.N.M.; Dichaeta furcata Coq. The holotype is deposited in the National Museum of Natural History,

Washington, D. C. Coquillett's description also lists three male and two female cotypes from Biscayne Bay and Lake Worth, Florida; the type and type locality were subsequently designated by Cresson in 1917 as indicated above.

Diagnosis. --Although this species resembles N. bispinosa, it may be distinguished from the latter by the following combination of characters. The first and second antennal segments are dark, blackish in color and the third segment is concolorous except for the base which in some specimens is yellowish. Usually N. furcata also has more arisal branches, 9 to 12. The fourth and fifth abdominal tergites of N. furcata are Dichaeta-like; the fifth tergite extends posteriorly as a slender process which bears several bristles and the large bristles along the posterior margin of the fourth tergite are more robust and numerous, approximately 11 to 13. The male postabdomen of N. furcata is unique from all other species of Agrolimna. This is especially evident in the shape of the hypandrial process and apical margin of the epandrium. See figures 99, 148, and 152.

Description. --Small to medium sized flies, length 2.8 to 4.1 mm, with light brown to gray coloration and some darker brown markings.

Head. Head ratio 1:0.70; postfrons ratio 1:0.56; coloration of the frons quite uniform except for darkened areas on either side of the median triangular area. Dorsalmost postocular bristles large,

considerably larger than postocellars; two subequal proclinate fronto-orbital setae. First and second antennal segments dark; third segment often with basal area that is pale, yellowish; 9 to 13 aristal branches. Face niveous; facial setae hair-like, extending two-thirds facial height; prefrons ratio 1:0.73. Eye ratio 1:0.78; eye-to-cheek ratio 1:0.18; gena narrow, cinereous; genal bristle subequal to dorsal-most postocular bristle. Maxillary palpi pale, wide, yellowish-orange.

Thorax. Mesonotum light brown, with some light vittate markings; mesopleuron generally unicolorous but with a slight, brown marking; pleura gray. Femora and tibiae grayish-black except apices which are pale, yellow; all tarsi yellowish-orange. Setal fascicle of hind basitarsus pale, entirely yellow. Wing ratio 1:0.46; costal vein ratio 1:0.44; M_{1+2} vein ratio 1:0.88.

Abdomen. Abdomen ratio 1:0.61; length of fourth tergite to fifth tergite ratio in males 1:0.75; fifth tergite ratio in males 1:0.56. Brown fascia distinct, posterior edge well demarcated from gray background color, continuing onto lateral margins and ventral surface. Large bristle along posterior margin of fourth tergite stout and long, numbering approximately 10 to 12. Fifth tergite produced posteriorly into a slender process with apical bristles and more slender bristles along its lateral sides. Male postabdomen distinctive, see figures 99, 148, and 152.

Specimens examined. -- Two hundred thirty-seven specimens from the following localities: UNITED STATES: Alabama: Mobile Co., Coden (USNM). Delaware: Sussex Co., Rehoboth (ANSP, USNM). Florida: Hibernia (KU); Middle Cape-Cape Sable (CNC); Royal Palm Park (ANSP, KU, MCZ, USNM); Broward Co., Fort Lauderdale (MCZ), Hollywood (KU); Charlotte Co., Punta Gorda (FSCA); Collier Co., Everglades (ANSP, CNC, USNM); Dade Co., Everglades National Park (CNC, FSCA, KSU), Dodge Island (USNM), Biscayne Bay (AMNH, ANSP, FSCA, USNM), Miami (AMNH, UMN, USNM), 30 mi N Miami (KSU), 25 mi W Miami (KU), Big Pine Key (FSCA, KSU, USNM), Paradise Key (ANSP, CNC, MCZ, USNM), Key Largo (FSCA); Duval Co., Ortega River near Jacksonville (FSCA); Gulf Co., McNeil's (UMI), Port Saint Joe (UMI); Highlands Co. (USNM), Lake Placid (KU), Sebring (FSCA); Jefferson Co., Lloyd (MCA); Martin Co., Jupiter Island (FSCA); Monroe Co., Everglades National Park (FSCA), Flamingo (CNC), No Name Key (FSCA); Orange Co., Orlando (ANSP, USNM); Palm Beach Co., Lake Worth (USNM), South Bay (KU), West Palm Beach (KU), Palm Beach (USNM), Belle Glade (KU); Pinellas Co., Saint Petersburg (ANSP); Saint Johns Co., Saint Augustine (ANSP, KU, MCZ); Swannee Co., Branford (KU). Georgia: Liberty Co., Saint Catherine Island (AMNH). Louisiana: Cameron Parish, Cameron (ANSP, OHSU); Orleans Parish, New Orleans (ANSP); Plaquemines Parish, Port Sulfur (KU, USNM); Saint Tammany

Parish, Slidell (OHSU); Terrebonne Parish, Houma (USNM).

Mississippi: Harrison Co., Gulfport (CU). South Carolina: Alledale Co., Fairfax (AMNH). Texas: Galveston Co., Galveston (ANSP, AMNH, USNM), Dickinson (ANSP); Orange Co., Orange (USNM).

Virginia: Accomack Co., Assateague Island-Tom's Cave and vicinity (CU).

Remarks.--The external structures of the male fourth and fifth abdominal segments closely resemble those of Dichaeta species and evidence a close relationship between Dichaeta and Notiphila (Agrolimna). However, the internal male genitalia are typically notiphiline.

Like N. bispinosa, this species inhabits coastal estuaries. The details of its biology should be interesting and perhaps they will also mirror the morphological intermediacy of this species.

N. furcata occurs along the southern Atlantic Coast in North America from Delaware south and along the Gulf Coast (map 5).

Collection dates are from 6 February to 17 December.

Scalaris Species-Group

All but five Nearctic species of the subgenus Agrolimna are included in this species-group. The group may be distinguished by the following combination of characters. Usually the antennal segments and maxillary palpi are entirely black; the ventral margin of

epandrium of the male postabdomen is not produced into a process; and the hypandrial processes are not as long or as slender as homologous structures are in the pulchrifrons species-group.

Members of this species-group are widely distributed in North America, although they predominate in the West where they occur abundantly.

Notiphila (Agrolimna) aenigma Cresson

(figures 104, 156; map 9)

Notiphila (Agrolimna) olivacea var. aenigma Cresson, 1917, Trans.

Amer. Ent. Soc. 43:54.

Notiphila (Agrolimna) olivacea, Cresson (in part), 1946, Trans.

Amer. Ent. Soc. 72:232.

Notiphila (Agrolimna) aenigma, Wirth, 1965, U.S.D.A., Agri.

Handbk. No. 276, p. 747.

Types and type locality.--Male holotype: Seattle Washington, 15 July 1901; ♂ ; HoloTYPE 6113; Holo-TYPE Notiphila aenigma, E.T. Cresson Jr. The type is deposited in the Academy of Natural Sciences of Philadelphia, Philadelphia, Pennsylvania, type number 6113.

Diagnosis.--N. aenigma bears close resemblance to N. olivacea but may be readily distinguished by the brown maculation on the

mesopleuron and by the vittate mesonotum. The brown maculation pattern is subrectangular and extends from the prothoracic spiracle to the two large bristles near the posterior margin of the mesopleuron. The vittate mesonotum is variable; I have examined specimens, generally poorly preserved, that bear little evidence of stripes but most specimens are conspicuously marked. Although very similar, the male postabdomen of N. aenigma differs from that of N. olivacea in the shape of the hypandrial process. The preapical swelling is more abruptly rounded and the apical process is broader. Compare figures 104 and 113.

Description. --Medium sized flies, length 3.46 to 4.53 mm, with light olive brown to brown coloration.

Head. Head ratio 1:0.73; mesofrons with light colored tan, triangular area which extends posteriorly from broadly formed vertex at anterior margin of postfrons to vertex including ocellar triangle; lateral margins of frons contrasting in coloration with mesofrons, darker, blackish-brown; postfrons ratio 1:0.65. Two subequal proclinate fronto-orbital setae; postocular bristles large, slightly larger than genal bristles. All antennal segments dark, black, appearing pollinose; 9 to 13 arisal branches. Face grayish-yellow; prefrons ratio 1:0.69; facial setae hair-like. Eye ratio 1:0.78; eye-to-cheek ratio 1:0.19; gena gray. Maxillary palpi black.

Thorax. Mesonotum darker than pleural areas, usually with median stripe and often with other vittate markings. Mesopleuron with brown, subrectangular maculation; pleura in general becoming lighter in color ventrally. All femora and tibiae more or less concolorous, grayish-black; tarsi light grayish -orange to subdued yellow; setal fascicle of hind basitarsus pale, yellowish-orange. Wing ratio 1:0.46; costal vein ratio 1:0.5; M_{1+2} vein ratio 1:0.92.

Abdomen. Abdomen ratio in males 1:0.72; length of fourth tergite to fifth tergite in males 1:0.75; fifth tergite ratio in males 1:0.51.

Third and fourth tergites with dark brown fascia along anterior margin which do not generally extend onto ventral surface; fifth tergite of male generally dark brown except for small median gray stripe and some lightened areas toward the anterolateral surfaces. Male post-abdomen as in diagnosis and in figures 104 and 156.

Specimens examined. -- Four hundred thirteen specimens from the following localities: CANADA: Alberta: Wabamun (ANSP). British Columbia: Hatzic Lake (CNC); Mission City (CNC); Royal Oak (ANSP). UNITED STATES: California: Colusa Co., Colusa (UCB); Los Angeles Co., Long Beach, Los Angeles River (WSU); San Bernardino Co., Redlands (ANSP); San Francisco Co., Lake Merced (CAS); San Luis Obispo Co., Pismo Beach (WSU). Colorado: Boulder Co., Boulder (ANSP, CSU); Larimer Co., Ft. Collins (ANSP); Montezuma

Co., 8 mi W Cortez (WNM). Idaho: Kootenai Co., Lake Cour d'Alene, 1/2 mi E Harrison (WNM). Montana: Flathead Co., 1 mi W Bigfork (KSU), 6 mi NW Bigfork (KSU), 8 mi NW Bigfork (KSU), 2.3 mi E Bigfork (WNM); Lake Co., 5 mi S Bigfork (KSU), 3 mi E Polson (KSU), 4 mi E Polson (KSU, WNM), 1/2 mi SW Polson (KSU), 1/2 mi S Ronan (KSU), 3.2 mi S Ronan (WNM). Nevada: Washoe Co., Reno (CAS), Sparks (CAS). New Mexico: San Juan Co., 1 mi S Bloomfield (WNM); San Miguel Co., 1/2 mi NE Montezuma (WNM). Oregon: Benton Co., Finley Wildlife Refuge (WNM), McFadden Pond (WNM), Peavy Arboretum (WNM); Columbia Co., Clatskanie (MSU); Coos Co., Hauser (WNM); Curry Co., Cape Blanco (WNM); Klamath Co., 2.5 mi N highway 66 Brick Lake Road (WSU), Klamath National Forest Wildlife Refuge (WNM); Lake Co., Ana Reservoir (WNM); Lane Co., 6 mi E Florence (WNM); Lincoln Co., Newport-Yaquina Bay (WNM); Tillamook Co., 2 1/4 mi S Cloverdale (WNM). Utah: Utah Co., Goshen Pond (WNM), Provo Environs (WNM); Wasatch Co., Heber (MSU); Weber Co., Plain City (ANSP). Washington: Franklin Co., 7 mi SWS Eltopia (WNM); Grant Co. (WNM); Pierce Co., Lake Spanaway (WNM), Mount Rainier-Longmire (ANSP), 3 mi SWS DuPont (WNM); San Juan Co., Orcas Island (ANSP), Mt. Constitution (ANSP), Friday Harbour (ANSP); Snohomish Co., Stanwood (ANSP, USNM); Whitman Co., Pullman (WSU); Yakima Co., Byron Ponds near Prosser (WSU).

Remarks.--N. aenigma was previously reported only from the state of Washington (Cresson, 1946; Wirth, 1965), but it has now been collected from most of the western United States and Canada (map 9). It occurs inland as commonly as on the coast. Collection dates are from 7 May to 1 September.

The larvae and pupae of this species have been found attached to the roots of Scirpus maritimus L. variety paludosus (A. Nels) Keukenth, which were growing in stagnant water that had accumulated on a land fill which projected into Yaquina Bay, near Newport, Oregon. The immature stages appear almost identical to those of N. quadri-setosa, although they are slightly larger. The cephalopharangel skeletons of both species are very similar and at the present time, I cannot separate the larvae or pupae of either species except by rearing and subsequent association. This species is also common in Sparganium bogs and in sedge-meadow and marsh-reed habitats.

N. aenigma and its closely related congener, N. olivacea, often occur together. Because N. aenigma maintains its species integrity in areas sympatric with N. olivacea as well as in allopatry, the status of this taxon as a valid species is clearly founded, based on biological and supporting morphological evidence.

Notiphila (Agrolimna) atrata new species

(figures 103, 123, 157, map 9)

Diagnosis.--Externally, N. atrata very closely resembles N. quadrisetosa, N. nanosoma, and N. atripes. It appears to be most similar to N. atripes and has often been confused with this species. N. atrata may be distinguished from related congeners by the following characters. The overall length of N. atrata is generally longer than that of N. nanosoma, the mesonotum bears a median, posteriorly bifurcating stripe as in N. quadrisetosa and the tarsi are entirely dark, usually black. The male genitalia are also distinctive and are the most reliable characters for separating N. atrata from N. atripes. The shapes of the hypandrial process and surstyli are especially diagnostic. See figures 103, 123, and 157.

Description.--Small to medium sized flies, length 2.86 to 3.40 mm, with grayish-brown to olivaceous brown background coloration and dark brown to black markings.

Head. Head ratio 1:0.75; postfrons ratio 1:0.58; lateral margins and mesotriangular area of frons light grayish-brown, generally concolorous, remainder of frons darker with charcoal tinges. Dorsalmost postocular bristle moderately large, approximately twice the length of postocellars; two pairs of proclinate fronto-orbital setae. Antennal segments entirely black; arista with approximately ten aristal

branches. Face light yellow, pollinose, prefrons ratio 1:0.63; facial setae small, hair-like. Eye ratio 1:0.73; eye-to-cheek ratio 1:0.18. Genal bristle subequal to dorsalmost postocular; gena narrow, generally concolorous with face anteriorly, becoming grayer posteriorly. Maxillary palpi black.

Thorax. Mesonotum slightly darker than pleura and with a faint, median, posteriorly bifurcating stripe. Mesopleuron often with maculation area of darker color than surrounding color but not well defined. Legs mostly dark, usually entirely black. Setal fascicle of hind basitarsus amber. Wing ratio 1:0.40; costal vein ratio 1:0.58; M_{1+2} vein ratio 1:1.10.

Abdomen. Abdomen ratio in males 1:0.73; length of fourth tergite to fifth tergite ratio in males 1:0.95. Darkened fascia occupying most of abdominal tergites three through five, usually only with gray median stripe. Male postabdomen as in figures 103, 123, and 157.

Type material. --Male holotype: Arizona, White Mt., Res., E. of McNary, 8 July 1940; Gertsch and Hook, Acc. 37656; HOLOTYPE *Notiphila atrata* Mathis. Allotype: White River, Ar., VI-19-1950, L.D. Beamer (KU). One female and two male paratypes: White Mts. Ar., VI-19-1950, L.D. Beamer (KU, USNM). One female and four male paratypes: New Mexico, Jemez Springs, 4 July 1953; W W Wirth Collector (USNM). The holotype will be deposited with the American Museum of Natural History, New York.

Etymology.--The Latin adjective atrata meaning "dressed in black" refers to the darkened coloration of this species.

Remarks.--N. atrata occurs sympatrically with N. minima and N. atripes, the latter species being its most similar congener. It occurs in the mountainous areas of western New Mexico and eastern Arizona (map 9) and its biology is not known. Collection dates are from 19 June to 8 July.

Notiphila (Agrolimna) atripes Cresson

(figures 105, 121-122, 154; map 5)

Notiphila (Agrolimna) atripes Cresson, 1917, Trans. Amer. Ent. Soc. 43:50.

Types and type locality.--Male holotype: Beverly, Mass. Burgess (collector?), 15-6-76; Type No. 20726 U.S.N.M. (red); Holo-TYPE, Notiphila atripes, E. T. Cresson Jr. The type is deposited with the National Museum of Natural History, Washington, D.C., type number 20726. The original description also lists two female paratopotypes.

Diagnosis.--Externally, N. atripes is quite similar to N. quadrisetosa and N. uliginosa and it has often been confused with both of the latter species. However, N. atripes may be distinguished by many differences in the male postabdomen and in most cases by comparing the

external attributes which are as follows. The antennae, maxillary palpi and all legs are entirely black and usually the mesonotum and mesopleuron are immaculate although there are exceptions in which there are slight indications of vittate markings. Further, the fascia of the abdominal tergites are dark brown to black and extensive, often covering the entire dorsum of the fourth and fifth abdominal tergites. The ventral margin of the hypandrial process of N. atripes is sinuate and the shape of the preapical enlargement and surstyli are also characteristic. See figures 105, 121-122, and 154.

Description. --Small flies, length 2.56 to 4.10 mm, with light brownish-gray to gray coloration and dark brown to black markings.

Head. Head ratio 1:0.73; postfrons ratio 1:0.56; frons with meso-triangular area and lateral margins concolorous but not too distinct from remainder of frons; extreme anterolateral margins in some specimens light gray. Dorsalmost postocular bristles just slightly larger than biggest postocellar bristles; two pairs of proclinate fronto-orbital setae. Antennal segments entirely black; arista with 8 to 12 aristal branches. Face yellowish-gray; prefrons ratio 1:0.64; facial setae small, hair-like. Eye ratio 1:0.81; eye-to-cheek ratio 1:0.20; gena narrow, gray except for anterior portion which is concolorous with face; genal bristle distinct. Maxillary palpi black.

Thorax. Generally unicolorous, mostly gray, although mesonotum is

usually darker, brownish-gray. Mesonotum and mesopleuron immaculate. Legs entirely dark, usually black although the hind tarsi are paler, yellowish in a few specimens; setal fascicle of hind basitarsus pale, amber. Wing ratio 1:0.43; costal vein ratio 1:0.57; M_{1+2} vein ratio 1:1.1.

Abdomen. Abdomen ratio in males 1:0.79; length of fourth tergite to fifth tergite ratio in males 1:1.4; fifth tergite ratio in males 1:0.56. Fascia of abdominal tergites dark brown to black, distinctly contrasting with background coloration, especially on third and fourth tergites; sometimes entire dorsum of the fourth and fifth is unicolorous, dark brown to black. Postabdomen of males as in diagnosis and figures 105, 121-122, and 154.

Specimens examined. -- One thousand one hundred twenty specimens from the following localities: CANADA: Alberta: Carmangay-Little Bow River (USNM); Sheep River (USNM); Banff (CNC, CAS); Jasper (CNC); Kannanakis (CAS); Scandia (CNC). British Columbia: Clinton (CNC). Manitoba: Birtle (AMNH); Warkwork Creek near Churchill (CNC); Whitewater Lake (CNC). Northwest Territories: Norman Wells (CNC). Nova Scotia: Baddeck-Cape Breton (MCZ); English Town-Cape Breton (MCZ); Loua-Cape Breton Island (MCZ); Saint Ann-Cape Breton Island (MCZ); Petite Riviere (CNC). Ontario: Ottawa (ANSP, CNC). Quebec: Gaspé (AMNH, USNM); Gaspé-Anse Au Griffon

(ANSP, USNM); Montreal (AMNH). Saskatchewan: Attons Lake-Cut Knife (CNC); Lisieux (CNC); Val Marie (CNC). Yukon Territory: Whitehorse (CNC). UNITED STATES: California: Eldorado Co., Fallen Leaf (CNC); Inyo Co., Bishop (KU), Death Valley Floor near Furnace Creek (ANSP), Deep Springs (UCB); Lassen Co., 22 mi NW Susanville (WNM); Mariposa Co., Yosemite National Park (KU); Modoc Co., Alturas (WNM); Mono Co., 19 mi NW Benton (WNM), Convict Creek (UCB, USNM), Fales Hot Spring (USNM), Mono Lake (USNM, WNM), 2 mi N Mono (WNM); Nevada Co., Hobart Mills near Sage Hen (UCD), 2 1/2 mi NW Hobart Mills (WNM); Placer Co., Lake Tahoe (USNM); San Luis Obispo Co., Alamo Creek (UCB); Shasta Co., Moose Camp (UCD); Trinity Co., Trinity River Camp (UCD); Tulare Co., 15 mi NE California Hot Springs (WNM). Colorado: Electra Lake (WMNH); Lindland (ANSP, CSU, WSU); Shaffers Crossing (ANSP, CSU); Boulder Co., Nederland (CNC, KU); Chaffee Co., Buena Vista (CNC), Poncha Springs (ANSP, CSU); Clear Creek Co., Idaho Springs (CSU); Dolores Co., 6 1/2 mi W Dove Creek (WNM); Gilpin Co., East Portal (CNC); Hinsdale Co. (KU); Jackson Co., Gould (USU), Walden (USU); Jefferson Co., Golden (USNM); Lake Co., Tennessee Pass (KSU); LaPlata Co., Hesperus (WNM); Larimer Co., Fort Collins (ANSP, CSU, WSU), La Porte (CSU), Virginia Dale (MSU, USNM); Mesa Co., Glade Park (USNM); Montezuma Co., 8 mi W Cortez (WNM); Park Co., Fairplay (WSU), Hartsel (USNM); Pitkin Co.

(KNSU); Teller Co., Florissant (CAS); Weld Co., Roggen (WSU).

Idaho: Big Lost River-Salmon River Road Pass (ANSP). Iowa:

Dickinson Co., Excelsior Fen (ISU); Polk Co., Clive (USNM).

Massachusetts: Essex Co., Beverly (ANSP, USNM). Michigan: Mid-

land Co. (ANSP, MSU). Minnesota: Polk Co. (UMN). Montana:

Flathead Co., 1 mi W Bigfork (KSU), 2 mi W Bigfork (KSU), 8 mi NW

Bigfork (KSU), 10 mi NW Bigfork (KSU); Glacier Co., 2 mi E Babb

(KSU, USNM), 23 mi E Babb (KSU), NW Browning (KSU); Lake Co.,

3 mi E Polson (KSU), 4 mi E Polson (KSU, USNM), 8 mi NE Polson

(USNM); Powell Co., Deer Lodge and vicinity (CU). Nebraska:

Blaine Co., Dunning (MSU); Box Butte Co., Alliance (UN); Dawes Co.,

Marsland (UN, USNM); Morrill Co., Bayard (UN, USNM); Sheridan

Co. (MSU). Nevada: Elko Co., Wells (ANSP, CSU); Washoe Co.,

Reno (CAS). New Mexico: Catron Co., 32 mi E Glenwood (WNM);

Otero Co., Cloudcroft (KU, USNM); Sandoval Co., Seven Springs

Ranger Station (WNM), 11 mi SE Cuba (WNM), 7 1/2 mi N Jemez

Springs (WNM); San Miguel Co., 1/2 mi NE Montezuma (WNM).

Oregon: Deschutes Co., 3 mi SE La Pine (WNM); Grant Co., 1/2 mi

S Seneca (WNM); Harney Co., 2 mi E Burns (WNM), 16 mi N Burns

(WNM), Denio (USNM); Josephine Co., 4 mi W Selma (WNM);

Klamath Co., Wood River Spring (WSU); Lake Co., Hart Mountain

Refuge-Hot Spring Camp (WNM), Ana Reservoir (WNM), Hunter Hot

Spring (WNM), 4.8 mi N Summer Lake (WNM), Warner Canyon

(WNM), 19.8 mi NW Paisley (WNM), NW shore Alkali Lake (WNM); Union Co., North Powder (KU). South Dakota: Lake Oakwood (ANSP); Bennett Co., Martin (ANSP); Custer Co., Custer (ANSP), 7 mi W Custer (WNM); Lawrence Co., 1 mi W Savoy (WNM), 2 mi W Savoy (WNM); Lincoln Co., Canton (ANSP); Tripp Co., Winner (ANSP). Utah: Allen Canyon (CNC); Gooseberry (ISU); Sawtooth (ISU); Soldier Springs (UMN); Willow Creek Canyon (KU, UMN); Beaver Co., Beaver (UMN); Box Elder Co., Mantua (ISU); Carbon Co., Soldier Canyon (WNM), S Price (WNM); Cache Co., Logan (UMN), Logan Canyon (CNC, USU), Blacksmith Fork (USU), Richmond (UMN), Trenton (UMN); Duchesne Co., Indian Canyon (CU), Ashley National Forest-Lime Kiln Spring (WNM), 5 mi N Mountain Home (WNM), Hana (UMN); Emery Co., 1/2 mi N Castle Dale (WNM); Piute Co., Marysvale (CSU); Rich Co., Garden City (USNM), Laketown (ISU); Sevier Co., Salina (ISU); Uinta Co., Big Brush Creek - 22 mi N Vernal (CNC); Utah Co., Provo (UMN); Wasatch Co., Strawberry Reservoir (CNC, KU, UMN), 2 mi S Daniels Pass (CNC); Washington Co., Leeds (UMN), Saint George (UMN). Washington: Stevens Co., 15 mi W Kettle Falls (USNM). Wisconsin: Dodge Co., Beaver Dam (ANSP). Wyoming: Washakie (MSU); Albany Co., Tie Siding (USNM); Laramie Co., Horse Creek (KU); Niobrara Co., 12 mi NW Lusk (KU); Teton Co., Hoback (MSU); Uinta Co., 1 mi NW Evanston (KSU,

USNM); Yellowstone National Park, south entrance (UCB), Beach Springs (ANSP, USNM), Twin Lakes (USNM).

Remarks.--Size variation within N. atripes is considerable and care must be exercised in distinguishing between larger specimens of this species and specimens of N. quadrisetosa. Where both of these species occur together, separation is quite easy, but in allopatric situations, reference to the characters of the male postabdomen is often necessary. In the Southwest, this species has been confused with N. atrata, which is very similar except for the median, mesonotal stripe and the shape of the hypandrial process. Like N. atrata, N. atripes is more often collected in mountainous environments. This species has been collected in sedge-meadow habitats associated with both lotic and lentic environments.

N. atripes is widely distributed in the West, from the Yukon Territory south to southern California. In the Midwest and East, it is more restricted to the southern Canadian provinces and northern states of the United States (map 5). Collection dates are from 5 June to 4 August.

Notiphila (Agrolimna) decoris Williston

(figures 107, 124-125, 159; map 8)

Notiphila decoris Williston, 1893, N. Amer. Fauna, no. 7, Lipt. of Death Valley Exped., part 2, p. 258.

Notiphila (Agrolimna) atrisetis Cresson, 1917, Trans. Amer. Ent.

Soc. 43:52, NEW SYNONYMY.

Notiphila (Agrolimna) decoris, Wirth, 1965, U.S.D.A. Agri.

Handbk. No. 276, p. 747.

Type and type locality. --Female holotype: Panamint Vy., April 98 (1891) K.; Through C. V. Riley; TYPE, Notiphila decoris Will. (red).

The holotype is in the Snow Entomological Museum, type number 688, The University of Kansas, Lawrence, Kansas. The type of the junior synonym is deposited with the Academy of Natural Sciences of

Philadelphia, type number 6115, and bears the following label data:

Desert edge, San Diego Co., Cal. 17 April 1915, M C VanDuzee;

HoloTYPE 6115; Holo-TYPE male, Notiphila atrisetis, E. T.

Cresson Jr.

Diagnosis. --This species may be distinguished from others of the subgenus Agrolimna by the possession of the following combination of characters. The setal fascicle of the hind basitarsus has one dark brown to black seta, which is less than one-sixth the length of the basitarsal segment. The fore tarsi are usually dark brown to black and the mesopleuron is only slightly discolored dorsally; there is no well defined brown spot. The females of N. decoris could be confused with N. macrochaeta but the posteromedial area of the fifth abdominal

tergite is normally sclerotized, similar to the rest of the tergite.

The male genitalia of N. decoris are also distinctive, see figures 107, 124-125, and 159.

Description. --Small to medium sized flies, length 2.94 to 5.54 mm, with gray to light brown coloration and dark brown markings.

Head. Head ratio 1:0.70; lateral margins of frons usually gray, often concolorous with median triangular area; triangular area sometimes brownish-gray, pruinose; most of mesofrons subdued charcoal black, usually lightly pruinose; postfrons ratio 1:0.53; dorsalmost postocular bristles subequal to genal bristle. Antennal segments all black; 9 to 11 arisal branches. Face usually grayish-yellow to yellow; prefrons ratio 1:0.75; facial setae small, hair-like. Eye ratio 1:0.80; eye-to-cheek ratio 1:0.22; genal area becoming more grayed posteriorly; genal bristle prominent. Maxillary palpi black.

Thorax. Mesonotum lightly vittate; usually darker in color than pleura; mesopleuron without a definite maculation spot although some specimens have some discoloration along the dorsal margin. Femora and tibiae grayish-black to black; fore tarsi usually dark brown to black, sometimes lighter in color; mid and hind tarsi yellowish-orange to orange. Setal fascicle of hind basitarsus with a single, small, dark brown to black seta. Wing ratio 1:0.46; costal vein ratio 1:0.48; M_{1+2} vein ratio 1:1.

Abdomen. Abdominal ratio in males 1:0.72; fourth tergite to fifth tergite length ratio in males 1:0.72; fifth tergite ratio 1:0.56. Fascia of abdominal segments dark brown, well defined, contrasting with grayer ground color. Male postabdomen as in figures 197, 124-125, and 159.

Specimens examined. --One thousand one hundred seventy-two specimens from the following localities: CANADA: Alberta (ANSP).

Manitoba: Clear Lake-Riding Mountain National Park (CNC).

UNITED STATES: Arizona: Apache Co., 1 mi W Edgar (USU); Pima Co., Organ Pipe Cactus National Monument (USNM), Quinto Baquito (USNM).

California: Asilomar (USNM); Cathedral Canyon (USNM); Ebbet Pass (AMNH); Jenks Lake (USNM); Pine Lake (USNM);

Alameda Co., Albany (UCB), Alvarado (CAS), Sunol (UCB); Butte Co., Biggs (USNM); Calaveras Co., Milton (USNM); Colusa Co.,

Colusa (UCB, USNM), Maxwell (UCB, USNM); El Dorado Co., Echo (KU), Pino Grande (UCB); Fresno Co., Coalinga (AMNH); Humboldt Co., Orick (ANSP, USNM), Trinidad (ANSP, USNM); Imperial Co.,

Calipatria (ANSP, USNM), Palo Verde (UCB, USNM); Inyo Co.,

Antelope Springs (UCB), Ballarat (UCB, USNM), Bishop (KU), Death Valley Floor near Furnace Creek (ANSP), Deep Springs (UCR), Little

Lake (CAS, KU), Lone Pine (KU, USNM), Olancho (CAS), Panamint

Springs (CNC, KU), Tecopa Hot Springs (WNM), Warm Sulphur Spring

(UCR, USNM); Kern Co., Onyx (KU, USNM); Lake Co., Clear Lake (USNM), Lower Lake-Clear Lake (CAS); Lassen Co., 41 mi NW Susanville (WNM); Los Angeles Co., Lancaster (MCZ), Los Angeles (MCZ), Palmdale (MCZ); Modoc Co., 4 mi W Alturas (WNM), Canby (USNM), Lake City (UCD), Likeley (USNM), Lookout (WNM), Surprise Valley (UCB); Mono Co., Benton (UMN), Convict Creek (USNM), Crooked Creek (UCB), Hot Creek (CAS), Knoxville (USNM), Mammoth Lakes (KU, USNM), Mono Lake (KU, UCB), 2 mi N Mono Lake (WNM), Napa Co., Knoxville (USNM), Pope Creek ~ 5 mi NW Monticello (CAS), Samuel Spring (USNM); Nevada Co., near Hobart Mills (UCD), 1 mi NW Hobart Mills (WNM); Orange Co., Laguna Beach (USNM); Riverside Co., Coachella (CAS), Riverside (ANSP), San Jacinto (CAS); San Bernardino Co., Morongo (USNM), Needles (CU, USNM), Trona (CNC), Victorville (USNM); San Diego Co., Borego (UCB), Desert Edge (CAS), Jacumba Spring (ANSP, USNM), Russian River-Mesa Grande (ANSP); San Luis Obispo Co., Harmony (AMNH, USNM), Oso Flaco Lake (USNM); San Joaquin Co., Stockton (CAS); Santa Barbara Co., Carpinteria (WSU); Santa Clara Co., San Antonio Valley (UCB); Shasta Co., Cassel (UCB), Gibson (UCB, USNM); Siskiyou Co., Big Springs Wildlife Refuge (USNM), Bray area (UCR), Gazelle (MCZ), Shasta River - 1.3 mi E grenada (UCR); Stanislaus Co., Del Puerto Canyon (UCBM, USNM); Tehama Co., 1/2 mi S Corning (WNM); Tulare Co., Three Rivers (KU, USNM), Visalia (USNM); Ventura Co.,

Hueneme (UCB); Yolo Co., Davis (ANSP, UCD, USNM), Putah Canyon (UCD, USNM), Woodland (UCD, USNM). Colorado: Crowley Co., Crowley (ANSP, CSU, WSU); Pueblo Co., Pueblo (CSU); Weld Co., Roggen (ANSP). Idaho: Canyon Co., Caldwell (ANSP); Gooding Co., Hagerman (USNM); Payette Co., Payette (MCZ). Montana: Lake Co., 3 mi E Polson (KSU), 4 mi E Polson (WNM); Madison Co., Madison Junction (USNM). Nebraska: Lincoln Co., Wellfleet (USU); Thurston Co., 8 mi ENE Winnebago along Missouri River (ISU). Nevada: Eastgate (USNM); Churchill Co., Fallon (USNM), Hazen (USNM), Soda Lake near Hazen (ANSP); Humboldt Co., Winnemucca Lake (USNM); Lander Co., 25 mi N Austin (AMNH); Lyon Co., Fernley (ANSP, CSU, WSU); Nye Co., Beatty (USNM), 1.6 mi S Springdale (AMNH); Ormsby Co. (KU, USNM); Washoe Co., Garlach (CAS), Pyramid Lake (CAS), Steamboat (USNM). New Mexico: McKinley Co., Zuni Salt Lake (USNM); Otero Co., White Sands National Monument (WSU); San Juan Co., 1 mi S Bloomfield (WNM); Socorro Co., Socorro (ANSP, KU, USNM). Oregon: Benton Co., Finley Wildlife Refuge (WNM); Deschutes Co., Paulina Lake (WNM); Grant Co., John Day Gorge (CAS), 1/2 mi S Seneca (WNM); Harney Co. (USNM), 9 mi N Andrews (WNM), 5 mi NE Fields (WNM), Harney Lake (USNM), Harney Hot Spring (CAS, USNM, WNM), hot spring in desert N of State hwy 78 and 8.4 mi E Lawen (CU), W Whitehorse Ranch-Willow Creek (WNM); Jackson Co., Little Squaw Lake (WNM); Klamath Co., Bly (WSU),

Deming Creek-Reservoir NE Bly (WSU); Lake Co., Ana Reservoir (WNM), NW shore Alkali Lake (WNM), Goose Lake State Park (CU), Hunter Hot Spring (WNM), Lakeview Hot Spring (WNM), 4.3 mi NW Paisley (WNM), Summer Lake (WNM); Lane Co., 8 mi S Florence (WNM); Malheur Co., 8 mi N Andrews (WNM), 15 mi NW Vale - margin of hot spring (WNM); Morrow Co., 2 mi N Irrigon (WNM); Umatilla Co., Cold Springs (WSU). Texas: Lubbock Co., Buffalo-Spring Lake (USNM). Utah: Flux (ANSP, USNM); Taylor (USU); Box Elder Co., Bear River Refuge (ISU), Blue Creek (USU), Collinston (UMN), Kelton (USU), Kosmo (USU), Locomotive Springs (USU), Snowville (USU); Cache Co., Benson (USU), Providence (USU); Carbon Co., Price (KU, WNM); Emery Co., 1/2 mi N Castle Dale (WNM); Grand Co., Moab (ISU, USU); Rich Co., Woodruff (ANSP); Salt Lake Co., Garfield (ANSP, USNM), Great Salt Lake (ANSP, CAS), Saltair (USNM); San Juan Co., Bluff (USU); Sevier Co., Monroe (USU); Uintah Co., Vernal Canyon-Uinta Mountains (ANSP); Utah Co., Goshen (KU), Goshen pond (WNM), Hobble Creek (KU), Colton (ISU), Lakeshore (ISU), Utah Lake near Lehi (USNM), E shore Utah Lake (WNM), Spanish Fork (KU); Weber Co., Ogden (USU). Washington: Lind Lake (WSU); Clark Co., Lacamas Lake (ANSP, USNM); Franklin Co., 7 mi WSW Eltopia (WNM), Kahlotus Lake (WSU), 2 mi E Pasco (WNM), Scooteney Reservoir-Recreational Area (WNM); Grant Co., Bank Lake (WNM), O'Sullivan Dam (WSU); Okanogan Co., Brewster (USNM); Whitman

Co., Almota (USNM); Yakima Co., Yakima (CAS), Byron Ponds near Prosser (WSU). Wyoming: Yellowstone National Park: Old Faithful (ANSP, USNM), U Geyser Basin (ANSP, USNM), West Thumb (MCZ), White Dome Geyser vicinity (CU).

Remarks. --N. decoris is one of the most variable species in size and color of the subgenus Agrolimna. Typically, it is very similar to N. macrochaeta and it usually occurs sympatrically with the latter. Both species often have a dusted white appearance, especially the anterior margin of the frons, and the male genitalia are also similar. Larger specimens are sometimes confused with N. olivacea, being browner and approximately the same size, but the darkened bristle in the setal fascicle of the hind basitarsus is diagnostic for N. decoris.

N. decoris is often abundant, particularly around the littoral zone of ponds, stock watering holes, etc. It is also common in habitats where the water is alkaline or where the water source is a hot spring.

Although the type of the senior synonym is a female specimen, it was easily identifiable and its name associated with this species.

N. decoris occurs mainly west of the 100th parallel in North America. I have examined specimens from as far north as Manitoba (Clear Lake-Riding Mountain National Park) and southward into Mexico (map 8). Collection dates are from 31 March to 9 November.

Notiphila (Agrolimna) deonieri new species

(figures 106, 127, 158)

Diagnosis.--N. deonieri is most similar to N. olivacea and based on external characters alone, I cannot consistently separate them.

Usually the frons of N. deonieri is browner and often the median edges of the abdominal fascia extend to near the posterior margin of each tergite. In both of the above characters, however, there is considerable overlap with specimens of N. olivacea. The male genitalia are distinctive and may be used to identify this species. The preapical enlargement is almost pointed dorsally and is not as long as the homologous structure in N. olivacea. See figures 106 and 113 for comparisons.

Description.--Medium sized flies, length 3.55 to 4.58 mm, with brownish-gray coloration and brown markings.

Head. Head ratio 1:0.72; postfrons ratio 1:0.65; frons generally light brown, pruinose; mesotriangular area and lateral margins concolorous, lighter than remainder of frons, gray. Dorsalmost postocular bristles much larger than postocellars; two pairs of proclinate fronto-orbital setae. Antennae entirely black; arista with 10 to 13 aristal branching hairs. Face grayish-yellow, pruinose; prefrons ratio 1:0.71; facial setae small, hair-like. Eye ratio 1:0.77; eye-to-cheek ratio 1:0.20; gena narrow with distinct bristle, subequal to

dorsalmost postocular bristle; gena gray except for anterior margin which is concolorous with face. Maxillary palpi black.

Thorax. Dorsum slightly darker than pleural areas; mesonotum immaculate; mesopleuron usually with brown, undefined spot near dorsal edge. Femora and tibiae grayish-black; tarsi generally yellow, fore tarsi and in some cases the mid tarsi darkened, brownish-yellow. Setal fascicle of hind basitarsus pale. Wing ratio 1:0.41; costal vein ratio 1:0.36; M_{1+2} vein ratio 1:0.80.

Abdomen. Abdomen ratio in males 1:0.70; length of fourth tergite to fifth tergite ratio in males 1:0.73; fifth tergite ratio in males 1:0.51. Fascia brown; on third and fourth segments the median edge often reaching posterior margin of tergites, otherwise the posterior margin is gray, contrasting with darker fascia. Male postabdomen as in figures 106, 127, and 158.

Type material.--Male holotype: Goose Lake, Hamilton Co., Iowa VIII-14-1966, D. L. Deonier; HOLOTYPE *Notiphila deonieri* Mathis (red). Allotype and 11 paratypes (six males, five females) with the same label data as the type. The type will be deposited with the National Museum of Natural History, Washington, D. C., type number 73542.

Etymology.--The genitive patronym deonieri honors the collector of the type series, Dr. D. L. Deonier, who has contributed substantially

to our knowledge of the Nearctic Ephydridae with his revision of Hydrellia.

Remarks.--This species is recognizable only after examining the structures of the male genitalia. It occurs sympatrically with N. olivacea, which is its most similar congener. N. deonieri is presently known only from the type locality in Iowa.

Notiphila (Agrolimna) deserta new species

(figures 108, 126, 160)

Diagnosis.--Superficially, N. deserta resembles N. decoris, as evidenced by a single, normally developed, darkened seta in the setal fascicle of the hind basitarsus, but otherwise, N. deserta appears to be more similar to N. pallidipalpis or to N. sicca. The latter associations are especially evident in the structural similarities of the male postabdomens. However, N. deserta may be distinguished from all other species of Agrolimna by the possession of the following combination of characters. The palpi and antennae are entirely black, the mesopleuron usually has a darkened maculation area toward the dorsal margin, the mesonotum is more or less immaculate although a few specimens have some very light vittate markings, the setal fascicle of the hind basitarsus has one darkened seta, and the fascia of the abdominal tergites are well defined, brown, but do not extend

on the ventral surfaces. The hypandrial process of N. deserta is quite similar to the homologous structure of N. sicca but the shape of the surstyli, especially the apices, differs considerably in both species. The resemblance of the male genitalia of N. deserta with those of N. pallidipalpis is even closer but after close comparison, they can be seen to consistently differ in several respects. See figures 108 and 114 for a comparison.

Description. --Medium sized flies, length 3.54 to 4.40 mm, with light brownish-gray coloration and brown markings.

Head. Head ratio 1:0.72; postfrons ratio 1:0.60; lateral margins and mesotriangular area of frons concolorous; remainder of frons subdued, charcoal black, lightly pruinose; dorsalmost postocular bristles much larger than postocellars, subequal to genal bristle; two pairs of proclinate fronto-orbital setae. Antennae entirely black; arista with 9 to 11 aristal branches. Face light grayish-yellow; prefrons ratio 1:0.81; facial setae hair-like, usually not numbering more than six or seven. Eye ratio 1:0.75; eye-to-cheek ratio 1:0.21; genal bristle distinct; gena concolorous with face anteriorly, becoming gray posteriorly. Maxillary palpi black.

Thorax. Thorax in general unicolorous although the mesonotum is slightly darker; some specimens with light vittate markings on mesonotum. Mesopleuron usually with a brownish maculation area; pleura

brownish-gray, becoming grayer posteriorly and ventrally. Femora and tibiae grayish-black; all tarsi pale, usually yellow; fore tarsi sometimes lightly tinged with some blackish coloration. Setal fascicle of hind basitarsus with one darkened seta of normal length. Wing ratio 1:0.37; costal vein ratio 1:0.37; M_{1+2} vein ratio 1:0.85.

Abdomen. Abdomen ratio in males 1:0.63; length of fourth tergite to fifth tergite ratio in males 1:0.76; fifth tergite ratio in males 1:0.54. Background color of abdominal segments concolorous with thoracic pleura; fascia brown, well defined, especially posteriorly but not extending on ventral surface. Male postabdomen as in figures 108, 126, and 160.

Type material. --Male holotype: N. MEX: San Juan Co, 1 mi S Bloomfield, 25 June 1973, Wayne N. Mathis; HOLOTYPE *Notiphila deserta* Mathis (red). Twenty-three paratypes (female allotype, 5 males, 17 females) with the same locality data as the type. One female and male paratype: N. MEXICO San Miguel Co., 1/2 mi NE Montezuma, 26 June 1973, Wayne N. Mathis. One female paratype: UTAH San Juan Co, 2 mi S Blanding, 23 June 1973, Wayne N. Mathis. The type will be deposited with the National Museum of Natural History, Washington, D.C., type number 73543.

Etymology. --Deserta, a Latin adjective meaning "abandoned" or "waste," in allusion to the habitat of the type series.

Remarks.--N. deserta was collected along the grass-sedge flood banks of the San Juan and Gallinas Rivers in New Mexico. A single female was swept from emergent vegetation associated with a pond south of Blanding, Utah. This species has always been found sympatric with several other Notiphila species. It is distributed in northern New Mexico and southeastern Utah.

Notiphila (Agrolimna) elophila new species

(figures 109, 128-129)

Diagnosis.--Although this species closely resembles N. olivacea and N. uliginosa, it may be distinguished from either by the following combination of characters. There are only five to seven arisal branches in N. elophila and the dorsalmost postocular bristles are very large, approximately twice the length of the postocellars. The male genitalia are as in figures 109 and 128-129 and demonstrate the close relationship between this species and its similar congeners. The surstyli do not have a secondary lobe as in N. uliginosa and the shape of the hypandrial process distinguished this species from any other.

Description.--Medium sized flies, length approximately 4.55 mm (taken from the allotype), with light brown to grayish-brown coloration and some darker brown markings.

Head. Head ratio 1:0.74; postfrons ratio 1:0.61; mesotriangular area and lateral margins of frons concolorous, slightly lighter than remainder of frons, pruinose, light brown; remainder of frons with some charcoal tinges. Dorsalmost postocular bristles very large, equal or slightly more than twice the length of postocellars; two pairs of proclinate fronto-orbital setae. Antennal segments entirely dark, black; arista with five to seven aristal branches. Face golden brown, facial setae long, numbering five to seven; prefrons ratio 1:0.69. Eye ratio 1:0.69; eye-to-cheek ratio 1:0.19. Gena fairly narrow, generally concolorous with facial color anteriorly, becoming grayer posteriorly; genal bristle subequal to dorsalmost postocular or slightly smaller. Maxillary palpi dark, black.

Thorax. Mesonotum light brown with some brownish-gold pruinosity posteriorly, anteriorly more grayed, immaculate, darker than pleura. Mesopleuron with faint darkened area but without definite maculation spot. Femora and tibiae generally concolorous, dark, with extensive grayed, dusted areas, apically pale; tarsi generally pale, fore pair slightly darker. Setal fascicle of hind basitarsus pale. Wing ratio 1:0.40; costal vein ratio 1:0.53; M_{1+2} vein ratio 1:0.93.

Abdomen. Generally as in N. uliginosa or N. lama. Male genitalia as in diagnosis and in figures 109 and 128-129.

Type material. --Male holotype: River head, Long Island, New York, 4 July 1952, Roy Latham; HOLOTYPE *Notiphila elophila* Mathis (red). Allotype: Montauk, Long Island, New York, 4 September 1953, Roy Latham. The holotype and allotype will be deposited with the National Museum of Natural History, Washington, D.C., type number 73544.

Etymology. --Elo (Greek meaning "marsh") plus philia (Greek meaning "love") in allusion to the habitat of this species.

Remarks. --This species occurs sympatrically with *N. olivacea*. Nothing is known regarding its biology and it is only known from Long Island, New York.

Notiphila (Agrolimna) macrochaeta Loew

(figures 110, 130-131, 161; map 4)

Notiphila macrochaeta Loew, 1878, Ztschr. f. die Gesam. Naturw. 51:192.

Notiphila (Agrolimna) macrochaeta, Cresson, 1917, Trans. Amer. Ent. Soc. 43:54.

Notiphila (Agrolimna) macrochaeta brachychaeta Cresson, 1946, Trans. Amer. Ent. Soc. 72:232. Wirth, 1965, U.S.D.A. Agri. Handbk. No. 276, p. 747.

Type and type locality. --Male holotype: Texas Left. (?) (green); Loew Coll.; macrochaeta n. sn.; Type 11131; *Notiphila macrochaeta* Lw, det W. Wirth '61. The holotype is presently in the possession of the Museum of Comparative Zoology, Harvard University. The type of *N. macrochaeta brachychaeta* is deposited with the Academy of Natural Sciences of Philadelphia, type number 6673; it bears the following label data: Pacific Grove, June Cal., W.H. Mann; 1285; TYPE 6673 *Notiphila macrochaeta brachychaeta* Cresson TYPE.

Diagnosis. --This species is very similar to *N. decoris*, especially the females, but it may be distinguished by the following characters. The setal fascicle of the hind basitarsus has one black setae that is over one-third the length of the basitarsal segment in male specimens. The black seta of female specimens is not enlarged, however, but females may be separated from those of *N. decoris* by the membranaceous posteromedial area of the fifth abdominal tergite.

Description. --Small to medium sized flies, length 2.80 to 4.15 mm, with subdued grayish-brown to gray coloration.

Head. Head ratio 1:0.71; postfrons ratio 1:0.56; frons generally subdued, often the anterior margin is overcast with grayish-silver coloration; lateral margins of frons more or less concolorous with median triangular areas, rest of frons blackish. Dorsalmost postocular bristles subequal to postocellars; two pairs of proclinate

fronto-orbital setae. Antennae entirely black; eight to ten arisal branches. Face usually golden yellow, pruinose in texture; prefrons ratio 1:0.71; facial setae hair-like. Eye ratio 1:0.78; eye-to-cheek ratio 1:0.18. Gena becoming grayish-white posteriorly, genal bristle distinct. Maxillary palpi black.

Thorax. Generally unicolorous, mesonotum slightly darker; mesonotum vittate although not pronounced; mesopleuron without any maculation spot or but slightly discolored. Femora and tibiae grayish-black; tarsi yellowish-orange except fore tarsi which are darkened, tinged with some charcoal coloration. Setal fascicle of hind basitarsus with one black seta, in males seta is over one-third length of basitarsal segment. Wing ratio 1:0.46; costal vein ratio 1:0.49; M_{1+2} vein ratio 1:1.1.

Abdomen. Ground color generally concolorous with thorax; fascia contrasting, well defined and dark brown but not continuing on ventral surface. Abdominal ratio in males 1:0.76; length of fourth tergite to fifth tergite ratio in males 1:1.1; fifth tergite ratio 1:0.59. Male postabdomen as in figures 110, 130-131, and 161.

Specimens examined. --One thousand three hundred forty-seven specimens from the following localities: CANADA: Manitoba: Whitewater Lake - 4 mi N Whitewater (CNC). UNITED STATES: Arizona: Cochise Co., 13 mi E Douglas (UCD), Chiricahua Mountains (KU),

Herb Martyr Dam (FSCA, KSU, WNM), John Hand Park (FSCA),
 5 mi W Portal-Southwest Research Station (CAS), Elfrida (UA),
 Sunnyside Canyon-Huachuca Mountains (USNM); Coconino Co., Bill
 Williams Forest (KU), Oak Creek Canyon-Sedona (USNM); Maricopa
 Co., Tempe (ISU); Pima Co. (US), Santa Cruz River (UA); Gila Co.,
 5 mi N Payson-Verde River (WNM); Yavapai Co., Montezuma-Well
 National Monument (USNM). Arkansas: Washington Co. (USNM).
California: Asilomar (USNM); Ortega Highway (USNM); Alameda Co.,
 Berkeley (CAS); Butte Co., Chino (USNM); Contra Costa Co., Antioch
 (UCR); Fresno Co., 3.5 mi NE Piedras (UCR); Humboldt Co., Mad
 River Beach (UCB); Inyo Co., Deep Springs (UCD, UCR, USNM),
 Crooked Creek Laboratory; White Mountains (UCB), One Pine (KU),
 Owens River (CU), Shoshone (USNM); Kern Co., S Inlet-Lake Isabella
 (UCR), Rosamond (KU, USNM), Onyx (KU); Los Angeles Co.,
 Inglewood-Ingleside (CU), Los Angeles River (ANSP); Marin Co.,
 15 mi NW Olema (UCB), Mill Valley (CAS); Modoc Co., Lake City
 (UCD, USNM); Mono Co., 2 mi N Mono Lake (WNM); Monterey Co.,
 Del Monte (USNM), Pacific Grove (USNM), Marina (CAS), Monterey
 (AMNH), Cala (AMNH); Napa Co., Knoxville (UCD); Nevada Co.,
 5 mi NW Hobart Mills (WNM); Orange Co., Buena Park (USNM),
 Capistrano-hot springs (USNM), Laguna Beach (CAS, UCB); River-
 side Co., Riverside (ANSP, USNM), Temecula (UC B, UCD, UCR,
 USNM), Vail Lake, Temecula (UCR); San Bernardino Co., Redlands

(USNM); San Diego Co., Desert edge (CAS), 25 mi N Ensenada (USNM), Escondido (USNM), Julian (UCD, USNM), La Jolla (CAS, KU), Lake Henshaw Dam (UCR), Mesa Grande-Russian River (ANSP), Solana Beach (CAS); San Luis Obispo Co., Harmony (AMNH, USNM), Morro Bay (USNM), Oso Flaco Lake (UCB, UCR, USNM), San Simeon (AMNH, USNM); Santa Barbara Co., Carpinteria (USNM); Santa Clara Co., Stanford (ANSP, CAS, USNM), San Antonio Valley (UCB); Santa Cruz Co., 8 mi S Grenada (WNM); Solano Co., Rio Vista (USNM), 1/2 mi E Pittman Road-Cordelia Road (CU); Sutter Co., Live Oak Park (USNM); Tulare Co., 22 mi N California Hot Springs (WNM), E Success Reservoir (UCR, USNM), Three Rivers (KU), Visalia (ANSP, USNM), Woodlake (USNM); Yolo Co., Putah Canyon (UCD). Colorado: Baca Co., 28 mi S Walsh (WSU); Clear Creek Co., Doolittle Ranch-Mount Evans (CNC), Echo Lake-Mount Evans (CNC), Chicago Creek-Mount Evans (CNC); Dolores Co., 6 1/2 mi W Dove Creek (WNM); El Paso Co. (KNSU); Lake Co., Independence Pass (CNC); Larimer Co., Fort Collins (CSU); Mesa Co., Grand Junction (KU); Park Co., Kenosha Pass (CSU); Pueblo Co., Pueblo (ANSP). Georgia: Neep Gap (USNM). Idaho: Canyon Co., Caldwell (ANSP); Oneida Co., Curlew Valley Reservoir (ISU). Iowa: Dickinson Co., Iowa Lakeside Laboratory (ISU), West Okoboji Lake (ISU); Fremont Co., Forney's Lake Public Hunting Area (ISU); Hamilton Co., Little Wall Lake (ISU, USNM); Story Co., Ames (CNC, ISU, USNM). Kansas: Allen Co.,

(KU); Butler Co. (ANSP); Clay Co. (CU), Clay Center (USR); Douglas Co. (KU), Lawrence (CNC, KU); Harper Co. (KU); Ottawa Co. (ANSP); Pottawatomie Co. (KNSU); Riley Co., Manhattan (KNSU); Seward Co., Liberal (KU). Louisiana: East Feliciana Parish, Clinton (ISU). Minnesota: Houston Co. (UMN); Olmstead, Rochester (KU); Saint Louis Co., Eaglesnest (USNM); Wabasha Co., Wabasha (UMN). Missouri: Barry Co., Roaring River State Park (CAS); Jackson Co., Atherton (ANSP); Laclede Co., Lebanon (USNM). Montana: Lake Co., 5 mi S Swan Lake (KSU); Treasure Co., US Hwy 94 at rest stop ca. 27 mi W Forsythe (CU). Nebraska: Chase Co., 10 mi SW Imperial (USNM, UN); Cherry Co., Snake Falls (MSU, USNM), Sargent (UN); Dawson Co., Willow Island (UCD); Dixon Co., Allen (KSU); Grant Co., 3 mi S Hyannis (UN); Holt Co., 24 mi S Atkinson-Lierman Ranch (UN); Knox Co., 15 mi NW Crofton-Lewis and Clark Lake (UN, USNM); Lancaster Co., Lincoln (UN), Hallman (USNM); Loup Co. (UN); Morrill Co. (MSU, USNM); Sioux Co., Andrews (UN). Nevada: Churchill Co., Fallon (KU, USNM); Nye Co., 4 1/2 mi N Beatty (WNM), 1.6 mi S Springdale (AMNH); Ormsby Co., Carson City (KU, USNM); Washoe Co., Reno (USHM). New Mexico: Catron Co., Apache Creek (WNM), Adam Hoague Lake (WNM); Dona Ana Co., Las Cruces (WNM); Grant Co., Mangus Springs - 11 mi S Cliff (WNM); Hidalgo Co., 20 mi S Rodeo (UCR); Otero Co., Alamogordo (KU); Sandoval Co., 7 1/2 mi N Jemez Springs (WNM); San Miguel Co.,

1/2 mi NE Montezuma (WNM); Socorro Co., Magdalena (AMNH, FSCA), Socorro (ANSP); Torrance Co., Estancia (KU). Oklahoma: Alfalfa Co., Cherokee (AMNH). Oregon: Harney Co., Denio (USNM), 5 mi NE Fields (WNM), hot springs in desert N of St Hwy 78 and 8.4 mi E Lawen (CU); Klamath Co., NE Bly-Deming Creek Reservoir (WSU); Lake Co., Ana Reservoir (WNM), NW shore Alkali Lake (WNM), Hunter Hot Spring (WNM), 19.8 mi NW Paisley (WNM); Summer Lake (WNM), 4.8 mi N Summer Lake (WNM); Morrow Co., 2 mi N Irrigon (WNM); Union Co., Hot Lake (WNM). South Dakota: Burdette (KU); Brookings Co., Brookings (ANSP, USNM); Mix Co., Lake Andes (ANSP); Stanley Co., Fort Pierre (ANSP); Todd Co., 15 mi S Mission (ISU); Union Co., 5 mi W Jefferson (ISU). Texas: Aransas Co., Aransas Refuge (USNM); Armstrong Co., Palo Duro State Park (USNM); Brazoria Co. (KU); Brooks Co. (KU); Cameron Co., Brownsville (CAS, USNM), Harlingen (USNM), San Benito (ISU); Balhoun Co., Lavaca Port (KNSU); Dallas Co. (UMN); Cherokii Co., Jacksonville (USNM); Galveston Co., Dickinson (ANSP), Galveston (AMNH, ANSP, KU, USNM); Gillespie Co., Pedernales River (USNM); Hays Co., San Marcos (USNM); Hidalgo Co., Laguna Madre - 25 mi SE Harlingen (ISU, USNM); Jackson Co., Edna (USNM); Jeff Davis Co., 23 mi W Fort Davis (CNC); Jim Wells Co. (KU, USNM); Kenedy Co., Sarita (IHNS); Kerr Co., Kerrville (CNC), 10 mi S Kerrville (CAS), Henkes Pond near Kerrville (USNM); Kimble Co., Roosevelt

(USNM); Lubbock Co., Buffalo Spring Lake (USNM); Sutton Co. (KU); Val Verde Co., Devil's River-Del Rio (CNC). Utah: Box Elder Co., Blue Creek (USU), Brigham (USU), Corinne (USU), Fielding (USU), Howell (USU); Cache Co., Amalga (USU), Logan (USU), Logan Canyon (ANSP, USU), Logan Dry Canyon (USU); Davis Co., Farmington (USNM), Syracuse (ANSP, USU), West Point (USU); Emery Co., Green River (UMN); Grand Co., Moab (USU, UMN); Iron Co., Parowan (USU); Rich Co., Randolph (ANSP); San Juan Co., 2 mi S Blanding (WNM); Sevier Co., Monroe (ANSP), Sigurd (ANSP); Utah Co., Benjamin (UMN), Goshen Pond (WNM), Payson (UMN), Provo Environs (WNM), Spanish Fork (ISU, USU), E side Utah Lake (WNM); Washington Co., Leeds (UMN); Weber Co., Hooper (ANSP, USU), Ogden (USU). Washington: Franklin Co., 7 mi WSW Eltopia (WNM), 2 mi E Pasco (WNM); Grant Co., O'Sullivan Dam (WSU); Jefferson Co., Port Townsend (WSU); Yakima Co., Byron Ponds near Prosser (WSU).

Remarks.--This species is not likely to be confused with any other species of the subgenus Agrolimna except for N. decoris. The characters mentioned in the key and diagnosis should serve to adequately separate them however.

N. macrochaeta often occurs sympatrically with N. decoris and frequently with N. olivacea. Like N. decoris, it is usually associated

with the littoral zone of lentic systems where some emergent vegetation exists. These areas usually have a higher percentage of grasses than sedges and the water level is quite seasonal, often drying up during the late summer. N. macrochaeta specimens have been collected at elevation of up to 12,100 feet in the Colorado Rockies.

This species is widely distributed in North America west of the Mississippi River and into the Southeast as far as Georgia. I have examined many specimens from Mexico also (map 4). Collection dates are from 25 January to 6 December.

Notiphila (Agrolimna) minima Cresson

(figures 111, 162)

Notiphila (Agrolimna) occidentalis var. minima Cresson, 1917, Trans. Amer. Ent. Soc. 43:52.

Notiphila (Agrolimna) occidentalis subsp. minima Cresson, Cresson, 1946, Trans. Amer. Ent. Soc. 72:233.

Notiphila (Agrolimna) minima, Wirth, 1965, U.S.D.A. Agri. Handbk. No. 276, p. 747.

Type and type locality. --Male holotype; Jemez Mts., IX-10-14, N.M.; male; Holo TYPE 6108; Holo-TYPE Notiphila minima, E.T. Cresson Jr. The holotype is deposited with The Academy of Natural

Sciences of Philadelphia. One male paratopotype is listed in Cresson's original description.

Diagnosis.--Externally, N. minima appears to be similar to N. nanosoma and N. atripes. N. minima is more in the size range of N. nanosoma and the male genitalia also evidence this association but the entirely darkened legs of the latter will serve to separate them.

Characters of the male genitalia will also distinguish N. minima from N. nanosoma. The aedeagal apodeme of N. minima is subtriangular and the dorsal edge is not rounded. The hypandrial process has a small prebasal swelling and the preapical enlargement is longer and more prominent than the same features of N. nanosoma. See figures 111 and 112 for a comparison.

Description.--Small flies, length 2.62 to 3.25 mm, with brownish-gray to gray coloration and black markings.

Head. Head ratio 1:0.68; postfrons ratio 1:0.55; lateral margins concolorous with mesotriangular area of frons, brownish-gray; remainder of frons subdued black, somewhat pruinose. Dorsalmost postocular bristles larger than postocellars, subequal to genal bristles; two pairs of proclinate fronto-orbital setae. Antennae entirely black; arista with eight to ten aristal branches. Face grayish-yellow; prefrons ratio 1:0.54; facial setae hair-like. Eye ratio 1:0.83; eye-to-cheek ratio 1:0.13. Gena narrow, concolorous

with face anteriorly, becoming grayish posteriorly; genal bristle subequal to dorsalmost postocular bristle. Maxillary palpi black.

Thorax. Mesonotum and mesopleura immaculate, light brownish-gray, becoming more gray ventrally. Femora and tibiae concolorous, grayish-black, fore tarsi generally dark although in some specimens there is some yellow coloration; mid and hind tarsi yellow. Setal fascicle of hind basitarsus pale, yellow. Wing ratio 1:0.42; costal vein ratio 1:0.54; M_{1+2} vein ratio 1:1.2.

Abdomen. Abdomen ratio 1:0.62; length of fourth tergite to fifth tergite ratio in males 1:0.97; fifth tergite ratio in males 1:0.70. Fifth abdominal segment entirely black; fourth tergite mostly black except for posterior margin; first, second, and third segments with considerable gray background color but third tergite also with black fascia along anterior margin. Male postabdomen as in diagnosis and figures 111 and 162.

Specimens examined. -- One hundred thirty from the following localities: UNITED STATES: Nevada: Nye Co., 1.6 mi S Springdale (ANSP, USNM). New Mexico: Catron Co., Apache Creek (WNM); Guadalupe Co., Santa Rose (USU); San Juan Co., 1 mi S Bloomfield (WNM); San Miguel Co., 1/2 mi NE Montezuma (WNM); Sandoval Co., Jemez Springs Mts. (ANSP); Valencia Co., Belen (KU). Utah: Iron Co., Parowan (UMN); Wasatch Co., Soldier Summit (UMN); Washington Co., Leeds (UMN, USNM).

Remarks.--Cresson named N. minima as a subspecies of N. occidentalis (= N. quadrisetosa) in his 1917 paper but in his synopsis of the genus in 1946, he synonymized it with the nominate species. However, Wirth (1965) recognized it as a full species which is amply confirmed by differences in their size, color, and male genitalic characters. This species is more closely related to N. nanosoma and N. atripes than to N. quadrisetosa.

This species occurs in the Southwest in Nevada, New Mexico, and Utah. Collection dates are from 26 May to 8 August.

Notiphila (Agrolimna) nanosoma new species

(figures 91, 112, 166, 178-179)

Diagnosis.--N. nanosoma resembles both N. minima and N. atripes but differs from either of the latter species by the following combination of characters. The legs are unicolorous, entirely black, except for the setal fascicle of the hind basitarsus which is pale, amber. The fascia of the abdominal tergites are broad, especially on the fourth and fifth tergites where they cover most of the dorsum.

Specimens of N. nanosoma are smaller on the average than N. atripes specimens and the male genitalia of N. nanosoma are quite distinctive. The hypandrial process of N. nanosoma and N. minima are similar but in general the process of N. nanosoma is broader and the preapical enlargement is not as extensive or prominent. Other differences

in the male genitalia may be noted in the shapes of the aedeagal apodeme which is rounded dorsally in N. minima, and the surstyli. Compare figures 111 and 111.

Description. --Small flies, length 2.56 to 3.46 mm, with grayish coloration and black markings.

Head. Head ratio 1:0.76; postfrons ratio 1:0.58; extreme lateral margin of frons whitish-gray, otherwise most of lateral margins concolorous with mesotriangular area; remainder of frons subdued black, lightly pruinose. Dorsalmost postocular bristle slightly larger than postocellar bristles; two pairs of proclinate fronto-orbital setae. Antennae entirely black; arista with eight to ten aristal branches. Face light grayish-yellow; prefrons ratio 1:0.56; facial setae small, hair-like. Eye ratio 1:0.80; eye-to-cheek ratio 1:0.16. Gena narrow, concolorous with face anteriorly, becoming gray posteriorly. Maxillary palpi black.

Thorax. Thorax light brownish-gray, pleura grayer than mesonotum; mesopleuron and mesonotum immaculate although some specimens have very light vittate markings on the mesonotum. Legs entirely grayish-black to black. Setal fascicle of hind basitarsus pale, amber. Wing ratio 1:0.42; costal vein ratio 1:0.60; M_{1+2} vein ratio 1:1.2.

Abdomen. Abdomen ratio 1:0.63; length of fourth tergite to fifth

tergite ratio in males 1:1; fifth tergite ratio in males 1:0.61. Fascia of abdominal tergites black; first and second tergites mostly gray; third tergite approximately half and half; fourth tergite mostly black except for a median gray area; fifth segment entirely black.

Type material. --Male holotype: CALIF Nevada Co, 5 mi NW Hobart Mill, 20 June 1974, Wayne N. Mathis; HOLOTYPE *Notiphila nanosoma* Mathis (red). Allotype and 79 paratypes (41 males, 37 females) with the same label data as the type. Other paratypes as follows: three males and one female: CALIF Nevada Co, 2 1/2 mi NW Hobart Mill, 20 June 1974, Wayne N. Mathis (WNM); six males and seven females: Sage Hen, 5 mi NW Hobart Mills, CALIF., VI-20-54, M.T. James (USNM, WSU); one female, two males: Sagehen ne. Hobart Mills, Calif. VI-25-54; R.H. Goodwin, Collector (UCB); two males, one female: CALIF: Nev. Co., Sagehen Creek, 6300' VII-18-67, W.J. Turner, Collector (UCB); one female: Sagehen ne., Hobart Mills, Calif. VII-4-62, C.A. Toschi, Collector (UCB); nine males, eleven females: ORE Deschutes Co, 15 mi S Sisters, 8 August 1973, 10 July 1972, Wayne N. Mathis. The holotype will be deposited with the National Museum of Natural History, Washington, D.C., type number 73545.

Etymology. --Nanosoma is a combination of the Greek nouns nanos,

meaning "dwarf" and soma, meaning "body," in reference to the small body size.

Remarks.--This species has been collected only from high mountain grass-sedge meadows in Oregon and California. These habitats are fragile and very seasonal. In Oregon, N. nanosoma has been collected only in July and August, and the specific collection site was limited to a small area of the total meadow where iron oxide had been leached from the soil and was floating on the water's surface. In California, this species occurs sympatrically with N. atripes and N. decoris.

Collection dates are from 20 June to 18 July.

Notiphila (Agrolimna) olivacea Cresson

(figures 113, 132, 163, 181; map 10)

Notiphila (Agrolimna) olivacea Cresson, 1917, Trans. Amer. Ent.

Soc. 43:52.

Types and type locality.--Male holotype: Sandusky, Ohio, July, 1914. The holotype is deposited with the Ohio State University insect collection. Cresson originally listed the type deposition as "Ohio Univ. Coll." This citation is either in error or the type was deposited in the Ohio State collection at a later date. Two male and six female paratopotypes were also listed in the original description.

Diagnosis.--N. olivacea closely resembles N. deonieri, N. uliginosa, N. paludia, N. aenigma, and N. elophila. The latter species are often confused with N. olivacea and in the case of N. deonieri, comparisons of the male genitalia are necessary to accurately distinguish the species. However, N. olivacea can usually be distinguished from the others by the following combination of external characters. The maxillary palpi and antennae are entirely black, the mesonotum and mesopleuron, although not immaculate, do not have well defined maculation patterns, the fore tarsi are usually darkened and the mid and hind tarsi plus the setal fascicle of the hind basitarsus are pale, yellow. The fascia of abdominal segments three and four are usually distinct, contrasting with the gray ground color along the posterior margins. The male genitalia are as in figures 113, 132, 163, and 181.

Description.--Medium sized flies, length 3.35 to 4.5 mm, with light brownish-gray to olive gray coloration and brown markings.

Head. Head ratio 1:0.72; postfrons ratio 1:0.64; frons with lateral margins and mesotriangular area concolorous, gray, pruinose; remainder of frons subdued black, also pruinose. Dorsalmost post-ocular bristles larger than postocellars although the largest pair of the latter bristles are but slightly smaller; two pairs of proclinate fronto-orbital setae. Antennae entirely black; arista with 10 to 13

aristal branching hairs. Face pale, grayish-yellow; prefrons ratio 1:0.72; facial setae numbering seven to nine, small, hair-like. Eye ratio 1:0.74; eye-to-cheek ratio 1:0.19. Gena narrow, gray except for anterior portion which is concolorous with face; genal bristles subequal to dorsalmost postocular bristles. Maxillary palpi black.

Thorax. Mesonotum a little darker than pleura, brownish-gray, immaculate, mesopleuron often with brown spot near dorsal edge but not subrectangular as in aenigma. Legs except for tarsi grayish-black, joints often pale; tarsi yellow, sometimes fore tarsi darkened with brown tinges. Setal fascicle of hind basitarsus pale, yellow.

Wing ratio 1:0.43; costal vein ratio 1:0.38; M_{1+2} vein ratio 1:0.83.

Abdomen. Abdomen ratio in males 1:0.86; length of fourth tergite to fifth tergite ratio in males 1:1.3; fifth tergite ratio in males 1:0.70. Fascia of third, fourth and fifth segments brown; posterior margins of third and fourth segment gray, contrasting with brown fascia. Male postabdomen as in figures 113, 132, 163, and 181.

Specimens examined. -- One thousand two hundred thirteen specimens from the following localities: CANADA: Alberta: Banff (ANSP, CNC); Carmangay-Little Bow River (USNM); Gull Lake (ANSP); Tabe River (ANSP). British Columbia: Kamloops-Alkali Lake (USNM); Keremeos (CNC); Hatzic Lake (CNC); Nicola (CNC); Okanagan Falls (CNC); Oliver (ANSP, CNC); Sawmill Lake-Telegraph Creek (CNC).

Manitoba: Aweme E. (CNC); 2 mi N Forest (CNC); 9 mi N Forest (CNC); International Peace Gardens-Turtle Mountain Forest Reserve (CNC); Max Lake-Turtle Mountain Forest Reserve (CNC); Ninette (CNC); Scorth (CNC); 5 mi SW Shilo (CNC); 4 mi N Whitewater-Whitewater Lake (CNC); Winnipeg-Beach (CNC). New Brunswick:

Glebe Road-Chamcook (CNC). Nova Scotia: Lockeport (CNC).

Ontario: Kent-Rondeau Park (ANSP, USNM); Long Point-Lake Erie (CNC); Marmora (CNC); Ottawa (ANSP, CNC); Ottawa River-Remic Rapids (CNC); Orillia (CNC); Perth Road (CNC); Point Pelee (CNC); Silver Creek (ANSP); Toronto (ANSP); Turkey Point (CNC). Quebec: L'Assomption (CNC); Montreal (AMNH); Horway Bay (CNC).

Saskatchewan: Christopher Lake (CNC); Indian Head (CNC). UNITED

STATES: Alaska: Anchorage-Fish Creek Flats (USNM). Arizona:

Pima Co., Picture Rock Pass-Tucson Mountains (US). California:

Upper Lake (FSCA); Alameda Co., Oakland (CAS); Inyo Co., 2 mi N

Cartago (USNM), Deep Springs (UCB, USNM); Kern Co., Kernville

(KU); Modoc Co., 4 mi W Alturas (WNM), Surprise Valley-dunes

Fort Bidwell (UCB); Mono Co., W shore Mono Lake (WNM); Monterey

Co., Carmel (USNM); Nevada Co., 1 mi NW Hobart Mills (WNM);

Riverside Co., Aguanga-4 mi W Riverside (USNM, UCD); San

Bernardino Co., Boulder Bay-Big Bear Lake (UCR); San Diego Co.,

Campo (KU), Mission-Beach (KU); Santa Barbara Co., Carpinteria

(USNM, WSU); Santa Clara Co., San Antonio Ranger Station (UCB);

Sierra Co., Sierraville (UCB); Solano Co., Cordelia Road - 1/2 mi E Pittman Road (CU). Colorado: Boulder Co., Boulder (WSU); Clear Creek Co., Idaho Springs (ANSP, CSU, WSU); Dolores Co., 6 1/2 mi W Dove Creek (WNM); Jefferson Co., Golden (USNM); Larimer Co., Fort Collins (ANSP, CSU, WSU); Mesa Co., Fruita (USNM); Mineral Co., Creede (ISU); Montezuma Co., 8 mi W Cortez (WNM); Pueblo Co., Pueblo (ANSP); Weld Co., Roggen (ANSP, WSU). Idaho: Caribou Co., Soda Springs - 1 mi N (WNM); Cassia Co., Burley (KU); Fremont Co., Saint Anthony (USHM); Kootenia Co., Cour d'Alene-Echo Bay (USNM), 1/2 mi E Harrison (WNM). Illinois: Pistakee Bay (USNM); Cook Co., Chicago (USNM); McHenry Co., McHenry (ANSP). Iowa: Boone Co., Ledges State Park (ISU); Guthrie Co., Springbrook State Park (ISU); Hamilton Co., Goose Lake (USNM), Little Wall Lake (ISU, USNM); Story Co., Ames (CNC), 4 mi E Gilbert (ISU); Woodbury Co., Brown's Lake (ISU). Kansas: Clark Co. (KU); Harvey Co., Newton (KU); Stafford Co. (ANSP). Massachusetts: Hough-Horse Neck Beach (USHM); Naushon (ANSP); Penikese Island (USNM); Barnstable Co., Falmouth (USNM), Provincetown (ANSP), Woods Hole (USNM); Bristol Co., New Bedford (AMNH, FSCA); Nantucket Co., Nantucket (ANSP). Michigan: Allegan Co., Douglas Lake (USNM); Alpena Co. (USNM); Arenac Co. (USNM); Bay Co. (ANSP, MSU, USNM); Houghton Co. (USNM); Iosco Co. (MSU); Mackinac Co. (MSU); Midland Co. (ANSP, MSU); Monroe Co., Monroe (ANSP,

USNM); Muskegon Co. (MSU); Schoolcraft Co. (MSU); Wayne Co. (USNM), Detroit (ANSP, USNM), Grosse Ile (USNM). Minnesota: Marshall Co. (UMN); Roseau Co., Warroad (ANSP); Sibley Co., River near Blakeley (UMN). Montana: Flathead Co., 1 mi W Bigfork (KSU, USNM), 2 mi W Bigfork (KSU), 6 mi NW Bigfork (KSU, USNM), 8 mi NW Bigfork (KSU, USNM); Lake Co., 15 mi S Bigfork (KSU), Black Lake - 2 mi W Dayton (KSU), Dayton (ANSP), 3 mi E Polson (KSU), 4 mi E Polson (KSU, USNM), 3 mi S Ronan (KSU), 3.2 mi S Ronan (WNM). Nebraska: Dawson Co., Willow Island (UCD); Hall Co., Grand Island (UCD). Nevada: Churchill Co., Soda Lakes near Hazen (USNM); Elko Co., Wells (USNM); Storey Co., Wadsworth (USNM); Washoe Co., Sparks (CAS). New Jersey: Cape May Co., Cape May (ANSP); Essex Co., Newark (AMNH), W Orange (ANSP); Ocean Co., Manahawkin (ANSP). New Mexico: Bernalillo Co., US 85 - 3 mi S Isleta (CU); Catron Co., Apache Creek (WNM); Otero Co., Cloudcroft (KU); San Juan Co., 1 mi S Bloomfield (WNM); San Miguel Co., 1/2 mi NE Montezuma (WNM). New York: Bronx (AMNH); Whiteface Mountain (CNC); Cayuga Co., N Fairhaven (CU); Erie Co., Elma (ANSP), Ton. Indian Reservation (CU); Genessee Co., Bergen (KU); Queens Co., Flushing (USNM); Rockland Co., Bear Mountain Bridge (USNM); Schoharie Co., Sharon Springs (ANSP); Suffolk Co., Babylon (USNM), Cold Spring Harbor (USNM); Tompkins Co., 1.5 mi W Cardiff (CU), Ithaca (CU, UCR), Taughannock Falls (USNM); Wyoming

Co., Portageville-Genessee River (USNM). North Dakota: Benson Co., Broken Bone Lake (CU); Grand Forks Co., 100 yards E junction US Hwy 2 and St Hwy 32 (CU). Ohio: Carroll Co. (KSU); Erie Co., Kelleys Island (OHSU), Sandusky (ANSP, OHSU); Portage Co., 4.5 mi E Kent (KSU), 4.5 mi NE Kent (KSU), 8 mi SE Kent (KSU). Oregon: Beaver Marsh (UCB); Grant Co., 1.2 mi S Seneca (WNM); Harney Co., Denio (USNM), Harney Lake (USNM), S shore Harney Lake (WNM), Harney Hot Spring (WNM), Willow Creek - W Whitehorse Ranch (WNM); Lake Co., Ana Reservoir (WNM), NW shore Alkali Lake (WNM), Hunter Hot Springs (WNM), 4.3 mi NW Paisley (WNM), 19.8 mi NW Paisley (WNM), 4.8 mi N Summer Lake (WNM), Warner Canyon (WNM); Malheur Co., Vale (USU); Morrow Co., 2 mi N Irrigon (WNM); Umatilla Co., Hermiston (WNM); Wheeler Co., 18 1/2 mi E Mitchell (WNM). South Dakota: Lake Oakwood (ANSP); Custer Co., 7 mi W Custer (WNM); Fall River Co., Hot Springs (ANSP); Lawrence Co., Spearfish (ANSP); Union Co., Elk Point (ANSP). Texas: Buffalo Spring Lake (USNM); Lubbock Co., Lubbock (CSU). Utah: Cache Co., Logan (UMN), Logan Canyon (ANSP), Mendon (ANSP), Hyde Park (USU), Millville (KSU), Trenton (UMN); Carbon Co., Clear Creek Canyon (ISU), S Price (WNM); Duchesne Co., Duchesne (USU); Emery Co., 1/2 mi N Castle Dale (WNM), Green River (ISU); Grand Co., Moab (ISU); Iron Co., Coal Creek (USU); Kane Co., Kanab (ISU), Kanab Creek Canyon (ISU); Millard Co.,

Fillmore (UMN); Salt Lake Co., Salt Lake City (USNM), Sandy (USU); San Juan Co., 6 1/2 mi N LaSal Junction (WNM); Sevier Co., 9 mi E Cove Fort-Fish Lake National Forest (ISU), Richfield (ISU); Utah Co., Goshen (USU), Provo (UMN); Wasatch Co., Heber (USNM); Weber Co., Ogden (UMN), Ogden Canyon (ANSP, USU). Washington: Adams Co., Ritzville (USNM); Franklin Co., 7 mi SWS Eltopia (WNM), Kahlotus Lake (WSU), Palouse Falls (WNM), 2 mi E Pasco (WNM), Scooteneey Recreational Area (WNM); Grant Co., Bank Lake (WNM), Coulee City (USNM), O'Sullivan Dam (WSU); King Co., Seattle (USNM); Lincoln Co., Sprague (USNM); Pierce Co., Fort Lewis-Sears Lake (CAS); Snohomish Co., Stanwood (USNM); Whitman Co., Pullman (WSU); Yakima Co., Byron Ponds near Prosser (WSU), Moxee (USNM). Wyoming: Niobrara Co., 12 mi N Lusk (KU); Platte Co., Chugwater (ANSP); Yellowstone National Park, Riverside (ANSP, USNM).

Remarks.--This species is similar to several members of the subgenus Agrolimna, and in many cases, reference to the male genitalia is necessary to accurately identify it. I have collected N. olivacea from fresh water situations but also along the margins of shallow, alkaline lakes in eastern Oregon where sedge-meadows are found. In the West, it commonly occurs with N. macrochaeta and N. decoris and I have also found it sympatrically with N. aenigma. Deonier collected a large series of both N. olivacea and N. deonieri from Goose Lake, Iowa.

N. olivacea is one of the most widely distributed species of the subgenus Agrolimna. It occurs throughout North America except for the Southeast (map 10). Collection dates are from 12 April to 18 October.

Notiphila (Agrolimna) pallidipalpis Cresson

(figures 115, 167; map 7)

Notiphila pallidipalpis Cresson, 1940, Notulae Nat. Acad. Nat. Sci. Phila. 38:8.

Notiphila (Agrolimna) pallidipalpis Cresson, Cresson, 1946, Trans. Amer. Ent. Soc. 72:233.

Types and type locality. --Male holotype; Isle Royale, Mich., Aug. 3-7, 1936, C. Sabrosky; TYPE 6544 Male Notiphila PALLIDIPALPIS, E.T. Cresson, Jr. The holotype is deposited with The Academy of Natural Sciences of Philadelphia. The following paratypes were also designated by Cresson: two females, Leelanau County, Michigan, June 21, 1937; one female, Beaver Dam, Wisconsin, July 2, 1915; one female, Moore's Lake, Anoka County, Minnesota, June 19, 1925; one female, Lake Calhoun, Hennepin County, Minnesota, June 12, 1921, one male and female, Orillia, Ontario, Canada, July 17, 1923, one female, Uhrhoff, Ontario, Canada, July 14, 1923.

Diagnosis. -- N. pallidipalpis may be distinguished from all other species of Agrolimna by the following combination of characters. All antennal segments are entirely black; the maxillary palpi are pale, yellowish-orange; the mesonotum and meopleuron are immaculate; all tarsi are pale, although the fore tarsi are often slightly darkened and the setal fascicle of the hind basitarsus is pale; and the fascia of the abdominal tergites are blackish-brown with well defined posterior margins. The characters of the male postabdomen of N. pallidipalpis bear closest resemblance with those of N. sicca and N. deserta. The aedeagal apodemes of N. deserta and N. pallidipalpis are especially similar and the hypandrial processes of both also closely resemble each other. However, they differ as shown by comparing figures 108 and 115.

Description. -- Medium sized flies, length 3.25 to 4.45 mm, with brownish-gray to olive gray coloration and dark blackish-brown markings.

Head. Head ratio 1:0.75; postfrons ratio 1:0.55; frons with meso-triangular area and lateral margins generally concolorous, however, the lateral margins are often lighter; remainder of frons darker brown with some black tinges, pruinose. Dorsalmost post-ocular bristles larger than postocellar bristles, subequal to genal bristle; two pairs of proclinate fronto-orbital setae. Antennae

entirely black; arista with 8 to 12 aristal branches. Face pale, grayish-yellow; prefrons ratio 1:0.62; facial setae hair-like. Eye ratio 1:0.72; eye-to-cheek ratio 1:0.185; gena concolorous with face anteriorly, becoming gray posteriorly; genal bristle as above.

Maxillary palpi pale, mostly orange.

Thorax. Dorsum slightly darker than pleura, grayish-brown to gray; mesonotum and mesopleuron immaculate. Femora and tibiae black with some gray dusted areas; fore tarsi usually yellow but often with some darkening; mid and hind tarsi yellow; setal fascicle of hind basitarsus pale. Wing ratio 1:0.41; costal vein ratio 1:0.53; M_{1+2} vein ratio 1:1.

Abdomen. Abdomen ratio in males 1:0.78; length of fourth tergite to fifth tergite ratio in males 1:1.13; fifth tergite ratio in males 1:0.67. Fascia dark brown with posterior edge distinct; fifth segment mostly dark brown. Male postabdomen as in diagnosis and figures 115 and 167.

Specimens examined. --One hundred forty-nine specimens from the following localities: CANADA: Manitoba: Teulon (CNC); Wabowden (CNC). New Brunswick: Cahmcook, Glebe Road (CNC). Nova Scotia: Lockeport (CNC). Ontario: Britannia (CNC); Mer Bleue (ANSP, CNC); Norway Point, Lake of Bays (CNC); Orillia (ANSP); Uthhoff (ANSP). Quebec: Hull (CNC); Knowlton (CNC); Wakefield

(CNC). Saskatchewan: Waskesiu Lake (CNC); Waskesiu River (USNM); White Fox (CNC). UNITED STATES: Idaho: Kootenai Co., 1/2 mi E Harrison (WNM). Iowa: Hamilton Co., Goose Lake (USNM); Story Co., Ames (CNC); Wright Co., Little Wall Lake (USNM). Michigan: Cheboygan Co. (KU, MSU, USNM), Mackinaw City (ANSP); Crawford Co. (USNM); Iosco Co. (MSU); Iron Co. (USNM); Keweenaw Co. (USNM), Copper Harbor (ANSP); Leelanau Co. (USNM); Muskegon Co. (USNM); Travers Co. (USNM); Wexford Co. (USNM). Minnesota: Anoka Co., Moore's Lake (ANSP); Cook Co., Grand Marais (ANSP); Hennepin Co., Lake Calhoun (ANSP); Lake Co., Basswood Lake (UMN); Ramsey Co., Saint Anthony Park (UMN). Montana: Lake Co., 2 mi W Bigfork (KSU), 2.3 mi E Bigfork (WNM), 1 mi S Swan Lake (WNM), 2.5 mi S Swan Lake (WNM), 20 mi S Swan Lake (KSU). New Hampshire: Lost River (ANSP); Crawford Notch (USNM); Lakes of the Clouds (CNC); Franconia Notch (ANSP, USNM); Grafton Co., Stinson Lake, White Mts. (MCZ, USNM). New York: Oswego Co., Saint Marys Pond (CU); Tompkins Co., Dryden Lake Outlet (CU); Wayne Co., Sodus Pt. (ANSP).

Remarks.--N. pallidipalpis is a distinctive species of the subgenus Agrolimna with pale maxillary palpi and well defined abdominal fascia. Its distribution is apparently limited to northern United States and southern Canada (map 7). It has been collected from both

lotic and lentic environments in sedge-meadow and reed-marsh habitats. Collection dates are from 3 June to 7 October.

Notiphila (Agrolimna) paludia new species

(figures 115, 135, 164)

Diagnosis.--Externally, N. paludia is very similar to many members of the scalaris species-group; I cannot distinguish this species without recourse to characters of the male genitalia. The most diagnostic character I have found is the shape of the hypandrial process. See figures 113 and 115 for comparisons.

Description.--Medium sized flies, length 3.4 to 4.2 mm, with light brown coloration and darker brown markings on the abdomen.

Head. Head ratio 1:0.75; postfrons ratio 1:0.60; frons mostly tan, mesotriangular area and lateral margins lighter in color, grayed, remainder of frons with charcoal tinges. Dorsalmost postocular bristles not much larger than postocellars; two pairs of proclinate fronto-orbital setae. Antennal segments entirely dark, black; arista with 10 to 11 aristal branches. Face light yellow, slightly dusted, prefrons ratio 1:0.68. Eye ratio 1:0.70; eye-to-cheek ratio 1:0.18. Gena narrow, concolorous with face anteriorly becoming grayer posteriorly, genal bristle approximately subequal to dorsalmost postocular. Maxillary palpi black.

Thorax. Mesonotum slightly darker than pleura, light brown, grayed anteriorly, immaculate. Mesopleuron immaculate. Femora and tibiae dark, mostly black but with some gray dusted areas, pale apically; tarsi usually pale, often fore pair slightly darker. Setal fascicle of hind basitarsus pale. Wing ratio 1:0.44; costal vein ratio 1:0.46; M_{1+2} vein ratio 1:0.91.

Abdomen. Abdomen ratio in males 1:0.73; length of fourth tergite to fifth tergite in males 1:0.63; fifth tergite ratio in males 1:0.46. Fascia of abdominal segments four and three distinct, generally sharply contrasting with grayer posterior margin; fifth segment mostly dark brown. Male genitalia as in figures 114, 135, and 164.

Type material. --Male holotype, allotype and 12 paratypes (four males and eight females): Nebraska, Champion, 12 July 1960, W.F. Rapp (UN, USNM, WNM). Two paratypes (one male and one female): Nebraska, Wellfleet, 12 July 1960, W.F. Rapp (UN). The male holotype will be deposited with the National Museum of Natural History, Washington, D.C., type number 73546.

Etymology. --Palus (Latin for marsh, bog, fen) in reference to the typical habitat of this species.

Remarks. --The structures of the male genitalia of this species are the only diagnostic characters that I was able to find. Because it

occurs sympatrically with N. olivacea and is consistently different with respect to the genitalic characters mentioned in the diagnosis, I feel justified in describing this taxon as a new species. This species is known only from the fens of Nebraska.

Notiphila (Agrolimna) quadrisetosa Thomson

(figures 1-3, 8-10, 90, 93, 118, 133-134, 177, 180; map 11)

Notiphila quadrisetosa Thomson, 1869, Dipt. Species nova desc.

p. 594.

Notiphila (Agrolimna) occidentalis Cresson, 1917, Trans. Amer.

Ent. Soc. 43:51, NEW SYNONYMY.

Notiphila (Agrolimna) quadrisetosa, Wirth, 1965, U.S.D.A. Agri.

Handbk. No. 276, p. 747.

Types and type locality. --Female lectotype (here designated); California; Kinb.; Typus; 292, 73 (pink); Riksmuseum, Stockholm (green); LECTOTYPE Notiphila quadrisetosa Thomson by W.N. Mathis (red). Six paralectotypes (one male, five females) with the same label data as the lectotype except the "typus" label is missing, and the accession numbers are from 293 to 298. The lectotype and paralectotype series are in the possession of the Naturhistoriska Riksmuseet, Stockholm, type number 292. The label data for the junior synonym is as follows: Alameda, V, 5, 08, Cal., Salt Marsh;

male; HOLOTYPE 6112; HOLO-TYPE *Notiphila occidentalis*, E. T. Cresson Jr. The holotype of *N. occidentalis* is deposited in the Academy of Natural Sciences of Philadelphia; the postabdomen has been dissected.

Diagnosis.--Externally, *N. quadrisetosa* is very similar to *N. atripes* and the melanic form of *N. uliginosa*. All of the above species may be characterized by their overall dark appearance. *N. quadrisetosa*, however, may be distinguished from resembling congeners by the following characters. *N. quadrisetosa* is usually larger than *N. atripes* and there is a median, bifurcating stripe on mesonotum; the stripe is weakly developed or absent in *N. atripes*. The differences between *N. quadrisetosa* and *N. uliginosa* are slight and difficult to ascertain but the characters of the male genitalia are diagnostic. The shape of the surstyli and hypandrial processes are particularly characteristic. See figures 118 and 120 for a comparison.

Description.--Small to medium sized flies, length 2.86 to 4.36 mm, with grayish-brown to brown coloration and dark brown to black markings.

Head. Head ratio 1:0.79; postfrons ratio 1:0.75; frons pruinose, mesotriangular area and lateral margins concolorous, lighter in color, gray, remainder of frons charcoal tinged. Dorsalmost

postocular bristles large, approximately equal to genal bristle; two pairs of proclinate, fronto-orbital setae. Antennal entirely black; arista with approximately ten aristal branches. Face entirely gray to lacteous, varying considerably; facial setae weakly developed, numbering six to seven; prefrons ratio 1:0.72. Eye ratio 1:0.75; eye-to-cheek ratio 1:0.19. Gena relatively narrow, usually more grayed than face in color; genal bristle equal to dorsalmost postocular bristle. Maxillary palpi black.

Thorax. Mesonotum brown, anteriorly somewhat grayed with some green tinges, usually with distinct median, bifurcating stripe. Pleura generally lighter in color than mesonotum, becoming grayer ventrally; mesopleuron with some darkened maculation area but without distinct spot or mark. Femora and tibiae concolorous, dark, gray dusted over large areas; fore and mid tarsi also dark but with some pale areas, usually apically and on ventral surfaces, hind tarsi with considerable pallor, especially on venter. Setal fascicle of hind basitarsus pale. Wing ratio 1:0.44; costal vein ratio 1:0.54; M_{1+2} vein ratio 1:1.1.

Abdomen. Abdomen ratio in males 1:0.70; length of fourth tergite to fifth tergite ratio in males 1:0.72; fifth tergite ratio in males 1:0.59. Fascia of abdominal tergites not contrasting distinctly with lighter, gray anterior margins, margins gradually; third and fourth tergites often mostly dark brown to black, fifth segment almost entirely

darkened. Male postabdomen as in diagnosis and in figures 118, 133-134, 177, and 180.

Specimens examined. --One thousand one hundred thirty-two specimens from the following localities: CANADA: British Columbia: Hatzic Lake (CNC); Jaskatla-Queen Charlotte Islands (CNC); McClinton Bay-Queen Charlotte Islands (CNC); Mill Bay (CNC); Milner (CNC); Mission City (CNC); Okanogan Falls (CNC); Oliver (CNC); Salmon Arm (CNC); Vernon (CNC). UNITED STATES: Arizona: Cochise Co., 5 mi W Portal-Southwest Research Station (CAS). California: Barton Flat (USNM); Barton Store (USNM); Sugarload-Barton Flat (USNM); Alameda Co., Alameda (ANSP, CAS, USNM), Alvarado (CAS), Arroyo Mocho - 20 mi S Livermore (UCB), Berkeley (ANSP, CAS), Emeryville (UCB); Del Norte Co., Smith River (USNM); Fresno Co., Centerville (UCR); Humboldt Co., Eureka (KU), Mad River Beach (UCB), Orick (ANSP); Inyo Co., Antelope Springs (UCB); Lake Co., Clear Lake (USNM); Lassen Co., NE Eagle Lake (WNM), Hallelujah Junction (UCB, UCD, UCR, USNM), 41 mi NW Susanville (WNM); Los Angeles Co., Sangus (ANSP), Whittier (USNM); Mariposa Co., Yosemite National Park (KU); Modoc Co., 4 mi W Alturas (WNM), Lookout (WNM); Mono Co., 19 mi NW Benton (WNM), 7 mi E Bodie (UCB), Coleville (CAS), Fales Hot Springs (UCB), Mono Lake (ANSP, CAS, KU, UCB, USNM,

WNM), 2 mi N Mono Lake (WNM); Monterey Co. (FSCA), Cala (AMNH), Moss Landing (CAS), Pacific Grove (ANSP, USNM); Nevada Co., Indian Spring Rd and Hwy 20 (UCR), Glenbrook (USNM), Floriston-E Truckee (ANSP, CSU); Orange Co., Laguna Beach (USNM), Sunset Beach (KU); Placer Co., Lake Tahoe (USNM); Plumas Co., Clio (USNM); Riverside Co., Herkey Creek-San Jacinto Mountains (UCB), Keen Camp (USNM), Lake Hemet (CAS, UCR, USNM), Saboba Springs (CAS, USNM), Santa Ana River (USNM), Temecula (USNM); San Benito Co., New Idria (UCB); San Bernardino Co., Helendale (CNC), Little Cienega (UCR), San Diego Co., Descanso (ANSP), Lake Henshaw (USNM), Oak Grove (USNM); San Luis Obispo Co., Alamo Creek (USNM), Cambria (AMNH, USNM), Harmony (AMNH, USNM), Morro Bay (USNM), Oso Flaco Lake (UCB, UCR), San Simeon (ANSP, USNM); San Mateo Co., Redwood City (USNM); Santa Barbara Co., Lompoc (CU); Santa Clara Co., Palo Alto (ANSP, USNM), Stanford (USNM), San Antonio Ranger Station (UCB, USNM); Santa Cruz Co., Santa Cruz (CAS), Capitola (ANSP, WSU); Shasta Co., Big Spring (UCB), 4 mi W Viola (UCB); Sierra Co., Goodyear Bar (CAS), Sierraville (UCB); Sonoma Co., Graton - 3 mi NW (UCB); Stanislaus Co., Del Puerto Canyon (UCB); Trinity Co., Burnt Ranch (UCB); Tulare Co., 15 mi NE California Hot Springs (WNM), 22 mi NE California Hot Springs (WNM), E Success Reservoir (UCR), Three Rivers (USNM); Tuolumne Co.,

Pinecrest (CAS), Strawberry (UCD, USNM). Idaho: Big Lost River-Salmon River Rd Pass (ANSP); 11 mi N West Springs (MSU); Canyon Co., Notus (ANSP); Caribou Co., 1 mi N Soda Springs (WNM); Custer Co., Challis (UCD); Gooding Co., Bliss (KU, USNM); Idaho Co., Grangeville (ANSP, USNM), Pollock (USNM), Whitebird (USNM); Kootenai Co., Coeur d'Alene-Echo Bay (USNM); Latah Co., Boville (WSU), Juliaetta (ANSP, USNM), Moscow (ANSP, USNM), Moscow Mountain (USNM), Potlatch (ANSP, USNM); Oneida Co., Rock Creek (USU); Valley Co., 24 mi N Crouch (WNM), Smiths Ferry 5 mi S (WNM). Montana: Flathead Co., 1 mi W Bigfork (KSU), 10 mi NE Bigfork (USNM); Lake Co., Black Lake - 2 mi W Dayton (KSU, USNM), 3 mi E Polson (KSU), 4 mi E Polson (KSU, USNM), 8 mi NE Polson (KSU, USNM), 1 mi S Swan Lake (WNM); Missoula Co., Lolo Hot Springs-Lolo Creek (CU). New Mexico: San Miguel Co., 1/2 mi NE Montezuma (WNM); Valencia Co., Belen (USNM). Nevada: Double Spring (ANSP, USNM); Douglas Co., 1 mi S Genoa (WNM); Storey Co., Wadsworth (CAS); Washoe Co., Steamboat (USNM); White Pine Co., Charcoal Ovens State Park (UCD). Oregon: Sheep Creek (WSU); Benton Co., Corvallis (ANSP, MSU, USNM, WNM), Finley Wildlife Refuge (WNM); Coos Co., Marshfield (ANSP, USNM), North Bend (WSU); Harney Co., 16 mi N Burns (WNM); Hood River Co., Hood River (USNM); Klamath Co., Deming Creek Reservoir (WSU), 22 mi NE Klamath Falls (WNM); Jackson Co., Little Squaw Lake (WNM);

Jefferson Co., Culver City (KU); Josephine Co., Kerby (ANSP, USNM); Lake Co. Goose Lake State Park (CU), Hart Mountain Refuge - Hot Spring (WNM), Hunter Hot Spring (WNM); Lane Co., 1 mi E Cheshire (WNM), Eugene (WNM), 1 1/2 mi E Florence (WNM), 8 mi S Florence (WNM); Lincoln Co., Beaver Creek-Newport (USNM), Newport (ANSP, USNM); Linn Co., 1 mi NE Crawfordsville (WNM); Tillamook Co., 2 mi S Sand Lake (WNM), 2 1/2 mi W Sand Lake (WNM); Umatilla Co., Hermiston (USNM), Ukiah (WSU); Wasco Co., 11 mi N Warm Springs (WNM); Wheeler Co., 18 1/2 mi E Mitchell (WNM), Mountain Creek (USNM). Utah: Trout Creek (ANSP), Box Elder Co., Brigham (UMN), Honeyville (UMN), Pleasant View (ANSP); Cache Co., Amalga (USU), Avon (USU), Blacksmith Fork Canyon (USU), Hyde Park (ISU, USU), Logan Canyon (CNC, USU), Smithfield (USU); Carbon Co., Clear Creek Canyon (ISU); Davis Co., Farmington (USNM); Emery Co., 1/2 mi N Castle Dale (WNM); Juab Co., Goshiute Indian Reservation (USNM), Mount Nebo (UMN); Kane Co., Kanab (USNM); Morgan Co., Emigrant Canyon (USNM); Sevier Co., Sevier (USNM); Summit Co., Henfer (USU); Tooele Co., Vernon Creek (UMN); Utah Co., Goshen Pond (WNM), Lakeshore (ISU), Payson (UMN), Provo (UMN), Spanish Fork (KU); Wasatch Co., Heber (MSU, USNM), Strawberry Reservoir (USNM); Washington Co., 1 mi W Saint George (WNM); Weber Co., Hooper (ANSP, USU), Ogden (ANSP, UMN). Washington: Blue Mountains (USNM); Holland

(ANSP, USNM); Asotin Co., Asotin (USNM), Clarkston (ANSP, USNM); Columbia Co., Tucanon Ranger Station-Blue Mountains (USNM); Douglas Co., Waterville (UN, USNM); Grant Co., Coulee City (USNM), O'Sullivan Dam (USNM, WSU); Franklin Co., 7 mi WSW Eltopia (WNM); Jefferson Co., Brinnon (ANSP); Pacific Co., Naselle River (ANSP, USNM), Ilwaco (ANSP, USNM); Pend Oreille Co., Cusick (UN); Pierce Co., Longmire-Mount Tainier (ANSP, USNM); San Juan Co., Friday Harbor (USNM); Snohomish Co., Stanwood (USNM); Spokane Co., Valley Ford (USNM), Mica (USNM); Walla Walla Co., Mill Creek-Walla Walla (ANSP, USNM); Whatcom Co., Birch Bay (WSU); Whitman Co., Colfax (USNM), Pullman (ANSP, USNM, WSU); Yakima Co., Donald (CAS), Moxee (CAS), Naches (CAS), Yakima (USNM). Wyoming: Yellowstone National Park: Beach Springs (AMNH, ANSP, USNM), U. Geyser Basin (ANSP, USNM).

Remarks.--N. quadrisetosa is widespread and variable. Reference to characters of the male genitalia is often necessary to distinguish it from related congeners. The medial, mesonotal stripe is usually constant but also varies in the degree of darkness expressed. The hind tarsi are usually paler than those of N. atripes, but in some specimens the tarsi are as dark.

This species has been collected from a wide variety of habitats ranging from the polluted effluent of a sulfurous spring to a fresh

mountain stream. Further details concerning the biology of this species may be found in the biology section.

N. quadrisetosa is restricted in distribution to the mountainous states or provinces of western North America (map 11). Collection dates are from 5 April to 5 October.

Notiphila (Agrolimna) scalaris Loew

(figures 116, 136, 165; map 9)

Notiphila scalaris Loew, 1862, Part I, Smithsn. Inst., Smithsn.

Misc. Coll. 6:134.

Notiphila (Agrolimna) scalaris, Cresson 1917, Trans. Amer. Ent.

Soc. 43:49.

Type and type locality. --Male lectotype (here designated): Mittel St. (green); Loew Coll.; scalar. ♂; Type 11129 (red); Notiphila scalaris Lw. det W. Wirth '61. The lectotype is in the Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts, type number 11129. I have not seen the female cotype Loew listed in the original description but I have examined a second male specimen with label data similar to the lectotype except that its type label has the number 2 in addition to the type number. This second male specimen may be the "female" of Loew.

Diagnosis.--Externally, N. scalaris is very similar to N. sicca and N. atripes; the close relationship with N. atripes is further evidenced by the resemblance of the male genitalia. However, N. scalaris may be distinguished from similar congeners by the following combination of characters. Unlike N. sicca, the antennae of N. scalaris are entirely black, without any pale coloration at the base of the third antennal segment. The mesonotum of N. scalaris is generally immaculate or a median stripe is only faintly indicated, but the mesopleuron has a darkened area on the dorsal half. The mid and hind tarsi are pale, yellow, as is the setal fascicle of the hind basitarsus. The abdominal fascia are dark brown and contrast sharply with the posterior margins of each abdominal tergite. The fascia continue on the ventral surfaces also. The male genitalia are distinctive, especially the shape of the hypandrial process. See figures 116, 136, and 165.

Description.--Small to medium sized flies, length 2.80 to 3.78 mm, with light brownish-gray to gray background coloration and dark brown markings.

Head. Head ratio 1:0.75; postfrons ratio 1:0.62; frons with meso-triangular area and lateral margins concolorous, gray; remainder of frons darker, charcoal gray. Dorsalmost postocular bristle larger than postocellars; two pairs of proclinate fronto-orbital setae.

Antennal segments entirely black; arista with 9 to 11 aristal branches. Face grayish-yellow, prefrons ratio 1:0.61; facial setae small, hair-like, numbering six to seven. Eye ratio 1:0.81; eye-to-cheek ratio 1:0.15. Gena narrow, genal bristle subequal to dorsalmost postocular. Maxillary palpi black.

Thorax. Mesonotum slightly darker than pleura, more brown, usually without median stripe although some specimens have a faint indication of one. Mesopleuron with a darkened area on the dorsal half. Femora, tibiae, and fore tarsi dark, generally black with some gray or pale areas; mid and hind tarsi pale, yellow. Setal fascicle of hind basitarsus pale, yellow. Wing ratio 1:0.45; costal vein ratio 1:0.48; M_{1+2} vein ratio 1:0.98.

Abdomen. Abdomen ratio in males 1:0.80; length of fourth tergite to fifth tergite ratio in males 1:0.88; fifth tergite ratio in males 1:0.53. Fascia of abdominal segments very distinct, markedly contrasting with gray posterior margins, continuing on ventral surfaces. Male postabdomen as in figures 116, 136, and 165.

Specimens examined. --Seven hundred thirty-five specimens from the following localities: CANADA: Nova Scotia: Antigonish (CNC); Whycogomah-Cape Breton Island (MCZ). Ontario: Burke Falls (CNC); Emsdale (CAS); Frankford (CNC); Grand Bend (CNC); Kearney (CAS); Mer Bleue (CNC); Midland (CNC); Orillia (ANSP, CNC); Putman

(CNC); Sandford (CU); Severn (CNC); Simcoe (CNC); Toronto (CAS); Turkey Point (CNC). Quebec: Abbotsford (CNC); Covey Hill (CNC); Hull (ANSP, CNC); Kazubazua (CNC); La Trappe (CNC); St. Chrysostome (CNC); Wakefield (CNC). UNITED STATES: Washington, D.C. (CSU, MCZ), Rock Creek (USNM). Connecticut: Hartford Co., Avon-Avon Old Farms (AMNH); Tolland Co., Storrs (ANSP). Illinois: Du Page Co., Glen Ellyn (USNM); McHenry Co., Algonquin (INHS, USNM); Vermilion Co., Munice (INHS). Indiana: Knox Co., Vincennes (ANSP, USNM); Tippecanoe Co., La Fayette (ANSP, USNM). Iowa: Boone Co., Boone (ISU); Guthrie Co., Springbrook State Park (ISU); Howard Co., Lime Springs (ISU). Kansas: Riley Co., Manhattan (KNSU); Stafford Co., Salt Marsh (KU). Maine: Penobscot Co., Orono (CAS). Maryland: Charles Co., Popes Creek (MCZ); Balto Co., Lack Raven (ANSP), Womomonee (USNM); Calvert Co., Chesapeake Beach (USNM); Prince Georges Co., Branchville to Beltsville (USNM), College Park (USNM). Massachusetts: Ellis (MCZ); Barnstable Co., Pocasset (USNM), Woods Hole (USNM); Berkshire Co., North Adams (MCZ); Bristol Co., New Bedford (USNM); Middlesex Co., Concord (MCZ, USNM); Plymouth Co., Middleboro (USNM); Worcester Co., Athol (ANSP), Petersham (USNM). Michigan: Benzie Co. (USNM); Berrien Co., Saint Joseph (MSU); Calhoun Co., Battle Creek (ANSP), Wise Lake (MSU); Cheboygan Co. (KU); Clare Co. (MSU, USNM);

Clinton Co., Bath (MSU); Delta Co. (MSU); Gladwin Co. (USNM); Grand Traverse Co., Traverse City (ANSP); Huron Co. (USNM); Isabella Co. (MSU, USNM); Lapeer Co., Deerfield Twp. (UMI, USNM); Leelanau Co. (ANSP, USNM); Macomb Co., New Baltimore (USNM), Utica (ANSP, USNM); Manistee Co., Manistee (USNM); Mecosta Co. (MSU, USNM); Midland Co. (ANSP, MSU, USNM); Monroe Co., Monroe (USNM); Muskegon Co. (MSU, USNM), North Muskegon (CAS); Oceana Co., Hart (ANSP, Shelby (ANSP); Osceola Co. (MSU, USNM); Wayne Co. (MSU, UMI), Detroit (USNM).

Minnesota: Anoka Co., Saint Paul Water Works (UMN); Clearwater Co., Itasca State Park (UMN); Hennepin Co., Lake Calhoun (CNAP, UMN); Houston Co. (UMN, USNM); Rock Co., Luverne (MSU); Wabasha Co., Wabasha (UMN); Winona Co., Winona (ANSP); Wright Co., Howard Lake (UMN). Nebraska: Blaine Co., Dunning (MSU); Butler Co., Bellwood (UN); Chase Co., Champion (UN); Cherry Co., Valentine (ISU). New Hampshire: Benton (ANSP); Grafton Co., Franconia (AMNH, USNM), North Haverhill (USNM). New Jersey: Anglesea (MCZ); Forest Hill (AMNH, USNM); Lake Branch (MCA); Shark River (MCZ); Camden Co., Berlin (CU), Clementon (MCZ); Cape May Co., Wildwood (MCZ); Essex Co., West Orange (AMNH); Sussex Co., Branchville (AMNH). New York: Ashford (KU); Beaverkill (ANSP); Albany Co., Vorheesville (NYSM); Cattaraugus Co., Gowanda (CAS); Cortland Co., Harford (ANSP, CU), McLean Bog

(CU), USNM); Delaware Co., Stamford (CU); Erie Co., Golden (CAS), Hamburg (CAS); Essex Co., Lake Tear (MCZ); Franklin Co., Saranac Inn (ANSP, NYSM); Fulton Co., Johnstown (ANSP, CU); Genessee Co., Bergen (KU); Hamilton Co., 7 mi S Long Lake (ISU), Inlet (CU); Jefferson Co., Ellisburg (CU); Monroe Co., Rochester (CAS); New York Co., New York (AMNH, USNM); Niagara Co., Niagara (MCZ, USNM); Rockland Co., Bear Mountain (USNM); Suffolk Co., Babylon (CU), Cold Spring Harbor (USNM), East Hampton (USNM), Montauk (USNM), Orient (USNM); Sullivan Co., Bridgeville (CU); Tompkins Co., Dryden Lake (ANSP, CU), Ithaca (ANSP, CU, USNM), Malloryville (CU), Mud Creek (ANSP, CU), Slaterville (ANSP, CU), Taughannock Falls (USNM), Woodwardia Bog (ANSP, CU); Westchester Co., Peekskill (USNM). North Carolina: Buncombe Co., Black Mountain (MCZ); Macon Co., Franklin (CNC), Highlands (ISU); Transylvania Co., Toxowany Falls (CNC). North Dakota: Richland Co., 25 mi N Wyndmere (UCB). Ohio: Carroll Co., Specht Marsh (KSU); Champaign Co. (USNM), Cedar Swamp (FSCA); Erie Co., Sandusky (ANSP, FSCA, OHSU); Franklin Co., Columbus (ANSP, OHSU); Medina Co., Hinkley (ANSP, OHSU), Wadsworth (KSU); Portage Co., 1 mi E Kent (KSU), 4.5 mi NW Kent (KSU, USNM); Summit Co., Akron (ANSP, OHSU), Hawkins (ANSP, OHSU). Pennsylvania: Castle Rock (ANSP); Allegheny Co., Natrona (MCZ), Pittsburgh (USNM); Bucks Co., Point Pleasant (ANSP); Dauphin Co.,

Grantville (CNC); Fulton Co., McConnellsburg (ANSP); Monroe Co., Pocono Lake (ANSP); Montgomery Co., Edge Hill (MCZ); Philadelphia Co., Germantown (ANSP), Holmesburg (ANSP), Philadelphia (MCZ), Roxborough (ANSP). Rhode Island: Washington Co., Charlestown (USNM). South Dakota: Bennett Co., Martin (ANSP); Yankton Co., Yankton (UN). Tennessee: Sullivan Co., Bristol (USNM). Virginia: Four-mile Run (ANSP); Glencarlyn (ANSP, MCZ); Potomac Creek (MCZ); Fairfax Co., Falls Church (ANSP, MCZ), Potomac River at Scott Run (USNM); Greene Co., Dyke (MCZ); Henry Co., Martinsville (CNC); Montgomery Co., Blacksburg (CNC); Norfolk Co., Norfolk (MCZ); Bockbridge Co., Natural Bridge (USNM). West Virginia: Greenbrier Co., Lewisburg (USNM); Hardy Co., Baker (USNM); Marion Co., Fairmont (ANSP); Pocahontas Co., Cranberry Glades (USNM). Wisconsin: Dodge Co., Beaver Dam (ANSP); Grant Co., Boscobel (MSU, UMI).

Remarks.--N. scalaris is one of the few species of the subgenus Agrolimna that is limited in distribution to eastern North America. It has not been reported from the Gulf Coast states of southeastern United States (map 9). Collection dates are 19 April to 14 September.

Dr. B.A. Foote and associates at Kent State University have been conducting biological studies on this species.

Notiphila (Agrolimna) sicca Cresson

(figures 117, 137, 169; map 6)

Notiphila sicca Cresson, 1940, Notulae Nat. Acad. Nat. Sci.

Phil. 38:8.

Notiphila (Agrolimna) sicca, Cresson, 1942, Trans. Amer. Ent.

Soc. 72:233.

Types and type locality. --Female holotype: Owens, Nev. Clark Co. 8-23' 19, 3000 ft; female; TYPE Notiphila sicca, E.T. Cresson, Jr. 6597. The holotype is deposited in the Academy of Natural Sciences of Philadelphia. Cresson also listed a second female paratopotype. The type number was published as 6543 but the number on the type specimen is 6597.

Diagnosis. --Evidently, N. sicca is closely related to N. pallidipalpis which is very similar. However, N. sicca may be distinguished from N. pallidipalpis or any other species of Agrolimna by the following combination of characters. The antennae are entirely black except for the base of the third segment which is pale, orange; the maxillary palpi are black; both the mesonotum and mesopleuron are immaculate; the setal fascicle of the hind basitarsus is pale; and the fascia, which are blackish-brown to black, are well defined with distinct posterior markings. The male postabdomen of N. sicca is also

distinctive. The hypandrial process of N. sicca is very similar to that of N. deserta but the surstyli differ considerably. Likewise, the surstyli may also be used to distinguish N. sicca from N. pallidipalpis.

Description. --Small to medium sized flies, length 2.87 to 3.93 mm, with brownish-gray to olive gray coloration and dark brown to black markings.

Head. Head ratio 1:0.71; postfrons 1:0.49; frons more or less totally subdued, grayish, pruinose but with outline indications of the mesotriangular area and the lateral margins; mesotriangular area often lighter in color, more grayed. Dorsalmost postocular bristle larger than postocellar bristle, subequal to genal bristle; two pairs of proclinate fronto-orbital bristles. Antennae entirely black except for base of third segment which is pale, orange; arista usually with 9 to 12 aristal branches. Face yellow, subdued; facial setae hair-like; prefrons ratio 1:0.60. Eye ratio 1:0.78; eye-to-cheek ratio 1:0.12. Gena narrow, gray except for anterior portion which is concolorous with face. Genal bristle as above. Maxillary palpi black.

Thorax. Light brownish-gray to olive gray; mesonotum and mesopleuron immaculate. All femora and tibiae black with some areas gray dusted; tarsi pale, yellow; setal fascicle of hind basitarsus pale. Wing ratio 1:0.44; costal vein ratio 1:0.46; M_{1+2} vein ratio 1:1.

Abdomen. Abdomen ratio in males 1:0.82; length of fourth tergite to fifth tergite ratio in males 1:0.84; fifth tergite ratio in males 1:0.58. Fascia of third and fourth tergites well defined, rectangular; fifth segment mostly concolorous with fascia, but with some gray areas toward venter on lateral margins. Male postabdomen as in figures 117, 137, and 169.

Specimens examined. --Six hundred fifty-four specimens from the following localities: UNITED STATES: Arizona: Apache Co. (KU); Cochise Co., Chiricahua Mountains (KU); Coconino Co. (KU); Yavapai Co., Montezuma Wells National Monument (USNM, UA). California: Inyo Co., Deep Springs (UCD, UCR, USNM), Little Lake (USNM), Lone Pine (UCB, CAS), Panamint Springs (CNC); Kern Co., South Inlet-Lake Isabella (UCR); Mono Co., Mammoth Lakes (KU); Riverside Co., Aguanga (USNM); San Bernardino Co., Baker (ANSP, USNM), Victorville (CU); San Diego Co., 2 mi N Warner Springs (CUR). Colorado: Fremont Co. (KNSU); Huerfano Co., Walserburg (CSU); Larimer Co., Fort Collins (ANSP, CSU, WSU); Montezuma Co., 8 mi W Cortez (WNM); Otero Co., 5 mi N Rocky Ford along Arkansas River (ISU); Pueblo Co. (USNM); Weld Co., Greeley (CSU). Idaho: Gooding Co., Bliss (KU). Iowa: County number 3 (USNM); Dickinson Co., fen SW Silver Lake (ISU), Excelsior Fen (ISU). Kansas: Scott Co. (KU). Minnesota: Clearwater Co. (UMN); Cook

Co., Grand Marais (UMN); Hennepin Co. (UMN); Ramsey Co. (UMN).
Montana: Flathead Co., 8 mi NW Bigfork (KSU). Nebraska: Chase
 Co., Champion (UN), 10 mi SW Imperial (UN); Frontier Co., Curtis
 (UN). Nevada: Ash Meadows (ANSP). New Mexico: Catron Co.,
 Apache Creek (WNM), Zuni Salt Lake - 20 mi W Quemado (USNM);
 Guadalupe Co., Santa Rosa (KU); Otero Co., Alamogordo (KU), 25 mi
 W Tularosa (KU); Sandoval Co., Jemez Mountains (ANSP); San Juan
 Co., 1 mi S Bloomfield (WNM); San Miguel Co., 1/2 mi NE
 Montezuma (WNM); Socorro Co., Blue Springs (USNM); Valencia
 Co., Belen (KU). Ohio: Erie Co., Sandusky (ANSP). Oregon:
 Jefferson Co., Culver City (USNM); Harney Co., 9 mi N Andrews-
 Alvord Hot Springs (WNM). South Dakota: Cascade Springs (ANSP).
Texas: Galveston Co., Galveston (AMNH, FSCA). Utah: Naples
 (ANSP); Beaver Co., Beaver (UMN), Beaver Canyon (UMN); Box
 Elder Co., Honeyville (UMN), Locomotive Springs (USU); Carbon
 Co., S Price (WNM); Emery Co., 1/2 mi N Castle Dale (WNM),
 Green River (UMN); Grand Co., Moab (ISU, USNM); Iron Co., Cedar
 City (KU, USNM); Kane Co., Kanab (ISU), Kanab Creek Canyon
 (ISU); San Juan Co., Indian Creek (USU), 6 1/2 mi N LaSal Junction
 (WNM); Sanpete Co., Manti (ANSP); Sevier Co., 9 mi E Cove Fort in
 Fish Lake National Forest (ISU), Fish Lake (KU); Utah Co.,
 American Fork (USU), Goshen (USU), Goshen Ponds (WNM), Provo
 (UMN), Payson (UMN), Spanish Fork (ISU); Wayne Co., Capital Reef

(USU); Weber Co., Hooper (USU). Wyoming: Yellowstone National Park, U. Geyser Basin (ANSP, USNM).

Remarks.--Although N. sicca is a common species in the West, it was not described until relatively recently (Cresson, 1940). It often occurs abundantly, especially in arid areas where some water is found.

This species occurs in most of the United States west of the 100th parallel except for the extreme Northwest. I have also examined specimens from Minnesota and Ohio (map 6). Collection dates are from 10 March to 7 October.

Notiphila (Agrolimna) uliginosa Haliday

(figures 97, 119-120, 138, 170-171, 172-176; map 3)

Notiphila uliginosa Haliday, 1839, Ann. Nat. Hist. III:222.

Notiphila (Agrolimna) olivacea Cresson (in part), 1917, Trans.

Amer. Ent. Soc. 43:52.

Type and type locality.--I have not located Haliday's syntype series of this species. Haliday's original description, however, does list the following localities for the syntypes (all in Ireland or Northern Ireland): 1) marsh between Glengariff and Adrighoule (County Cork); 2) banks of the Shannon at Tarbert (County Kerry, Shannon River); 3) shores of Belfast Lough (Northern Ireland). All of the localities

for the syntype series are brackish-water marshes along bays or rivers leading to the ocean. I have examined European specimens from Denmark and Sweden.

Diagnosis. --N. uliginosa is a variable species that closely resembles members of the scalaris species-group, especially N. quadrisetosa. It may be distinguished from all related species by characters of the male postabdomen, especially the shape of the hypandrial process. See figures 119-120 and 170-171. Externally, N. uliginosa differs from N. olivacea in the extent and degree of coloration contrast between the darkened abdominal fascia and the olivaceous to gray background color. Usually the color of the fascia of N. uliginosa do not contrast distinctly but merge gradually together and generally the fascia are also more extensive. The melanic form of N. uliginosa may be differentiated from N. quadrisetosa by the absence of a median, bifurcating, mesonotal stripe. Often the facial color is grayer in the melanic form of N. uliginosa but there is considerable overlap in this character with N. quadrisetosa.

Description. --Medium sized flies, length 3.46 to 4.53 mm, with yellowish-brown to olivaceous background coloration and some brown markings.

Head. Head ratio 1:0.73; postfrons ratio 1:0.61; frons mostly dark brown with some darker, charcoal coloration, mesotriangular area

and lateral margins concolorous, lighter in color, tending to be more yellowish. Dorsalmost postocular bristles large, approximately one-half to one-third longer than largest postocellars; two pairs of proclinate fronto-orbital setae present. Antennal segments entirely dark, dark brown to black; arista with seven to nine arisal branches. Face dusted yellow; prefrons ratio 1:0.74; facial setae hair-like, numbering six to seven and usually extending past mid-height of face. Eye ratio 1:0.78; eye-to-cheek ratio 1:0.21. Gena fairly narrow, concolorous with face anteriorly, becoming grayer posteriorly; genal bristle distinct, subequal to dorsalmost postocular bristles. Maxillary palpi dark, brownish-black.

Thorax. Mesonotum slightly darker in coloration than pleura but not distinctly contrasting, immaculate. Scutellum approximately concolorous with mesonotum. Mesopleura generally immaculate; remaining pleura tending to become lighter ventrally but not distinctly grayed or contrasting with dorsal portions. Femora dark, gray dusted; tibiae black, also with some gray dusted areas; fore tarsi mostly blackish but with extensive pale areas at apices and beneath, mid and hind tarsi pale. Setal fascicle of hind basitarsus pale, yellowish-orange. Wing ratio 1:0.42; costal vein ratio 1:0.50; M_{1+2} vein ratio 1:1.1.

Abdomen. Abdomen ratio in males 1:0.64; length of fourth tergite to fifth tergite ratio in males 1:0.97; fifth tergite ratio in males 1:0.61.

Coloration of tergites mostly olivaceous, darker areas on third, fourth and fifth tergites rather diffuse, not distinctly contrasting with background color, gradually merging. Male postabdomen as in figures 114, 120, 138, 170-171, and 172-176.

Melanic form. As above except as follows. Face often gray but usually dusted yellow. Legs entirely dark, usually black except for tarsal brushes and setal fascicle of hind basitarsus which are pale. Abdominal fascia brown, distinct on tergites three, four, and five; fifth tergite almost entirely dark. The general coloration also tends to be more brown rather than olivaceous.

Specimens examined. -- Five hundred eighteen specimens from the following localities: CANADA: Alberta: Banff (CNC); 13 mi N Banff-Jasper Highway (CNC); Cooking Lake (ANSP); Carmangay-Little Bow River (USNM); Edmonton (CAS); Full Lake (ANSP); Gull Lake (CNC); McMurray (CNC); Nordegg (ANSP, CNC); Waterton Lakes (CNC). British Columbia: Atlin (CNC); Clinton (CNC); King Salmon Lake (CNC); Lakelse Hot Spring (CNC); Lakelse near Terrance (CNC); Vernon (CNC). Manitoba: Brandon (CNC); 5 mi SW Shilo (CNC); Wabawden (CNC). Northwest Territories: Fort Smith (CNC); Norman Wells (CNC). Ontario: Marmora (CNC). Quebec: Brome Lake (CNC); Covey Hill (CNC); Lac Mondor-Ste. Flore (CNC); La Trappe (AMNH, FSCA, MSU); Missisquoi Bay (CNC); Rupert House

(CNC); Saint Chrysostome (CNC); Saint Placide (AMNH). Saskatchewan: Assiniboia (CNC); Attons Lake-Cut Knife (CNC); Cut Knife (CNC); Lisieux (CNC); Rutland (CNC); Val Marie (CNC); Willows (CNC). Yukon Territory: Watson Lake (CNC). UNITED STATES: Alaska: Anchorage (ANSP); Auke Bay (WSU); Unalakleet (CNC); Valdez - tidal flats (USNM). California: Lassen Co., 41 mi NW Susanville (WNM); Marin Co., 15 mi NW Olema (UCB); Modoc Co., 4 mi W Alturas (WNM); Lookout (WNM), Surprise Valley-Fort Bidwell (UCB); Nevada Co., 1 mi NW Hobart Mills (WNM), 2 1/2 mi NE Hobart Mills (WNM). Colorado: Boulder Co., Nederland (ANSP, CSU, KU, USNM, WSU); Clear Creek Co., Echo Lake-Mount Evans (CNC); Park Co., Kenosha Pass (CSU); Saguache Co., Saguache (CSU). Illinois: Jo Daviess Co., Galena (INHS); Lake Co., Lake Forest (CU). Michigan: Mackinac Co. (MSU); Manistee Co., Manistee (ANSP). Minnesota: Cook Co., Grand Marais (UMN); Marais (UMN); Marshall Co. (UMN). Montana: Flathead Co., 1 mi W Bigfork (KSU, USNM), 8 mi S West Glacier (KSU); Glacier Co., 2 mi E babb (KSU, USNM), NW Browning (KSU, USNM); Lake Co., 2.3 mi E Bigfork (WNM), Dayton (ANSP), 20 mi S Swan Lake (KSU). New Mexico: Sandoval Co., Jemez Springs (ANSP). Oregon: Benton Co., 12 mi S Corvallis-McFadden Pond (WNM); Grant Co., 1/2 mi S Seneca (WNM); Harney Co., 16 mi N Burns (WNM), 2 mi E Burns (WNM), S shore Harney Lake (WNM); Klamath Co., Aspen Lake

(WNM); Lake Co., Ana Reservoir (WNM), 4.3 mi NW Paisley (WNM), 4.8 mi N Summer Lake (WNM), Warner Canyon (WNM); Linn Co., 21 mi SE Idanha (WNM); Wheeler Co., 18 1/2 mi E Mitchell (WNM).
South Dakota: Custer Co., 7 mi W Custer (WNM), Flynn Creek - 8 mi N Pringle (CNC); Grant Co., Big Stone City (USNM); Meade Co., Piedmont (KU); Stanley Co., Fort Pierre (ANSP). Utah: Utah Co., Provo Canyon (UMN). Vermont: Windham Co., Jacksonville-Laurel Lake (UMN). Washington: Grant Co., Grand Coulee-Columbia River (WSU); Ferry Co., 15 mi W Kettle Falls (UN, USNM); Spokane Co., Liberty Lake (USNM); Whitman Co., Johnson (WSU).

Remarks.--N. uliginosa is a variable species in the Nearctic Region. In Oregon, California, and Utah, populations of this species are considerably darker, appearing melanic, whereas populations from northern Washington, Montana, South Dakota, and Canada are much lighter in color. The color of the hind tarsi in particular tends to vary.

Populations of the lighter morph are also divisible into two groups. Specimens from states or provinces surrounding the Great Lakes are externally similar to those from localities found further to the west, but the apical end of the hypandrial process of these specimens usually differs in shape. The distal end of the preapical enlargement is squared off and in some cases there is a distinct

step before the more typical rounding of the enlargement. The expression of this character, however, is not constant and considerable variation is evident. I have not examined specimens from enough localities to determine whether this variation is clinal although I suspect it is.

The dark color morph and both groups of the lighter morph could represent distinct species. The evidence at hand is not sufficient to properly assess this possibility. More specimens from localities between the somewhat isolated collection sites of each morph will be necessary in order to evaluate the extent and degree of variation. I have not studied specimens of the different morphs that occur sympatrically.

This species has been collected from a wide variety of environmental conditions. Specimens have been collected from along the shores of an alkaline lake, from emergent vegetation in shallow reservoirs, and from the margins of mountain streams.

N. uliginosa is distributed primarily in the West, where it is found as far north as Alaska, Yukon Territory, and the Northwest Territories. It occurs eastward as far as Vermont (map 3).

Collection dates are from 15 May to 28 August.

Species InquirendaNotiphila (Notiphila) latelimbata Curran

Notiphila latelimbata Curran, 1930, Bull. Amer. Mus. Nat. His.
61:77.

Type and type locality.--Female holotype: F.5061, Sta. Study Insects, Tuxedo, N.Y. 29.VI.1928; Collector, C.H. Curran; Notiphila latelimbata Curran Type (sic), ♀ (red). The type is deposited in the American Museum of Natural History, New York.

Remarks.--The unique type of N. latelimbata is very similar to specimens of N. bella and it may prove to be synonymous with the latter. I am deferring placement of this species for the following reasons: 1) no males of N. latelimbata are available; 2) there are very few specimens of N. latelimbata or N. bella; and 3) the extent of variation of N. bella or N. latelimbata has not been evaluated nor can it until more material is available.

Notiphila (Notiphila ?) riparia Meigen

Notiphila riparia Meigen, 1830, Syst. Besch. . . . zweifl. Insekt.
6:65.

Type and type locality.--Two syntype specimens, sex unknown.

Specimen 1: both antennae broken; some tarsi also broken; abdomen

destroyed by dermestids; four dorsal extensor bristles on mesotibiae. Specimen 2: badly damaged on the whole; head and antennae still in good condition, however; left mesotibia with three dorsal extensor bristles (right one broken); abdomen destroyed. The syntypes are deposited in the Museum National D'Histoire Naturelle, Paris, type number 2434 in Meigen's collection. The collecting locality of these specimens is not known but presumably is somewhere in Europe.

Remarks. -- The above information was provided by Dr. Loric Matile (personal communication) who compared Meigen's syntypes with two North American specimens which represent what North American authors have been considering N. riparia. From Dr. Matile's notes, I suspect that each of the syntypes represents a different species and the first specimen could be a member of the subgenus Agrolimna as it has four dorsal extensor bristles on the mesotibiae. I have examined European specimens that were identified as N. riparia and also compared photographs and drawings of the male genitalia of what Dahl (1959, 1972) treated as N. riparia. N. riparia of these European authors is not the same species that occurs in North America, nor have I examined any N. riparia of North American authors that is comparable with any European species. Based on the above evidence, I have described N. riparia of American authors as a new species, N. pulcra.

Whether N. riparia Meigen occurs in North America will depend on a clarification of its identity.

Species excluded from Notiphila

Dichaeta transversa (Walker) STATUS NOVUM

Notiphila transversa Walker, 1852, Dipt. Saund. p. 407.

Notiphila (Agrolimna) transversa, Wirth, 1965, U.S.D.A. Agri. Handbk. No. 276, p. 748.

Label data. --A folded white label with the following information:

"Genus Dichaeta (I examined this specimen - a ♂, the type of the species - today, before it was accidentally injured. It had 2 upwardly curved caudal spines, and an attenuated 5th abdominal segment, as in D. caudata, Fln. -- E. E. Austin, 25. X. 1911."

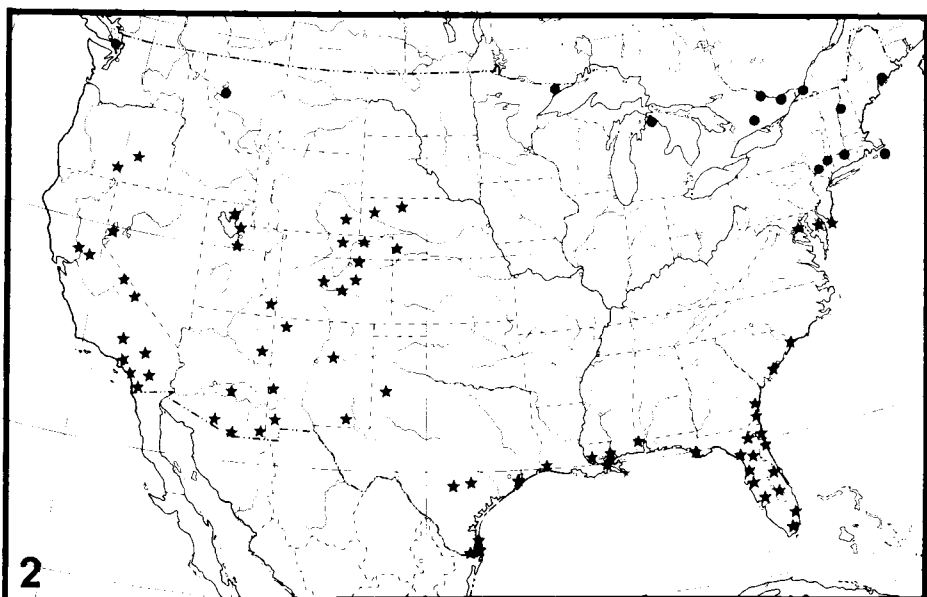
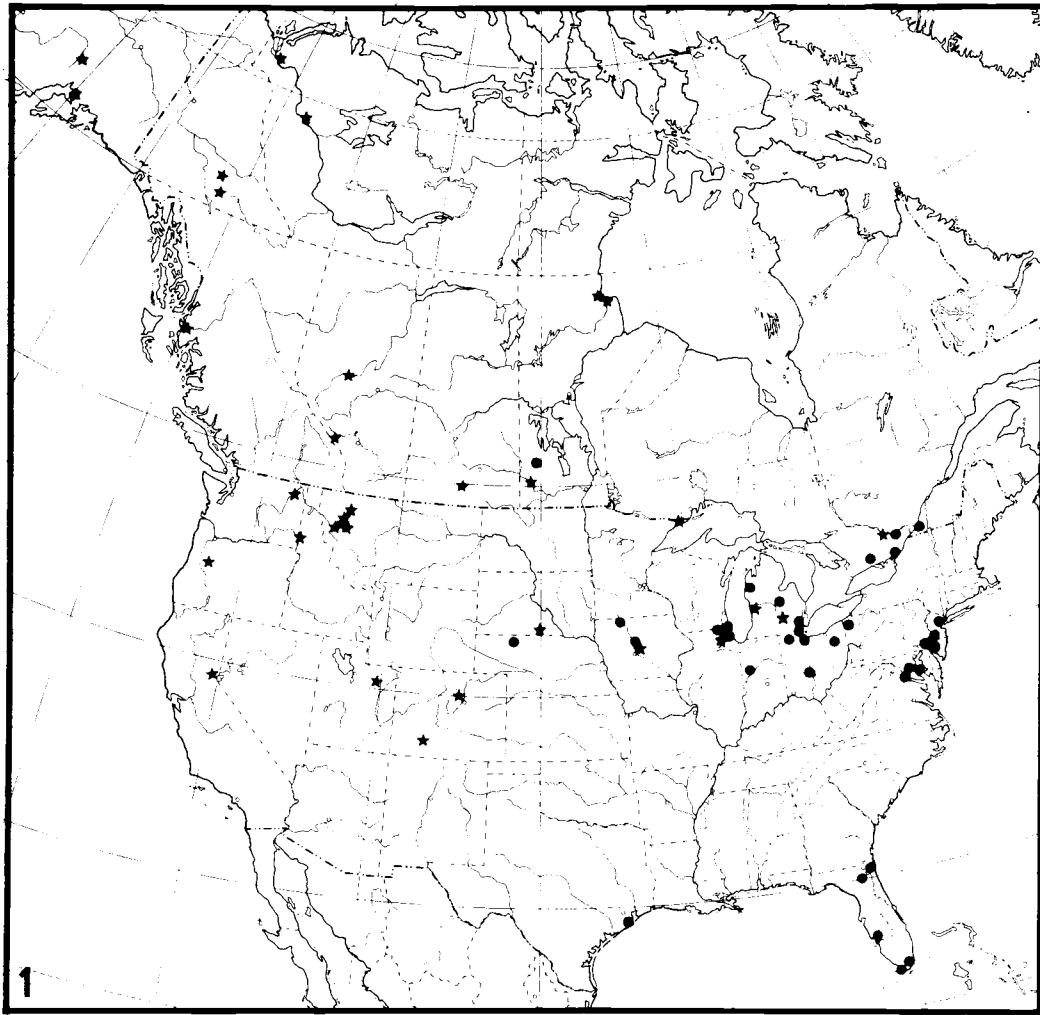
The remaining labels are as follows: "transversa"; "U.S. (?)"; "United States. W. W. Saunders, B. M. 1868 - 4." The type is deposited in the British Museum (Natural History).

Remarks. --Cresson (1917, 1946) suspected that this species was a synonym of N. furcata, and Wirth (1965) followed this precedent in the most recent catalog of North American Diptera. Through the kindness of Dr. B. H. Cogan, I was permitted to examine the type specimen, which is badly damaged (see label data), and can now

report that this species is a member of the genus Dichaeta. The male genitalia of the type are unlike those of any previously named Dichaeta species from North America; it is apparently the third Nearctic species.

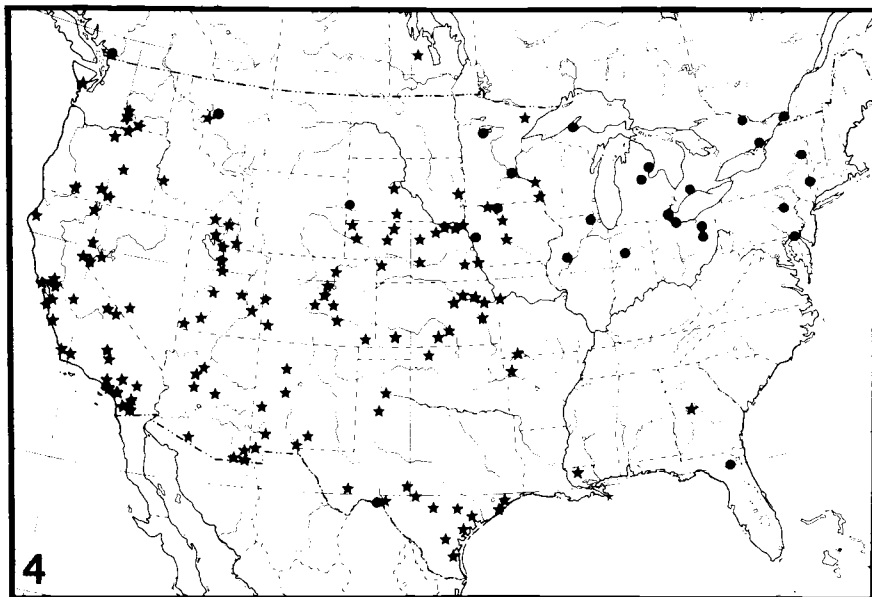
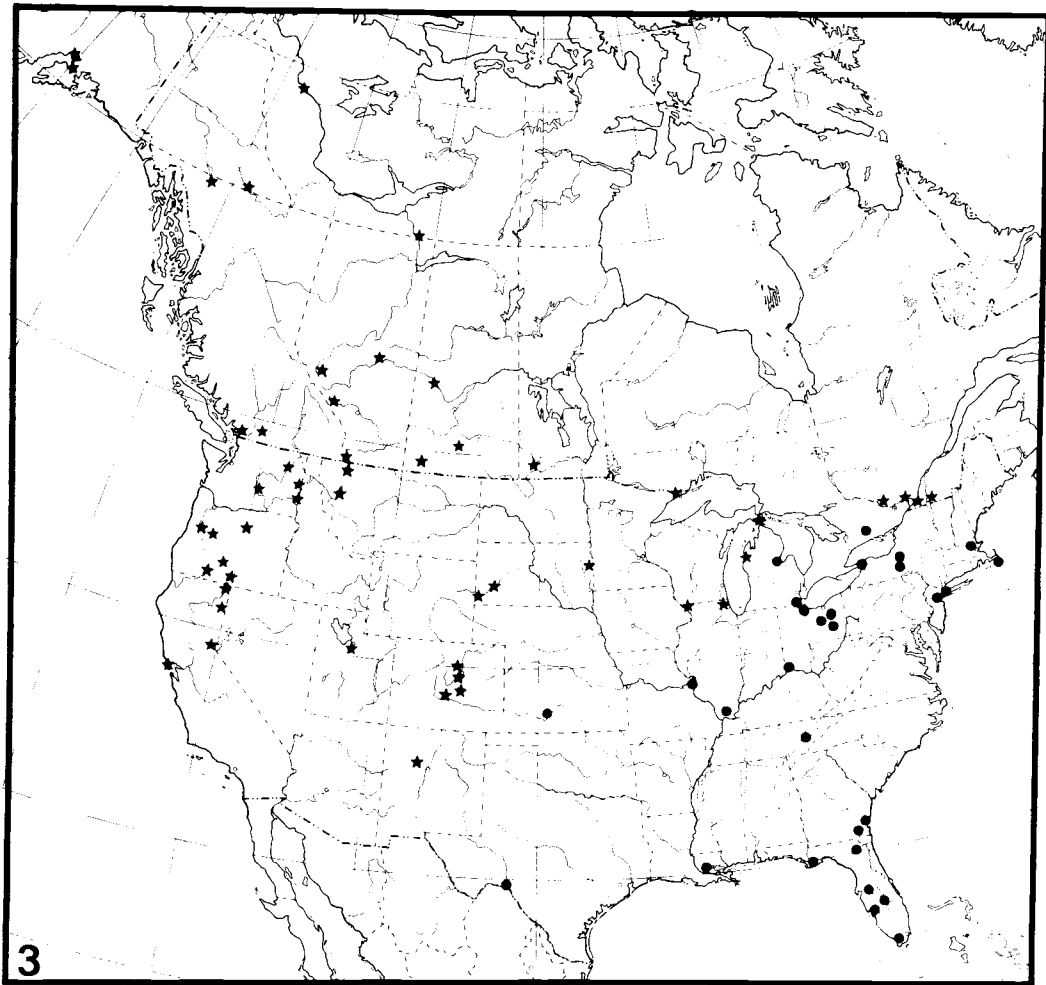
Map 1. Distribution of N. solita (circles) and N. avia (stars).

Map 2. Distribution of N. erythrocera (stars) and N. shewelli (circles).



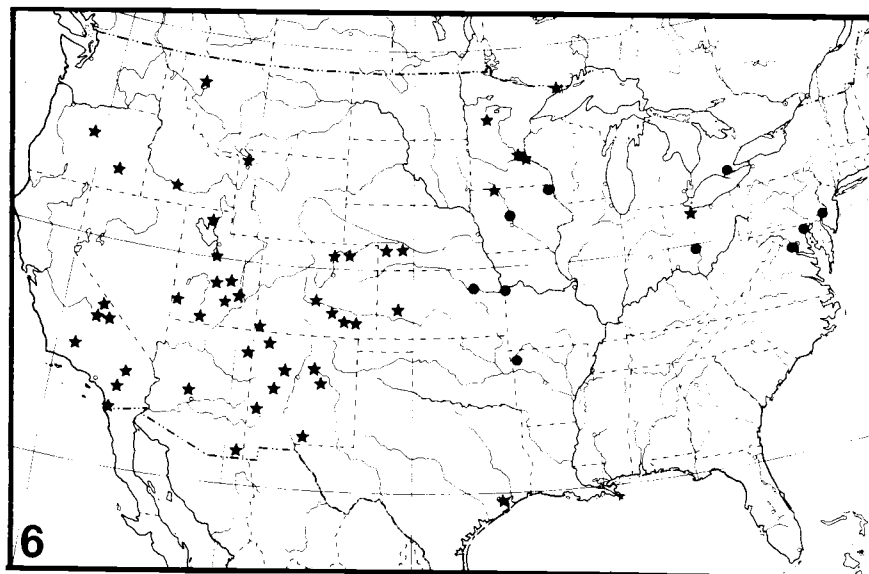
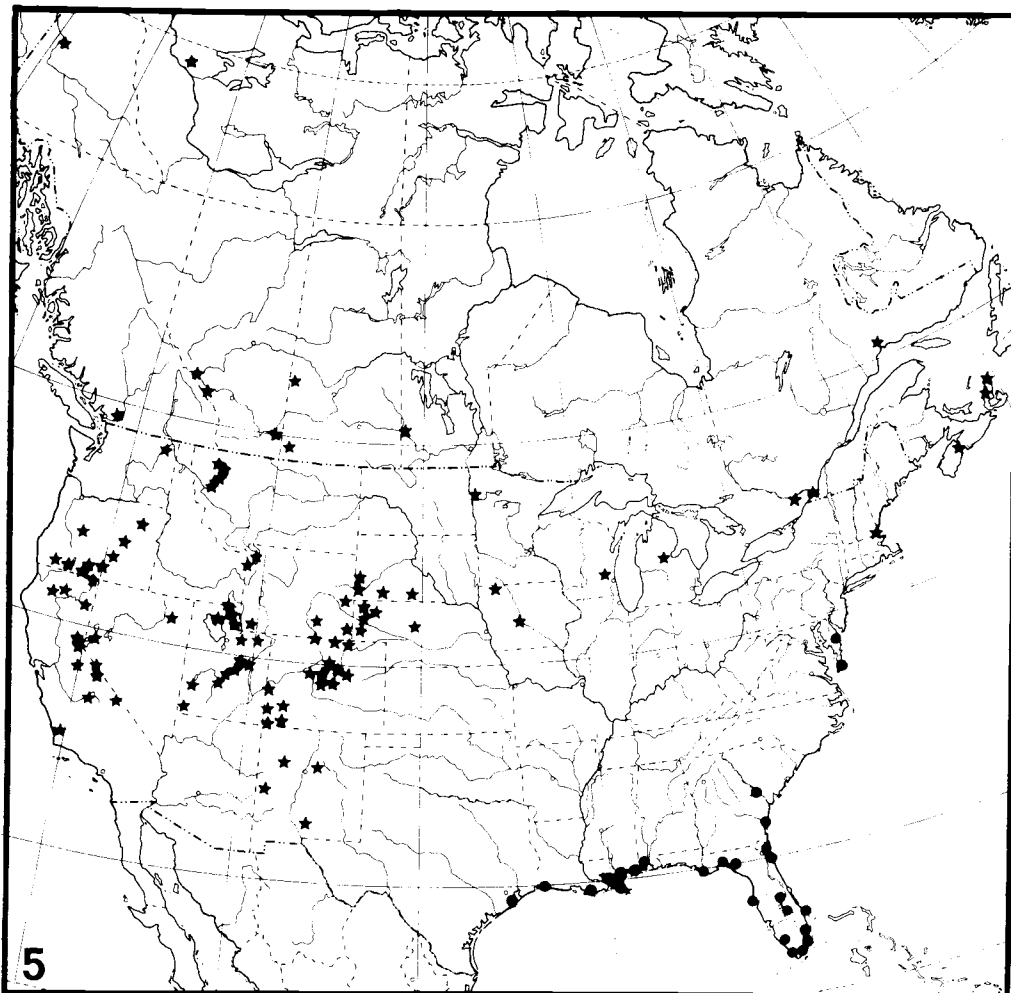
Map 3. Distribution of N. pulcra (circles) and N. uliginosa (stars).

Map 4. Distribution of N. loewi (circles) and N. macrochaeta (stars).



Map 5. Distribution of N. furcata (circles) N. atripes (stars).

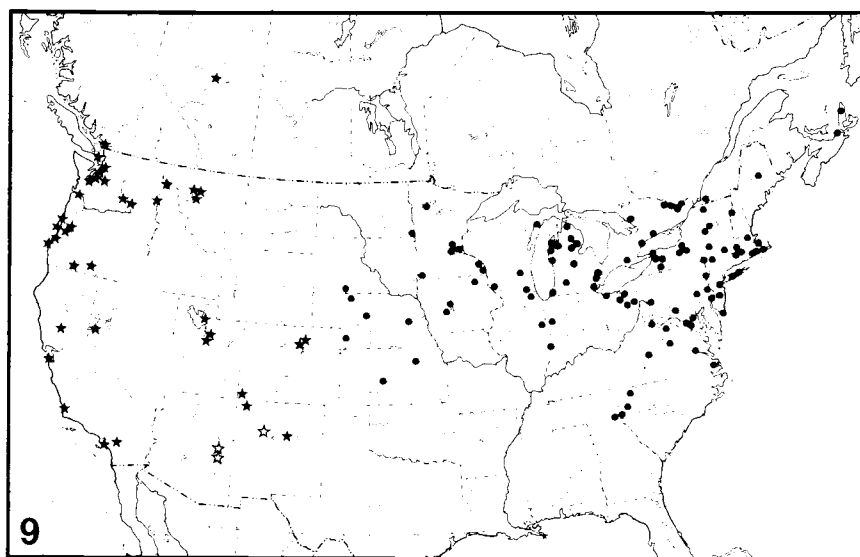
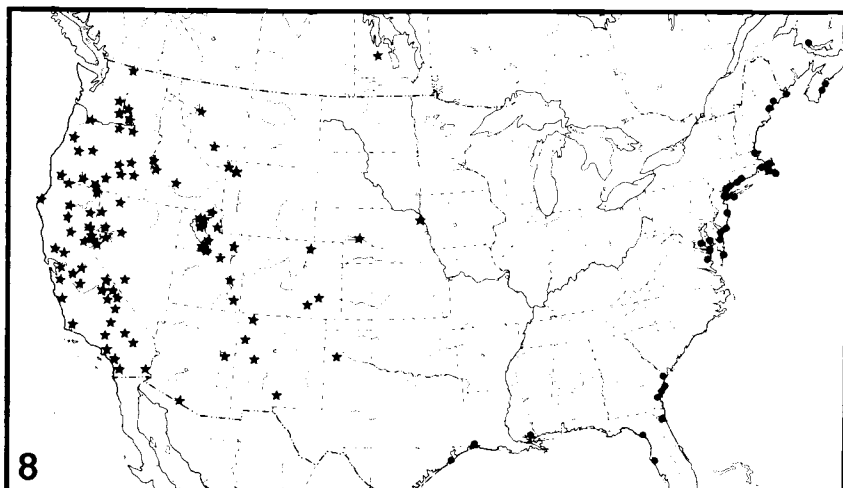
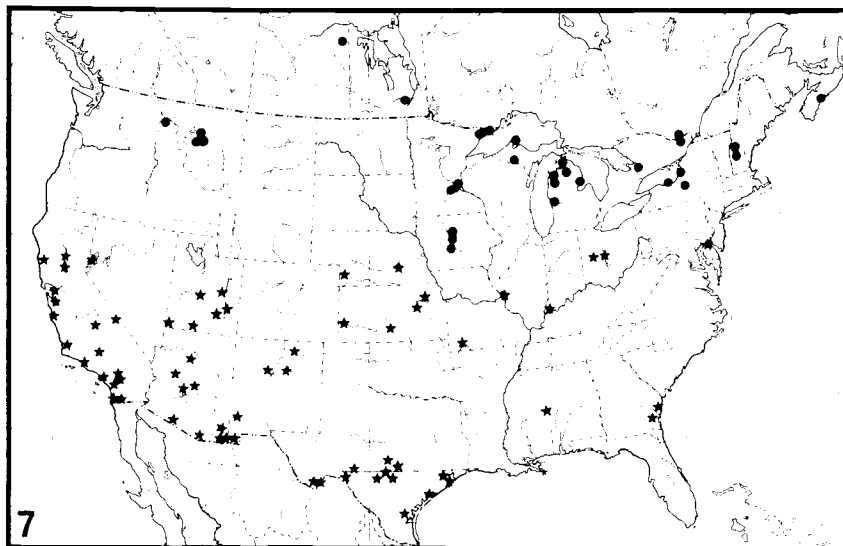
Map 6. Distribution of N. cressoni (circles) and N. sicca (stars).



Map 7. Distribution of N. pulchrifrons (stars) and N. pallidipalpis (circles).

Map 8. Distribution of N. bispinosa (circles) and N. decoris (stars).

Map 9. Distribution of N. atrata (open stars), N. aenigma (filled stars), and N. scalaris (circles).



Map 10. Distribution of N. olivacea (circles).

Map 11. Distribution of N. adusta (filled stars), N. carinata (filled circles), and N. quadrisetosa (open stars).

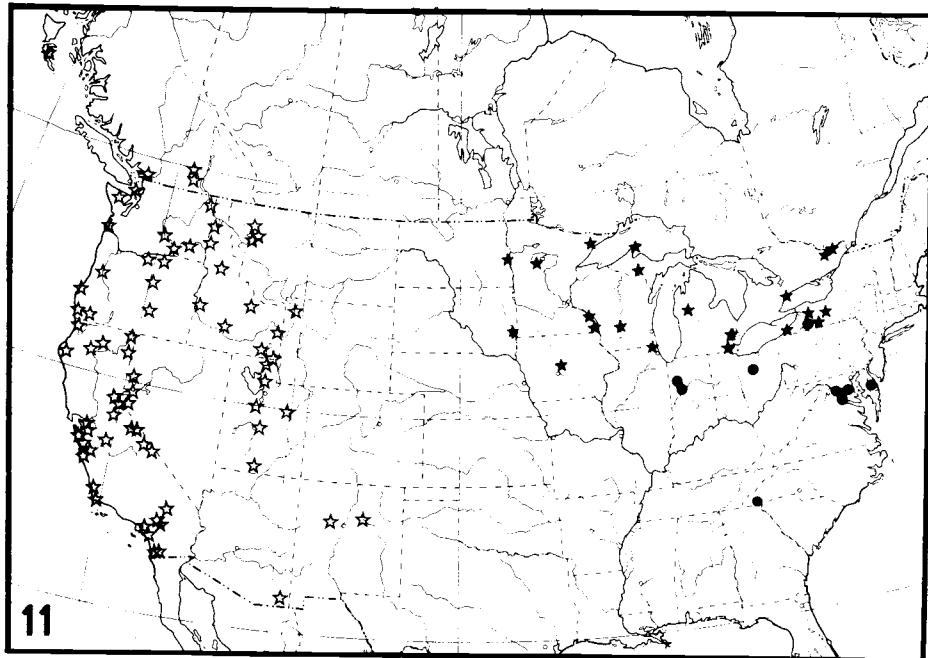
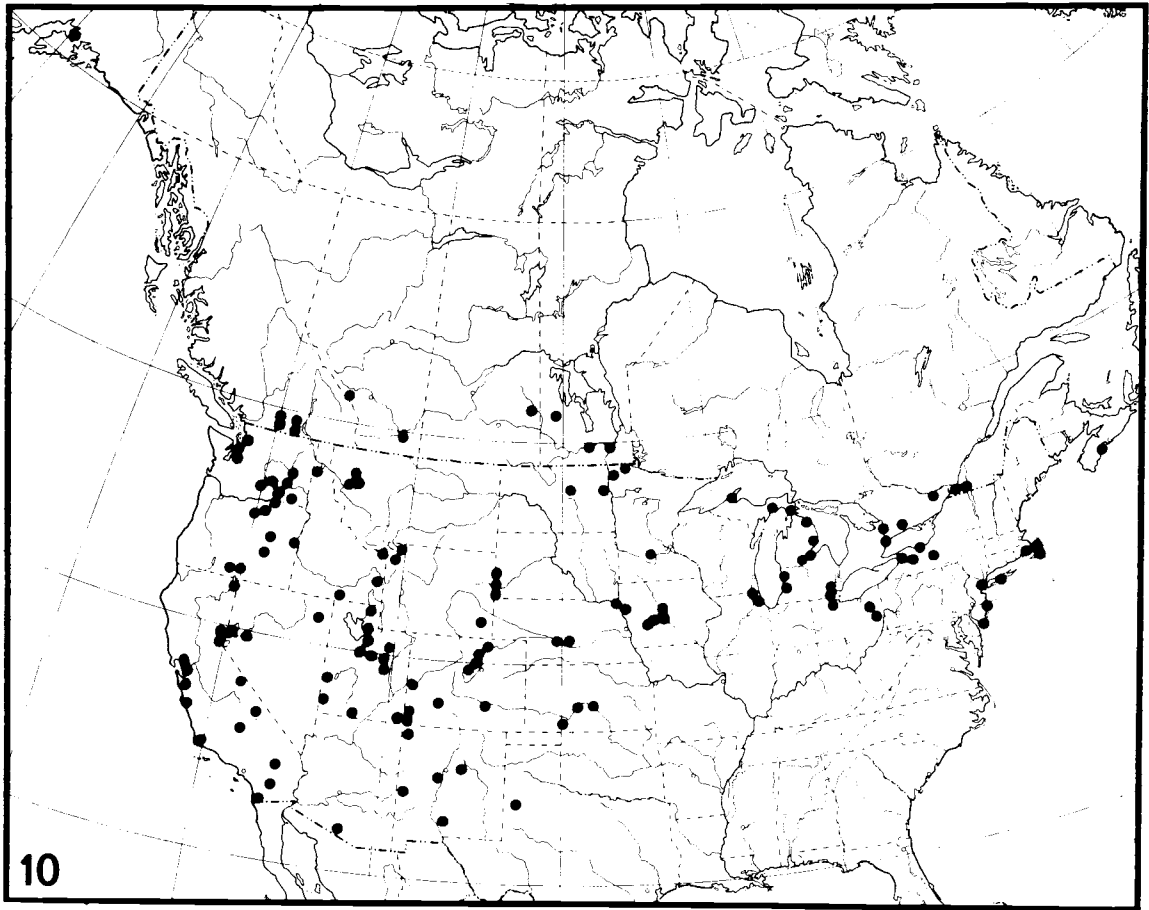


Table 2. Phenogram of 46 species of Notiphila based on unweighted pair-group method using arithmetic averages cluster analysis of average Euclidean distance coefficients. The cophenetic correlation coefficient was 0.86. Species numbering according to Appendix A.

1 *****
7 *****
14 *****
4 *****
18 *****
19 *****
9 *****
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21 *****
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38 *****
46 *****
33 *****
41 *****
48 *****
29 *****
45 *****
34 *****
36 *****
39 *****
44 *****
42 *****
35 *****
47 *****
30 *****
28 *****
6 *****
10 *****
22 *****
32 *****
11 *****

Table 3. Phenogram of 46 Notiphila species based on unweighted pair-group method using arithmetic averages cluster analysis of Manhattan distance coefficients. The cophenetic correlation coefficient was 0.84. Species numbering according to Appendix A.

1 *****
2 *****
3 *****
7 *****
14 *****
22 *****
10 *****
23 *****
24 *****
4 *****
18 *****
19 *****
9 *****
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43 *****
40 *****
38 *****
33 *****
46 *****
41 *****
48 *****
34 *****
36 *****
35 *****
47 *****
28 *****
32 *****
11 *****

Table 4. Phenogram of 25 species of the subgenus Notiphila based on weighted pair-group method using arithmetic averages cluster analysis of Manhattan distance coefficients. The cophenetic correlation coefficient was 0.80. Species numbering according to Appendix B.

1 *****
1 *****
2 *****
3 *****
13 *****
16 *****
19 *****
20 *****
5 *****
22 *****
12 *****
15 *****
18 *****
21 *****
24 *****
9 *****
11 *****
10 *****
7 *****
8 *****
14 *****
17 *****
25 *****
23 *****
4 *****
6 *****

Table 5. Phenogram of 22 species of the subgenus Agrolimna based on weighted pair-group method using arithmetic average cluster analysis of average Euclidean distance coefficients. The cophenetic correlation coefficient was 0.91. Species numbering according to Appendix C.

1 *****
7 *****
14 *****
4 *****
18 *****
19 *****
9 *****
8 *****
21 *****
2 *****
3 *****
23 *****
24 *****
5 *****
12 *****
13 *****
17 *****
16 *****
15 *****
20 *****
10 *****
22 *****
6 *****
11 *****

Table 6. Phenogram of 22 species of the subgenus Agrolimna based on complete linkage clustering analysis of average Euclidean distance coefficients. The cophenetic correlation coefficient was 0.87. Species numbering according to Appendix C.

1 *****
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4 *****
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5 *****
12 *****
13 *****
17 *****
16 *****
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20 *****
23 *****
24 *****
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22 *****
6 *****
11 *****

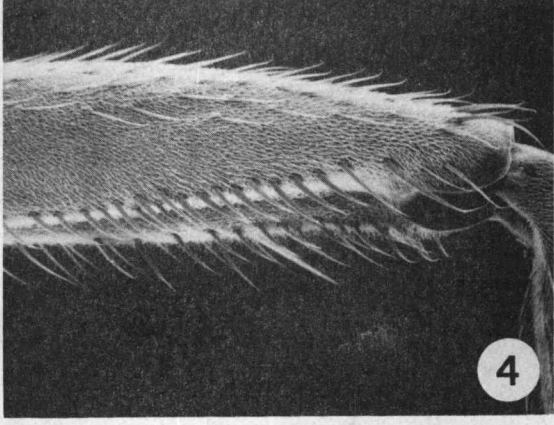
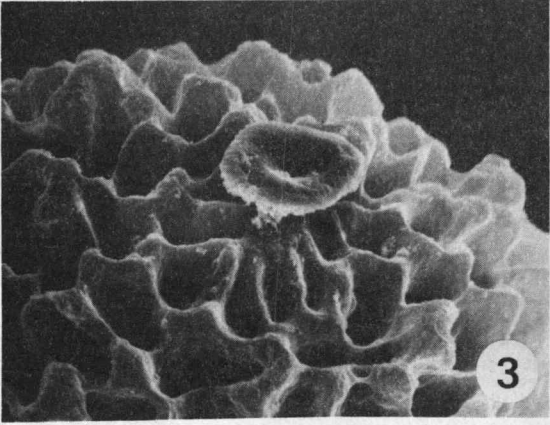
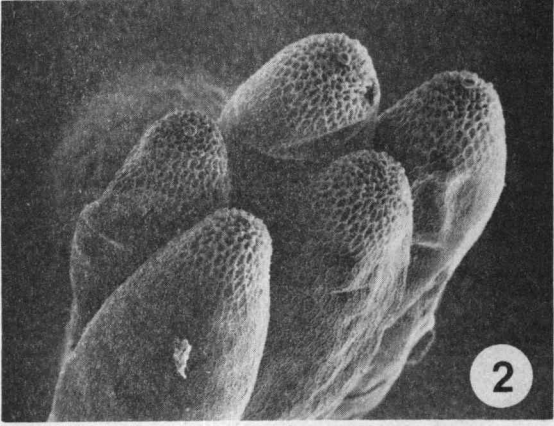
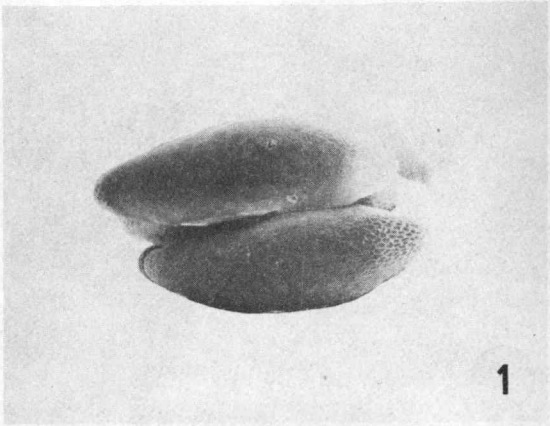
Table 7. Phenogram of 22 species of the subgenus Agrolimna based on unweighted pair-group method using arithmetic average clustering analysis of Manhattan distance coefficients. The cophenetic correlation coefficient was 0.87. Species numbering according to Appendix C.

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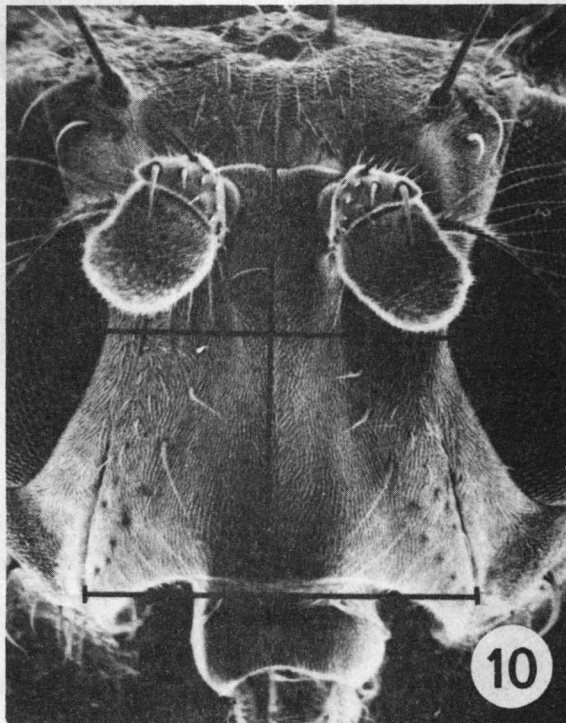
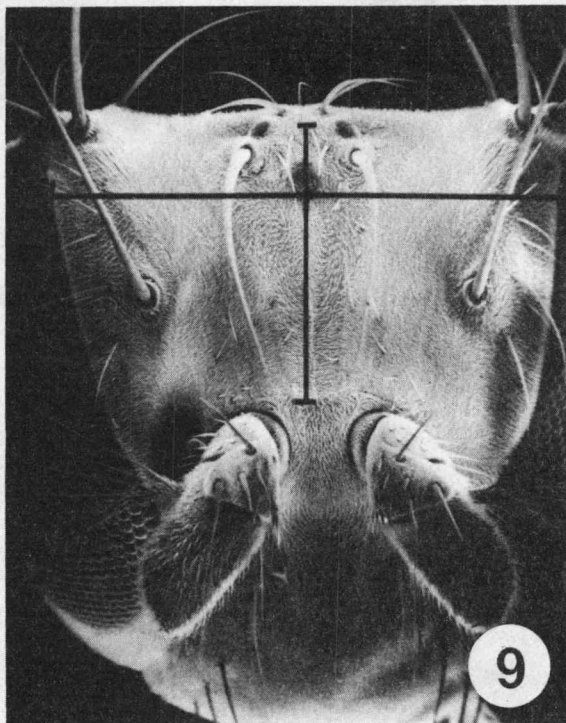
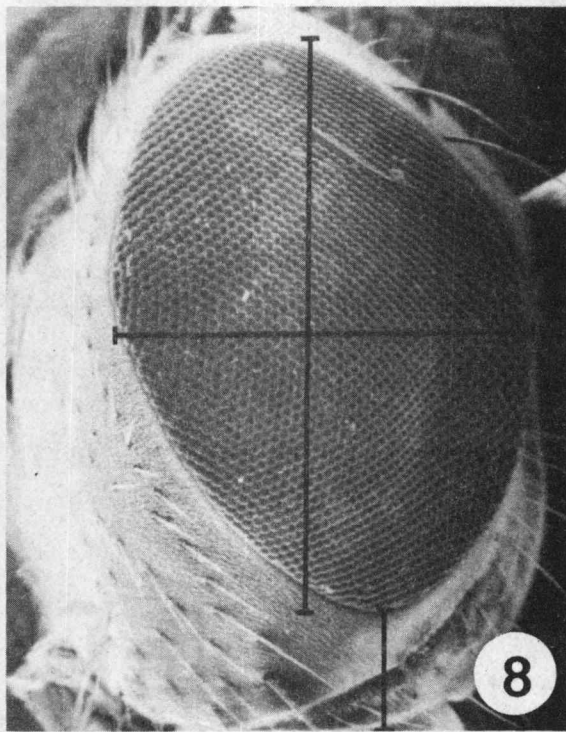
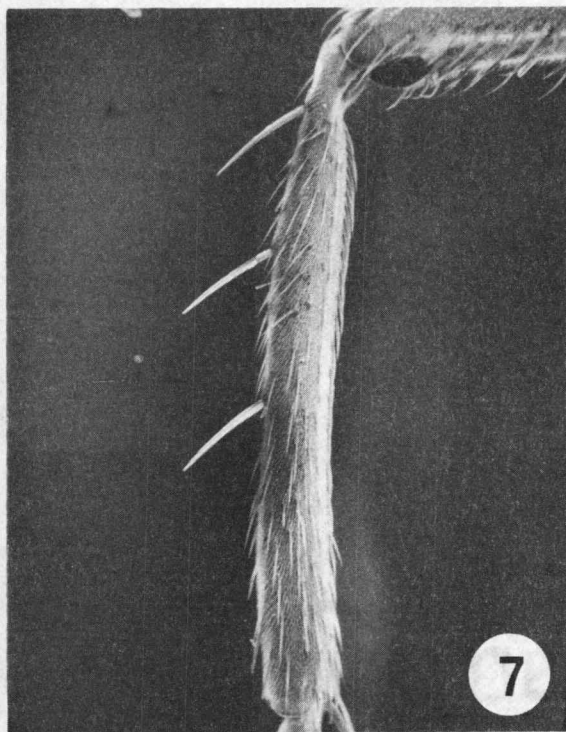
1 *****
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14 *****
22 *****
10 *****
23 *****
24 *****
4 *****
18 *****
19 *****
9 *****
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12 *****
13 *****
17 *****
16 *****
15 *****
20 *****
6 *****
11 *****

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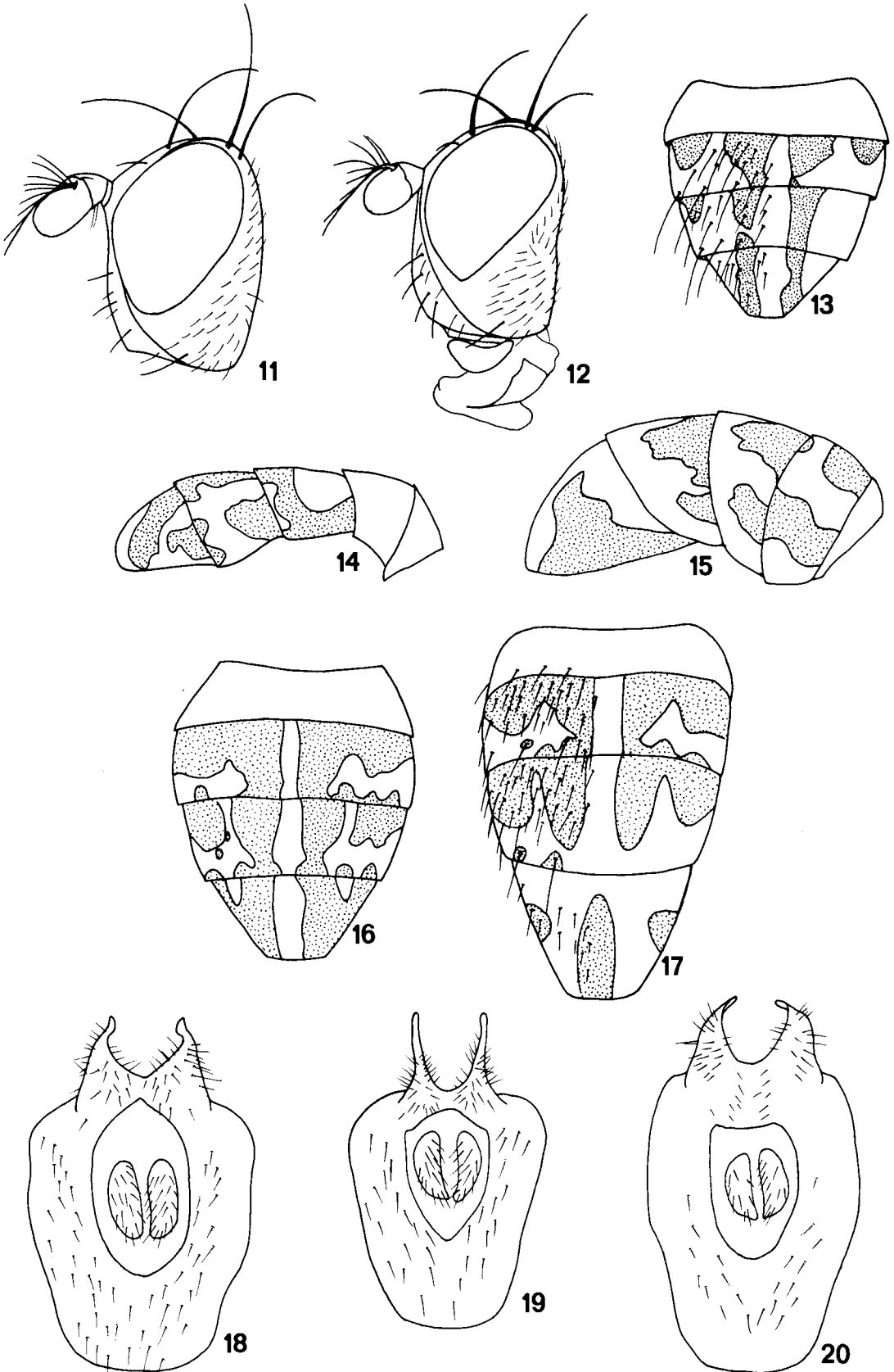
- Figure 1. Lateral view of eggs - N. quadrisetosa.
- Figure 2. Micropyle end of eggs - N. quadrisetosa.
- Figure 3. Close-up of micropyle - N. quadrisetosa.
- Figure 4. Posteroventral view of mesofemora showing comb-like row of bristles on males of Notiphila s. str. - N. erythrocera.
- Figure 5. Close-up of Figure 4.
- Figure 6. Ventral-oblique view of setal fascicle on hind basitarsus - N. erythrocera.



- Figure 7. Posterior view of mesotibia of Notiphila s. str. showing three dorsal extensor bristles - N. erythrocera.
- Figure 8. Lateral view of head showing where measurements were taken - N. quadrisetosa.
- Figure 9. Dorsal view of head showing frons (postfrons) and where measurements were taken - N. quadrisetosa.
- Figure 10. Cephalic view of head showing face (prefrons) and where measurements were taken - N. quadrisetosa.



- Figure 11. Lateral view of head - N. biseriata.
- Figure 12. Lateral view of head - N. cognata.
- Figure 13. Dorsal view of abdomen - N. cressoni.
- Figure 14. Lateral view of abdomen - N. pauroura.
- Figure 15. Lateral view of abdomen - N. solita.
- Figure 16. Dorsal view of abdomen - N. pauroura.
- Figure 17. Dorsal view of abdomen - N. solita.
- Figure 18. Ventral view of epandrium and cerci - N. cognata.
- Figure 19. Ventral view of epandrium and cerci - N. adusta.
- Figure 20. Ventral view of epandrium and cerci - N. bella.



Figures 21-24. Ventral view of epandrium and cerci.

21. N. biseriata
22. N. footei
23. N. pallicornis
24. N. taenia

Figure 25. Lateral view of epandrium and cerci - N. solita.

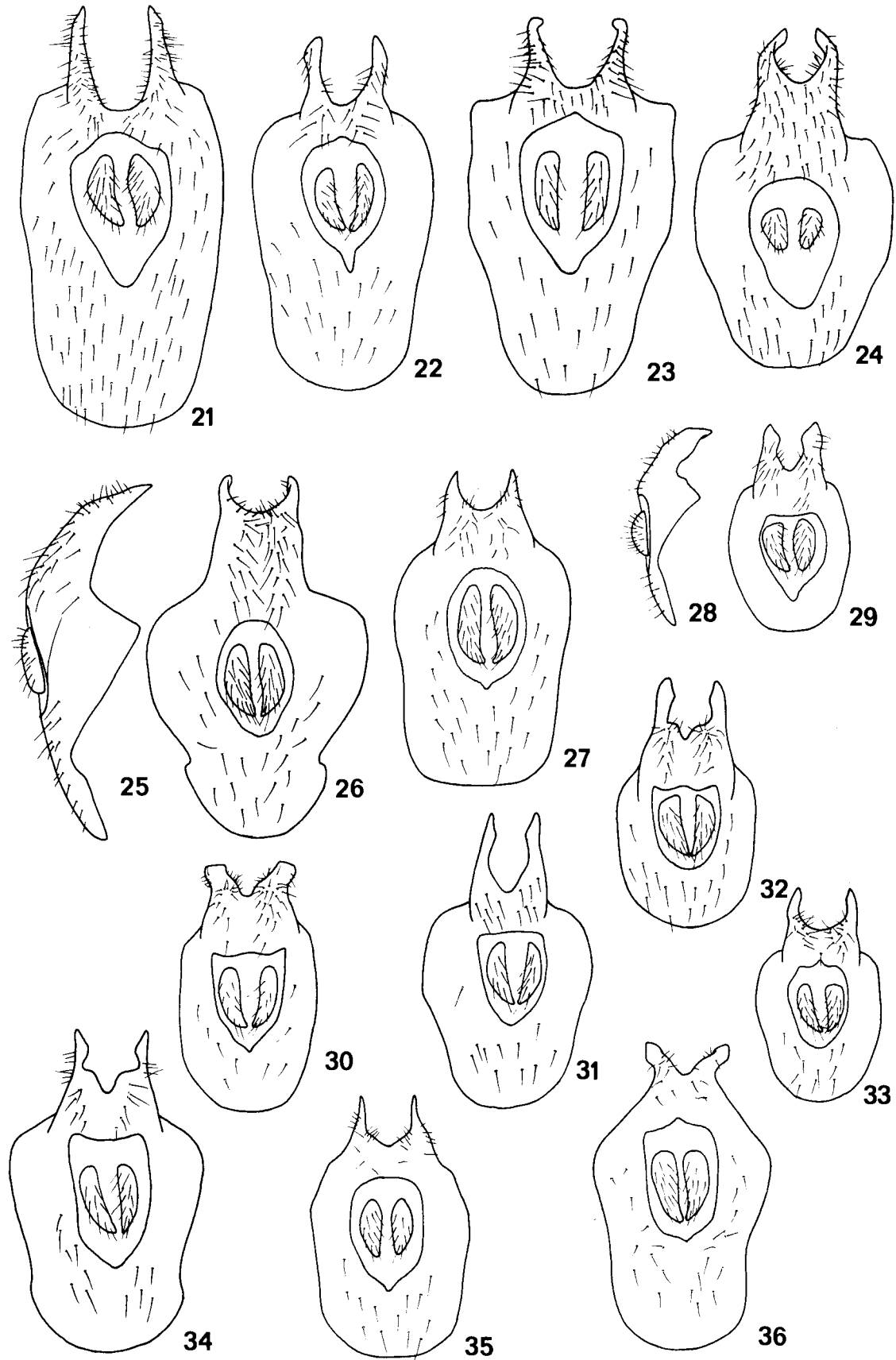
Figures 26-27. Ventral view of epandrium and cerci.

26. N. solita
27. N. pauroura

Figure 28. Lateral view of epandrium and cerci - N. cressoni.

Figures 29-36. Ventral view of epandrium and cerci.

29. N. cressoni
30. N. loewi
31. N. poliosoma
32. N. shewelli
33. N. carinata
34. N. eleomyia
35. N. paludicola
36. N. latigena



Figures 37-38. Ventral view of epandrium and cerci.

37. N. orientata

38. N. robusta

Figure 39. Lateral view of epandrium and cerci - N. floridensis.

Figures 40-42. Ventral view of epandrium and cerci.

40. N. floridensis

41. N. erythrocerata

42. N. avia

Figure 43. Lateral view of epandrium and cerci - N. phaeopsis.

Figures 44-45. Ventral view of epandrium and cerci.

44. N. phaeopsis

45. N. pulcra

Figure 46. Lateral view of internal male genitalia - N. nudipes.

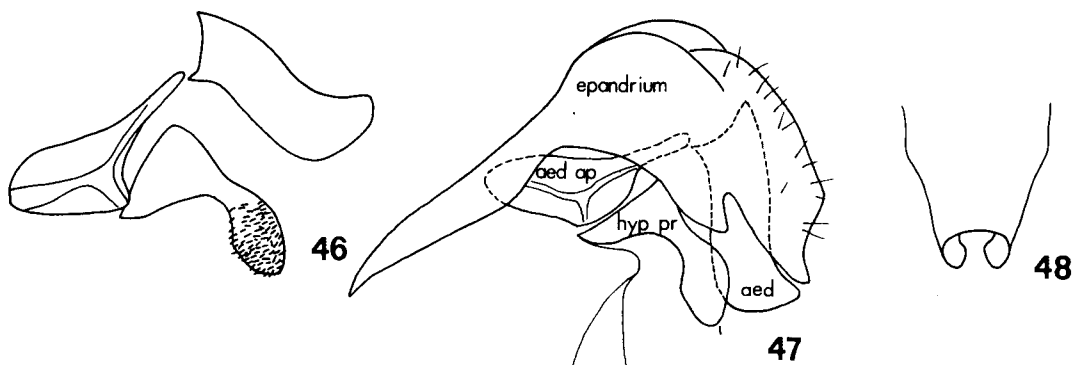
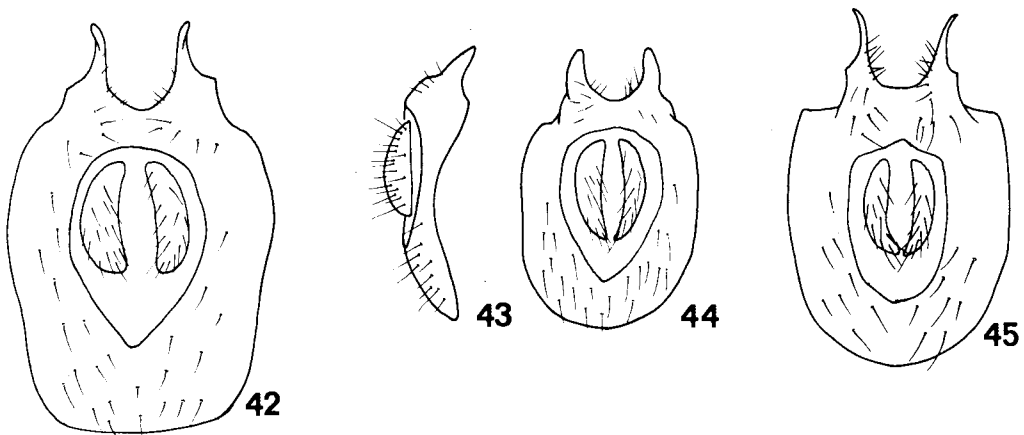
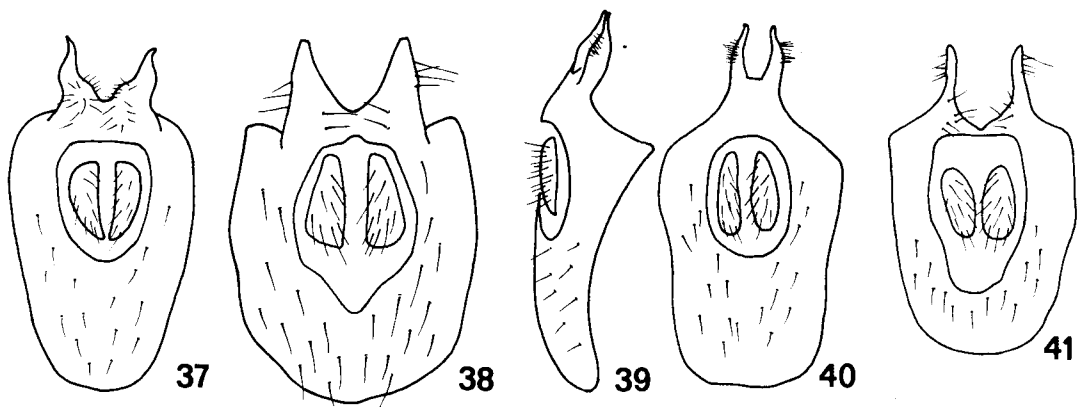
Figure 47. Habitus of male postabdomen - N. nudipes.

Figure 48. Ventral view of epandrial process - N. nudipes.

Figures 49-50. Lateral view of internal male genitalia.

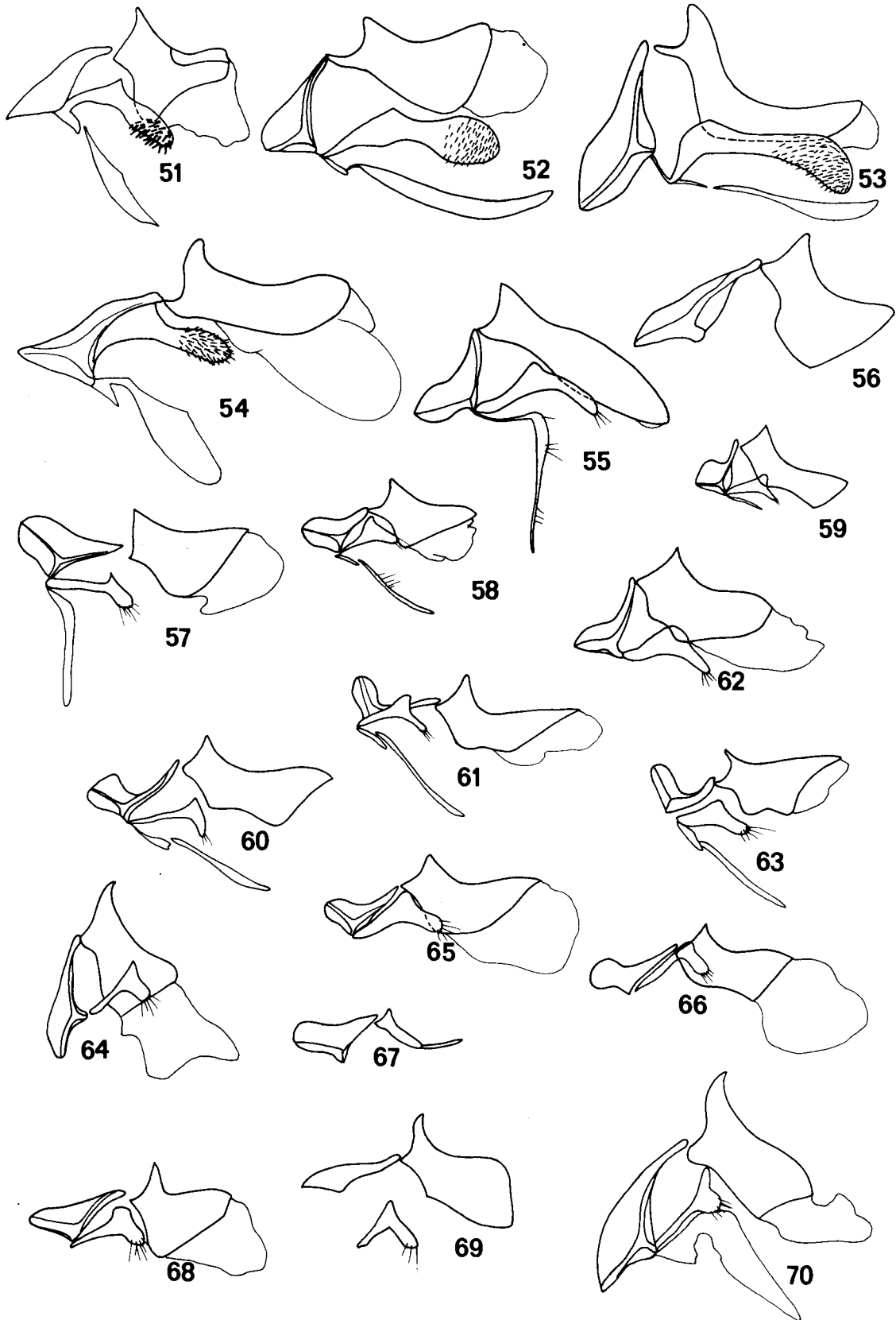
49. N. biseriata

50. N. cognata



Figures 51-70. Lateral view of internal male genitalia.

51. N. adusta
52. N. bella
53. N. taenia
54. N. pallicornis
55. N. solita
56. N. footei
57. N. pauroura
58. N. carinata
59. N. cressoni
60. N. latigena
61. N. loewi
63. N. eleomyia
63. N. shewelli
64. N. phaeopsis
65. N. poliosoma
66. N. paludicola
67. N. floridensis
68. N. orientalis
69. N. erythroceras
70. N. avia

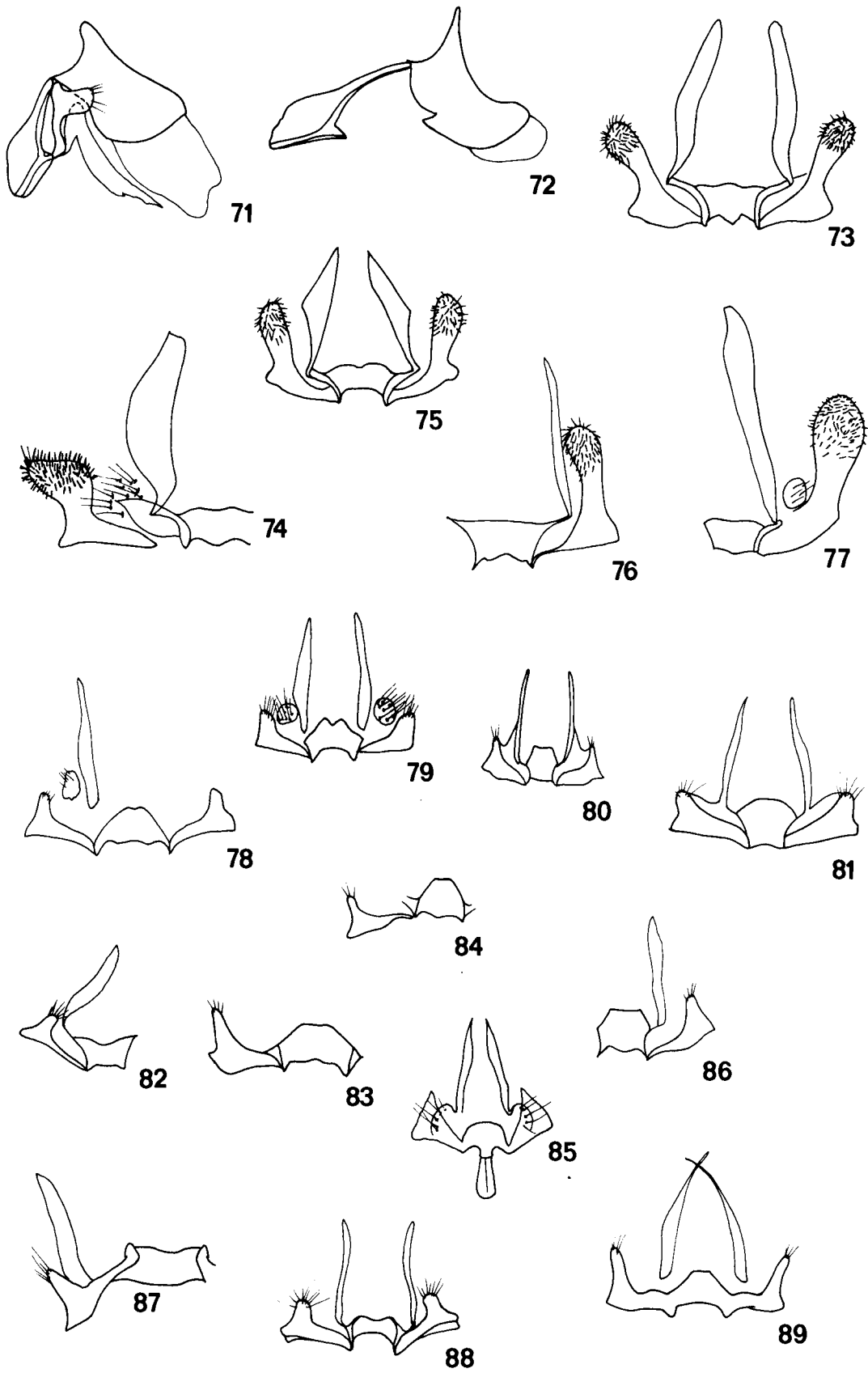


Figures 71-72. Lateral view of internal male genitalia.

- 71. N. pulcra
- 72. N. robusta

Figures 73-89. Ventral view of internal male genitalia showing paired hypandrial processes and sclerotized bands of hypandrial receptacle.

- 73. N. footei
- 74. N. biseriata
- 75. N. adusta
- 76. N. cognata
- 77. N. bella
- 78. N. latigena
- 79. N. shewelli
- 80. N. cressoni
- 81. N. pauroura
- 82. N. phaeopsis
- 83. N. eleomyia
- 84. N. loewi
- 85. N. floridensis
- 86. N. paludicola
- 87. N. robusta
- 88. N. orientata
- 89. N. poliosoma



Figures 90-92. Lateral view of head.

90. N. quadrisetosa

91. N. nanosoma

92. N. bispinosa

Figure 93. Dorsal view of right wing - N. quadrisetosa.

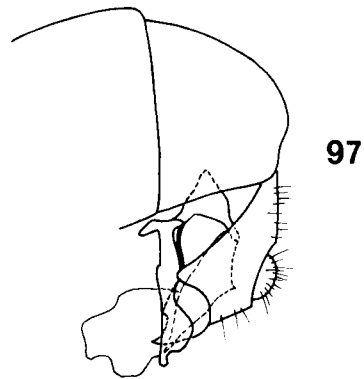
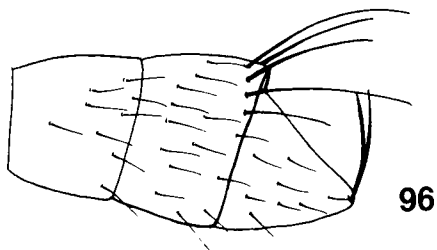
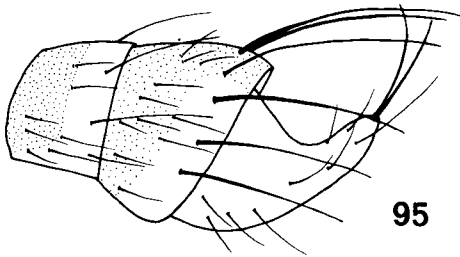
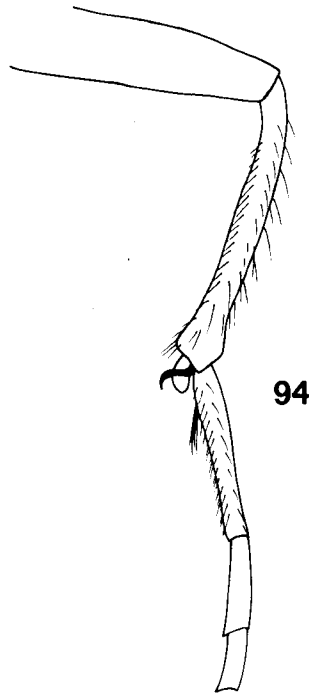
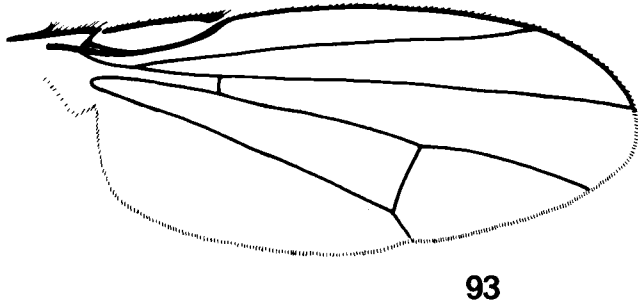
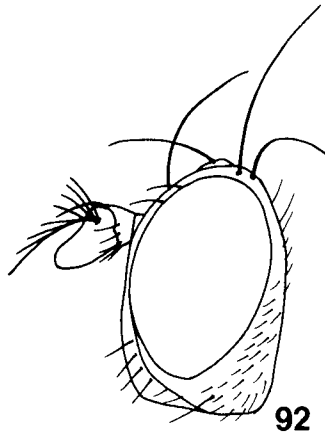
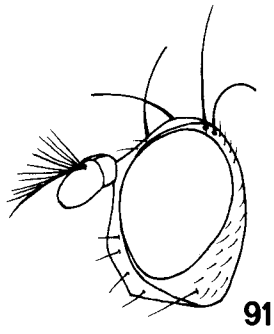
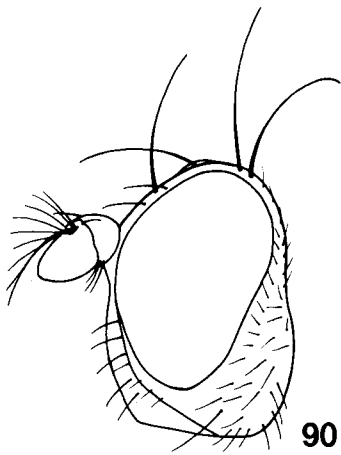
Figure 94. Posterior view of right hind leg - N. hamifera.

Figures 95-96. Lateral view of abdomen.

95. N. furcata

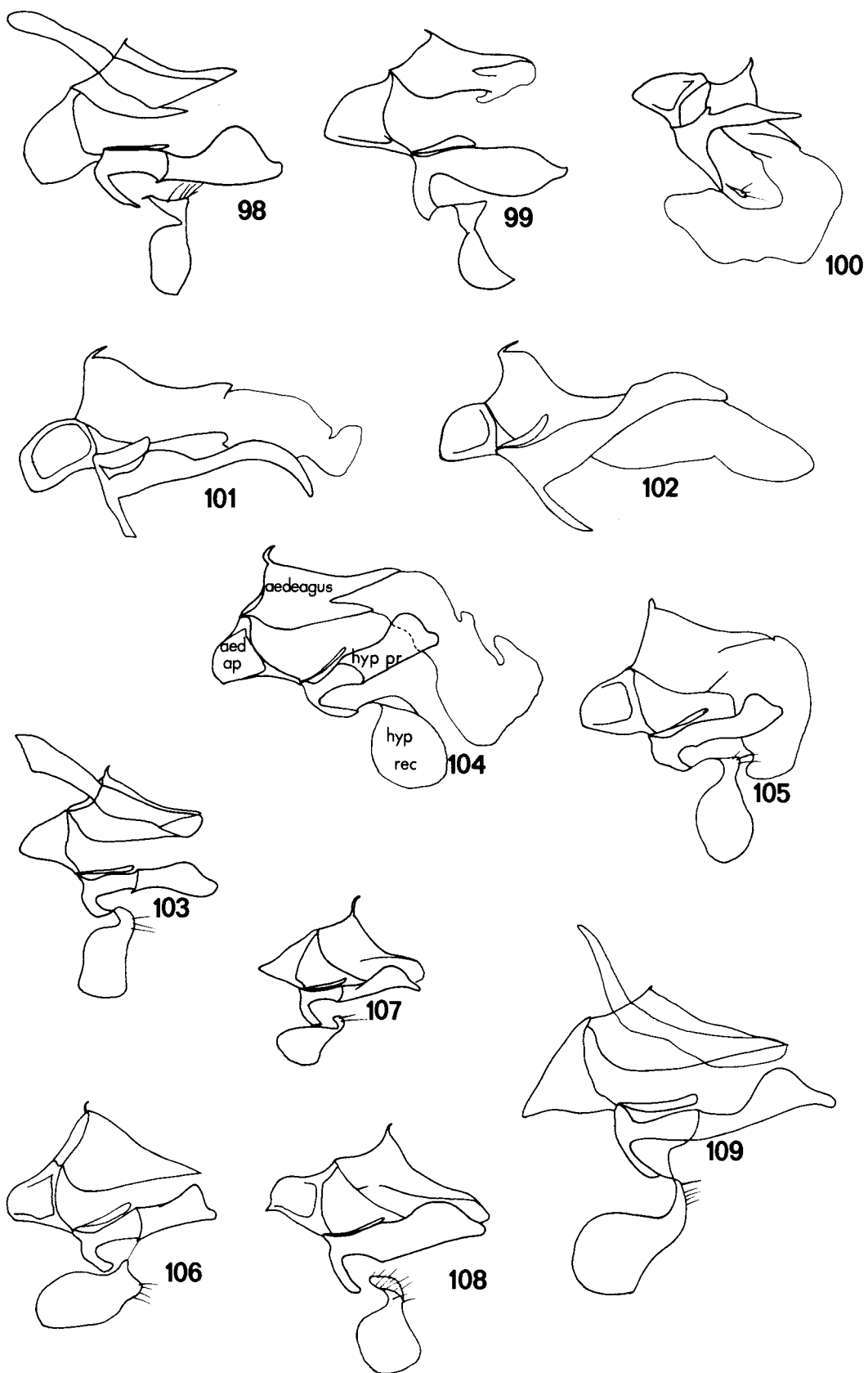
96. N. bispinosa

Figure 97. Habitus drawing of male postabdomen - N. uliginosa.



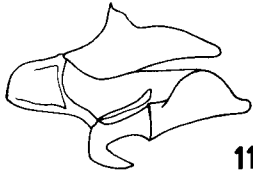
Figures 98-109. Lateral view of internal male genitalia showing aedeagus, aedeagal apodeme, hypandrial process, and hypandrial receptacle.

- 98. N. bispinosa
- 99. N. furcata
- 100. N. pulchrifrons
- 101. N. scoliochaeta
- 102. N. hamifera
- 103. N. atrata
- 104. N. aenigma
- 105. N. atripes
- 106. N. deonieri
- 107. N. decoris
- 108. N. deserta
- 109. N. elophila

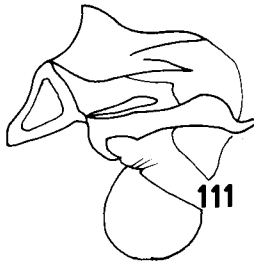


Figures 110-120. Lateral views of internal male genitalia showing aedeagus, aedeagal apodeme, hypandrial process, and hypandrial receptacle.

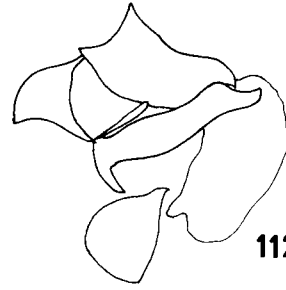
110. N. macrochaeta
111. N. minima
112. N. nanosoma
113. N. olivacea
114. N. pallidipalpis
115. N. paludia
116. N. scalaris
117. N. sicca
118. N. quadrisetosa
119. N. uliginosa (Great Lakes)
120. N. uliginosa (Alaska)



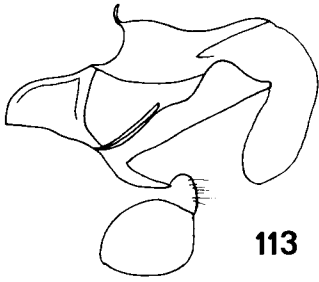
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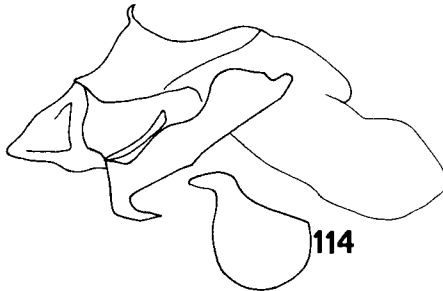
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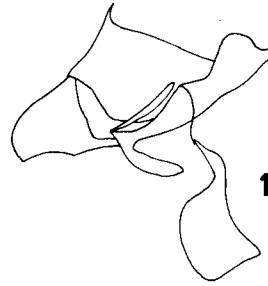
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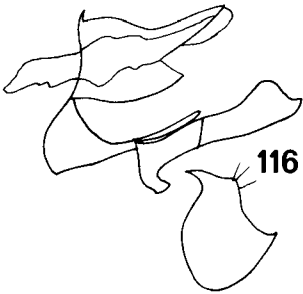
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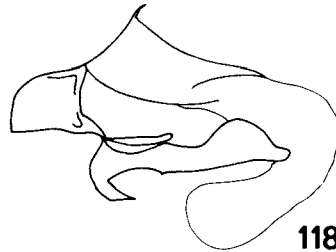
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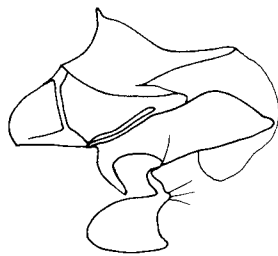
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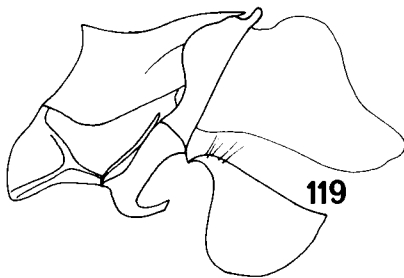
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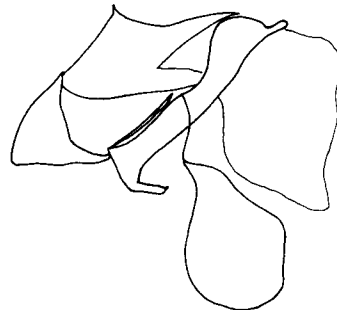
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117



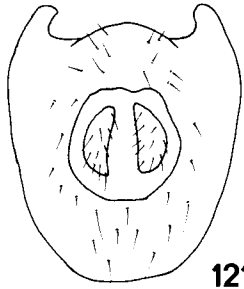
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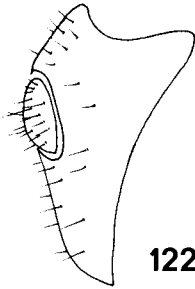
120

Figures 121-138. Ventral and some lateral views of the male epandrium and cerci.

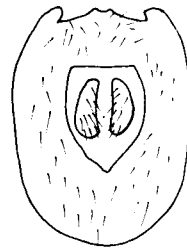
121. N. atripes
122. N. atripes
123. N. atrata
124. N. decoris
125. N. decoris
126. N. deserta
127. N. deonieri
128. N. elophila
129. N. elophila
130. N. macrochaeta
131. N. macrochaeta
132. N. olivacea
133. N. quadrisetosa
134. N. quadrisetosa
135. N. paludia
136. N. scalaris
137. N. sicca
138. N. uliginosa



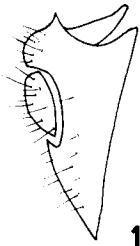
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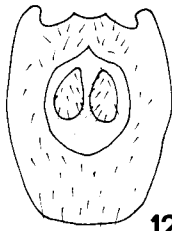
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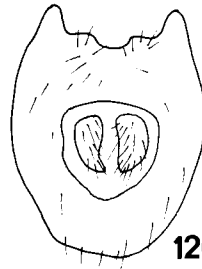
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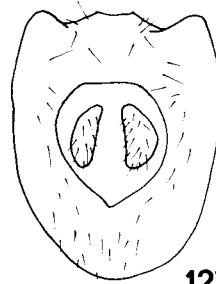
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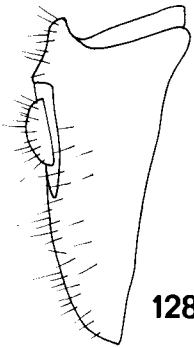
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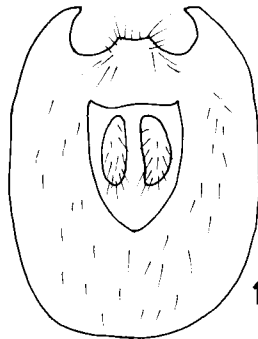
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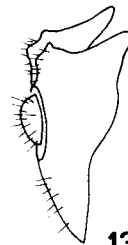
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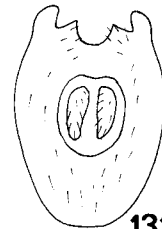
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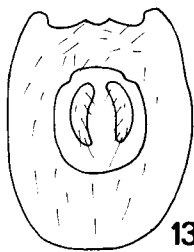
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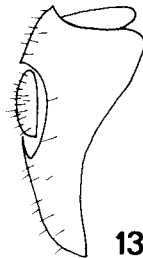
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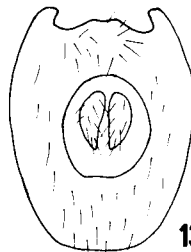
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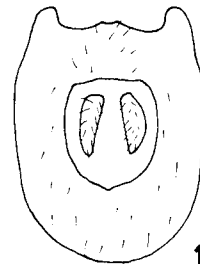
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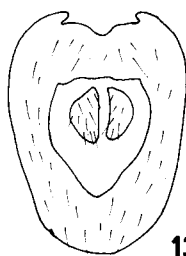
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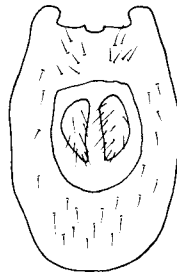
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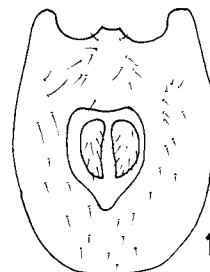
135



136



137



138

Figures 139-148. Ventral view of the male epandrium, cerci, and associated structures.

- 139. N. pulchrifrons
- 140. N. pulchrifrons (California)
- 141. N. pulchrifrons (Nebraska)
- 142. N. pulchrifrons (New Mexico)
- 143. N. pulchrifrons (Kansas)
- 144. N. pulchrifrons (Texas)
- 145. N. pulchrifrons (Georgia)
- 146. N. hamifera
- 147. N. scoliochaeta
- 148. N. furcata

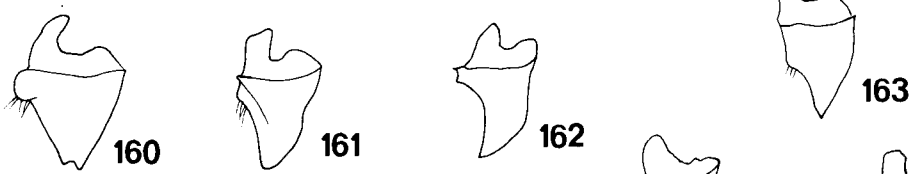
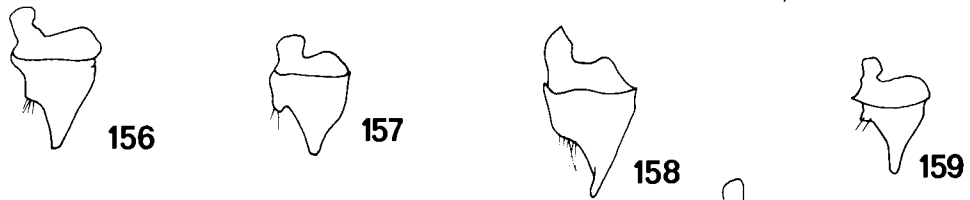
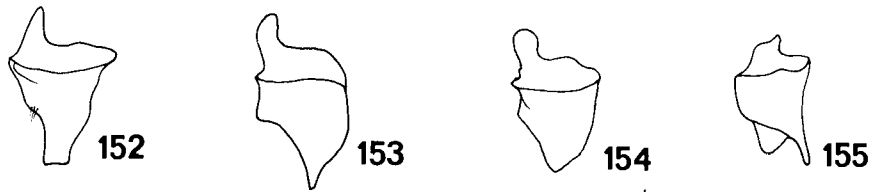
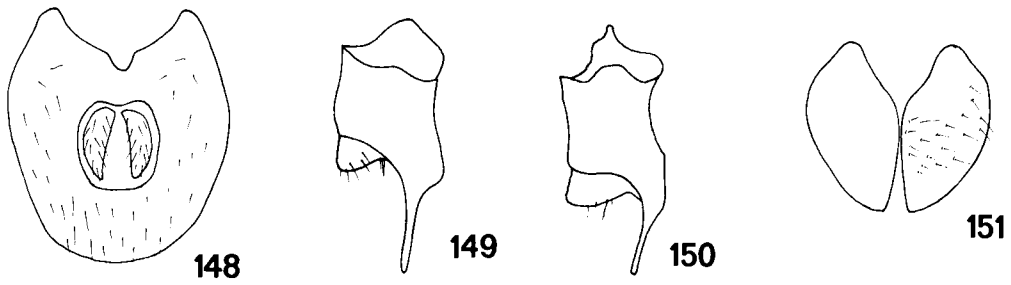
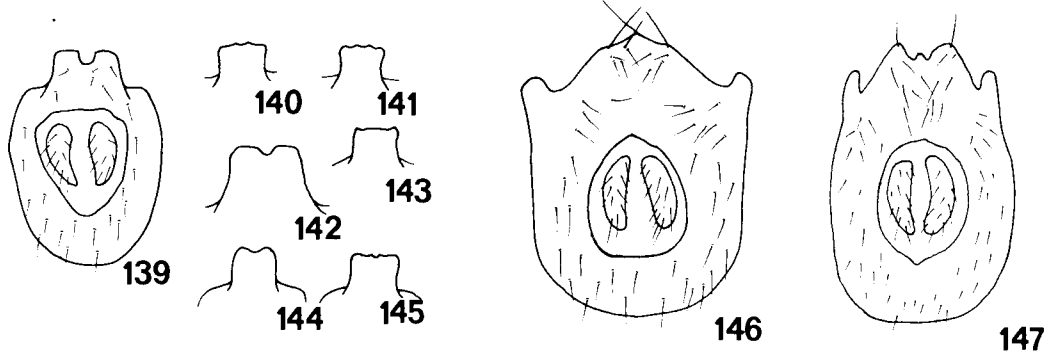
Figures 149-150. Lateral views of the right syrstylus of the male genitalia.

- 149. N. hamifera
- 150. N. scoliochaeta

Figure 151. Ventral view of hypandrial receptacle of N. scoliochaeta.

Figures 152-171. Lateral views of the right surstylus of the male genitalia.

- 152. N. furcata
- 153. N. bispinosa
- 154. N. atripes
- 155. N. pulchrifrons
- 156. N. aenigma
- 157. N. atrata
- 158. N. deonieri
- 159. N. decoris
- 160. N. deserta
- 161. N. macrochaeta
- 162. N. minima
- 163. N. olivacea
- 164. N. paludia
- 165. N. scalaris
- 166. N. nanosoma
- 167. N. pallidipalpis
- 168. N. quadrisetosa
- 169. N. sicca
- 170. N. uliginosa
- 171. N. uliginosa



Figures 172-176. Right hypandrial process.

- 172. N. uliginosa (Watson Lake, Yukon Territory)
- 173. N. uliginosa (Harney County, Oregon)
- 174. N. uliginosa (Babb, Montana)
- 175. N. uliginosa (Valdez, Alaska)
- 176. N. uliginosa (Parry Island, Ontario, Canada)

Figures 177-178. Lateral view of female postabdomen.

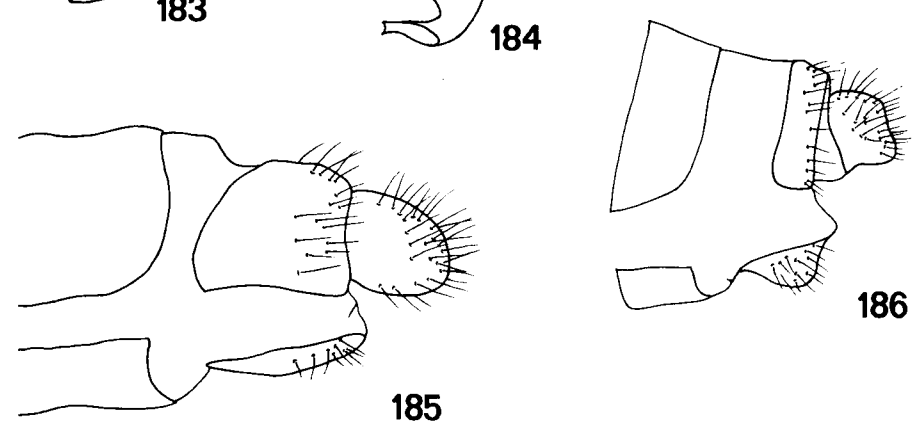
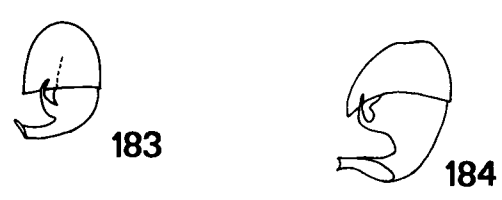
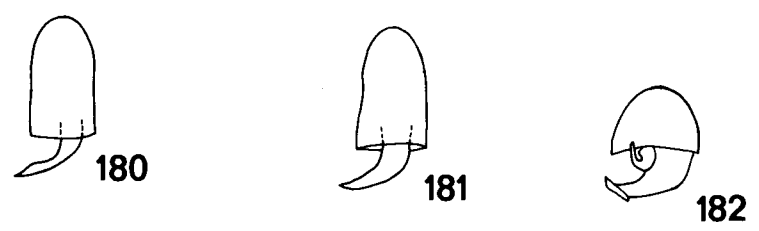
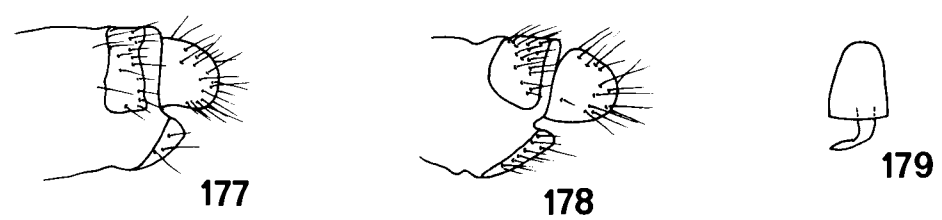
- 177. N. quadrisetosa
- 178. N. nanosoma

Figures 179-184. Lateral views of female ventral receptacle.

- 179. N. nanosoma
- 180. N. quadrisetosa
- 181. N. olivacea
- 182. N. shewelli
- 183. N. erythroceras
- 184. N. avia

Figures 185-186. Lateral view of female postabdomen.

- 185. N. avia
- 186. N. erythroceras



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APPENDICES

APPENDIX A

SPECIES AND NUMBERING SYSTEM FOR THE GENUS NOTIPHILA

- | | |
|--|-----------------------------|
| 1. <u>N. scoliochaeta</u> | 25. <u>N. avia</u> |
| 2. <u>N. hamifera</u> | 26. <u>N. robusta</u> |
| 3. <u>N. pulchrifrons</u> | 27. <u>N. phaeopsis</u> |
| 4. <u>N. sicca</u> | 28. <u>N. pulcra</u> |
| 5. <u>N. pallidipalpis</u> | 29. <u>N. erythrocerata</u> |
| 6. <u>N. deserta</u> | 30. <u>N. orientata</u> |
| 7. <u>N. macrochaeta</u> | 31. <u>N. shewelli</u> |
| 8. <u>N. decoris</u> | 32. <u>N. floridensis</u> |
| 9. <u>N. scalaris</u> | 33. <u>N. cognata</u> |
| 10. <u>N. minima</u> | 34. <u>N. bella</u> |
| 11. <u>N. nanosoma</u> | 35. <u>N. taenia</u> |
| 12. <u>N. atrata</u> | 36. <u>N. nudipes</u> |
| 13. <u>N. atripes</u> | 37. <u>N. biseriata</u> |
| 14. <u>N. quadrisetosa</u> | 38. <u>N. footei</u> |
| 15. <u>N. uliginosa</u> (Great Lakes form) | 39. <u>N. adusta</u> |
| 16. <u>N. uliginosa</u> (Northwestern form) | 40. <u>N. eleomyia</u> |
| 17. <u>N. uliginosa</u> (Pacific Coast form) | 41. <u>N. carinata</u> |
| 18. <u>N. paludia</u> | 42. <u>N. cressoni</u> |
| 19. <u>N. aenigma</u> | 43. <u>N. latigena</u> |
| 20. <u>N. olivacea</u> | 44. <u>N. loewi</u> |
| 21. <u>N. deonieri</u> | 45. <u>N. paludicola</u> |
| 22. <u>N. elophila</u> | 46. <u>N. poliosoma</u> |
| 23. <u>N. furcata</u> | 47. <u>N. solita</u> |
| 24. <u>N. bispinosa</u> | 48. <u>N. pauroura</u> |

APPENDIX B

SPECIES AND NUMBERING SYSTEM FOR
THE SUBGENUS NOTIPHILA

- | | |
|----------------------------|--------------------------|
| 1. <u>N. avia</u> | 14. <u>N. footei</u> |
| 2. <u>N. robusta</u> | 15. <u>N. adusta</u> |
| 3. <u>N. phaeopsis</u> | 16. <u>N. eleomyia</u> |
| 4. <u>N. pulcra</u> | 17. <u>N. carinata</u> |
| 5. <u>N. erythrocerata</u> | 18. <u>N. cressoni</u> |
| 6. <u>N. floridensis</u> | 19. <u>N. shewelli</u> |
| 7. <u>N. orientata</u> | 20. <u>N. latigena</u> |
| 8. <u>N. cognata</u> | 21. <u>N. loewi</u> |
| 9. <u>N. bella</u> | 22. <u>N. paludicola</u> |
| 10. <u>N. taenia</u> | 23. <u>N. poliosoma</u> |
| 11. <u>N. nudipes</u> | 24. <u>N. solita</u> |
| 12. <u>N. pallicornis</u> | 25. <u>N. pauroura</u> |
| 13. <u>N. biseriata</u> | |

APPENDIX C

SPECIES AND NUMBERING SYSTEM FOR
THE SUBGENUS AGROLIMNA

- | | |
|----------------------------|--|
| 1. <u>N. scoliochaeta</u> | 13. <u>N. atripes</u> |
| 2. <u>N. hamifera</u> | 14. <u>N. quadrisetosa</u> |
| 3. <u>N. pulchrifrons</u> | 15. <u>N. uliginosa</u> (Great Lakes form) |
| 4. <u>N. sicca</u> | 16. <u>N. uliginosa</u> (Northwestern form) |
| 5. <u>N. pallidipalpis</u> | 17. <u>N. uliginosa</u> (Pacific Coast form) |
| 6. <u>N. deserta</u> | 18. <u>N. paludia</u> |
| 7. <u>N. macrochaeta</u> | 19. <u>N. aenigma</u> |
| 8. <u>N. decoris</u> | 20. <u>N. olivacea</u> |
| 9. <u>N. scalaris</u> | 21. <u>N. deonieri</u> |
| 10. <u>N. minima</u> | 22. <u>N. elophila</u> |
| 11. <u>N. nanosoma</u> | 23. <u>N. furcata</u> |
| 12. <u>N. atrata</u> | 24. <u>N. bispinosa</u> |

APPENDIX D

CHARACTERS AND CHARACTER STATES FOR NUMERICAL
ANALYSIS OF NOTIPHILA SPECIES

<u>Character</u>	<u>Character states</u>
1. Eye height	measurement
2. Eye width	"
3. Genal height	"
4. Postfrons height	"
5. Postfrons width	"
6. Head height	"
7. Head width	"
8. Head length	"
9. Prefrons height	"
10. Narrowest prefrons width (between eyes)	"
11. Widest prefrons width (at base)	"
12. Postocular bristle length	"
13. Face width (profile)	"
14. Thorax length	"
15. Wing width	"
16. First costal section length	"
17. Second costal section length	"
18. First M ₁₊₂ section length	"

<u>Character</u>	<u>Character states</u>
19. Second M ₁₊₂ section length	measurement
20. Abdomen length (male)	"
21. Abdomen length (female)	"
22. Abdomen width (male)	"
23. Length of fourth segment (male)	"
24. Length of fifth segment (male)	"
25. Width of fifth segment (male)	"
26. Total length (male)	"
27. Total length (female)	"
28. Number of proclinate fronto-orbitals	number count
29. Color of maxillary palpi	0) pale 1) dark
30. First antennal segment color	0) pale 1) dark
31. Second antennal segment color	0) pale 1) dark
32. Third antennal segment color	0) pale 1) 1/2 dark 2) mostly dark 3) dark
33. Color of scutellum sides	0) blackish-contrasting with dorsum 1) unicolorous with dorsum
34. Mesopleural maculation	0) absent 1) intermediate 2) definite spot
35. Mesofemoral comb	0) absent 1) present
36. Mesotibial setal series	0) absent 1) present
37. Color of setal fascicle	0) pale 1) dark

<u>Character</u>	<u>Character states</u>
38. Color of fore tarsi	0) pale 1) dark
39. Color of mid tarsi	0) pale 1) dark
40. Color of hind tarsi	0) pale 1) dark
41. Dorsal extensor bristles	number count
42. Metatibial seta	0) absent 1) present (e.g., <u>N. hamifera</u>)
43. Fifth abdominal segment bristle	0) absent 1) present
44. Development of hypandrial process	0) as in <u>scalaris</u> or <u>furcata</u> species-groups 1) as in <u>pulchrifrons</u> species-group 2) as in subgenus <u>Notiphila</u>
45. Development of epandrial process	0) as in <u>scalaris</u> or <u>furcata</u> species-group 1) as in <u>pulchrifrons</u> species-group 2) as in <u>Notiphila s. str.</u>
46. Development of surstyli	0) as in <u>Agrolimna</u> spp. 1) as in <u>Notiphila s. str.</u> spp.
47. Hypandrial receptacle	0) as in <u>scalaris</u> species-group 1) as in <u>pulchrifrons</u> species-group 2) as in <u>Notiphila s. str.</u> spp.
48. Arista branches	number count
49. Length of respiratory neck in larvae and pupae	0) as in <u>Notiphila s. str.</u> spp. 1) as in <u>Agrolimna</u> spp.

APPENDIX E

Quantified character values for 25 species of the subgenus Notiphila that have been standardized and transformed. Columns are OTU's (numbered according to Appendix B); rows are characters (numbered according to Appendix D).

21					
22					
23					
24					
25					
1	-1.193	-1.586	.304	-0.670	1.053
2	-1.053	-1.492	1.144	-0.613	1.144
3	-0.426	-1.158	.158	-1.011	-0.426
4	-0.302	-1.333	.960	-0.934	.329
5	-1.063	-1.544	.544	-1.465	.142
6	-1.213	-1.728	.728	-0.566	.728
7	-0.596	-1.270	.618	-0.076	.709
8	-0.999	-1.766	.919	-0.939	.572
9	-1.150	-1.150	.284	-0.433	.284
10	-0.324	-0.324	.236	-0.934	-0.099
11	-1.159	-1.170	.857	-1.174	.349
12	-0.286	-0.246	.042	-0.236	.697
13	-0.087	-0.449	-0.087	-2.810	-1.449
14	-1.420	99.999	.451	-0.588	.243
15	1.336	-1.298	.269	-0.906	1.454
16	.423	-1.232	-0.232	-0.232	.751
17	.419	-1.774	.419	-0.678	.053
18	.341	-1.891	.713	-1.085	.713
19	.072	-0.790	.359	-1.653	-0.216
20	-0.903	99.999	.476	-1.510	-0.213
21	-1.493	99.999	.567	-0.547	.154
22	-1.011	99.999	-0.302	-1.720	.643
23	-1.203	99.999	-0.027	-0.366	-0.421
24	-0.201	99.999	.231	2.825	-0.221
25	-1.454	99.999	.284	.035	.538
26	-1.500	99.999	.700	.700	-0.500
27	-1.453	99.999	1.550	-0.360	.550
28	-0.913	-0.913	-0.912	-0.912	-0.912
29	.436	-0.795	-0.795	1.668	1.668
30	1.159	1.159	1.159	1.159	1.159
31	.970	.960	.960	.960	.960
32	.970	.970	.970	.970	.970
33	-1.062	-0.062	-0.062	.977	1.656
34	1.000	1.000	1.000	1.000	1.000
35	0	0	0	0	0
36	1.000	0	1.000	1.000	1.000
37	1.000	0	1.000	1.000	1.000
38	1.000	1.000	1.000	0	0
39	1.000	1.000	0	1.000	1.000
40	1.000	1.000	0	1.000	1.000
41	1.000	1.000	0	1.000	1.000
42	1.000	0	0	1.000	1.000
43	0	0	0	0	0
44	0	0	0	0	0
45	0	0	0	0	0
46	0	0	0	0	0
47	0	0	0	0	0
48	1.000	1.000	1.000	1.000	1.000
49	0	0	0	0	0

APPENDIX F

Quantified character values for 22 species of the subgenus Agrolimna (three OTU's for N. uliginosa) that have been standardized and transformed. Columns are OTU's (numbered according to Appendix C); rows are characters (numbered according to Appendix D).

APPENDIX G

Matrix of Average Euclidean Distance Coefficients for 46 species of Notiphila. Columns are OTU's (numbered according to Appendix A); rows are characters (numbered according to Appendix D).

	11	12	13	14	15	16	17	18	19	20
11										
12	2.1500									
13	2.2920	0.451								
14	1.1007	1.0007								
15	2.3722	.7722	1.185							
16	2.3880	.6960	.863	1.222						
17	2.2150	.5750	.753	1.066	0					
18	2.1987	.760	.581	.735	.780					
19	2.2210	.661	.959	.991	.845					
20	2.5550	.859	.815	1.300	.805					
21	1.9660	1.002	1.128	1.889	.810					
22	1.7999	1.247	1.290	1.046	1.814					
23	1.810	1.210	1.315	.825	1.317					
24	1.794	1.003	1.124	.856	1.217					
25	2.5660	1.279	1.209	1.534	.909					
26	2.5583	1.224	1.133	1.468	1.111					
27	2.4403	1.182	1.136	1.444	1.667					
28	2.6133	1.461	1.488	1.622	1.533					
29	2.4099	1.570	1.141	1.200	1.139					
30	2.2667	1.313	1.337	1.415	1.417					
31	2.128	1.144	1.158	1.183	1.662					
32	2.6322	1.756	1.829	1.255	1.901					
33	2.1986	1.166	1.311	1.246	1.168					
34	2.4997	.968	1.077	1.423	.946					
35	2.2563	1.215	1.297	1.297	1.172					
36	2.3399	1.109	1.183	1.286	1.288					
37	2.3388	1.411	1.446	1.464	1.474					
38	2.1932	1.366	1.408	1.161	1.222					
39	2.3355	.943	.951	1.224	1.224					
40	2.1931	1.241	1.268	1.141	1.239					
41	2.1801	1.037	1.164	1.054	1.276					
42	2.579	1.088	1.056	1.409	1.166					
43	2.1022	1.171	1.164	1.245	1.333					
44	2.6233	1.071	1.074	1.446	1.666					
45	2.4522	1.184	1.228	1.555	1.028					
46	2.1859	1.144	1.227	.610	1.209					
47	2.4443	1.295	1.397	1.597	1.306					
48	2.116	1.210	1.335	1.121	1.339					

21	21	22	23	24	25	26	27	28	29	30
22	0	0	0	0	0	0	0	0	0	0
23	1.092	1.013	1.471	1.419	1.633	1.777	1.050	1.111	1.000	1.111
24	.805	1.110	1.433	1.413	1.229	1.254	1.774	1.111	1.111	1.111
25	.934	1.110	1.310	1.316	1.033	1.973	1.774	1.111	1.111	1.111
26	1.078	1.110	1.433	1.418	1.229	1.254	1.774	1.111	1.111	1.111
27	1.172	1.110	1.310	1.316	1.033	1.973	1.774	1.111	1.111	1.111
28	.897	1.110	1.433	1.418	1.229	1.254	1.774	1.111	1.111	1.111
29	1.368	1.110	1.310	1.316	1.033	1.973	1.774	1.111	1.111	1.111
30	1.128	1.110	1.433	1.418	1.229	1.254	1.774	1.111	1.111	1.111
31	1.334	1.110	1.310	1.316	1.033	1.973	1.774	1.111	1.111	1.111
32	1.942	1.110	1.433	1.418	1.229	1.254	1.774	1.111	1.111	1.111
33	1.504	1.110	1.310	1.316	1.033	1.973	1.774	1.111	1.111	1.111
34	1.045	1.110	1.433	1.418	1.229	1.254	1.774	1.111	1.111	1.111
35	1.226	1.110	1.310	1.316	1.033	1.973	1.774	1.111	1.111	1.111
36	1.079	1.110	1.433	1.418	1.229	1.254	1.774	1.111	1.111	1.111
37	1.288	1.110	1.310	1.316	1.033	1.973	1.774	1.111	1.111	1.111
38	.987	1.110	1.433	1.418	1.229	1.254	1.774	1.111	1.111	1.111
39	.874	1.110	1.310	1.316	1.033	1.973	1.774	1.111	1.111	1.111
40	1.051	1.110	1.433	1.418	1.229	1.254	1.774	1.111	1.111	1.111
41	.990	1.110	1.310	1.316	1.033	1.973	1.774	1.111	1.111	1.111
42	1.138	1.110	1.433	1.418	1.229	1.254	1.774	1.111	1.111	1.111
43	1.336	1.110	1.310	1.316	1.033	1.973	1.774	1.111	1.111	1.111
44	.952	1.110	1.433	1.418	1.229	1.254	1.774	1.111	1.111	1.111
45	1.334	1.110	1.310	1.316	1.033	1.973	1.774	1.111	1.111	1.111
46	1.282	1.110	1.433	1.418	1.229	1.254	1.774	1.111	1.111	1.111
47	.923	1.110	1.310	1.316	1.033	1.973	1.774	1.111	1.111	1.111
48	1.292	1.110	1.433	1.418	1.229	1.254	1.774	1.111	1.111	1.111
	1.034	1.110	1.310	1.316	1.033	1.973	1.774	1.111	1.111	1.111
31	31	32	33	34	35	36	37	38	39	40
32	0	0	0	0	0	0	0	0	0	0
33	1.271	1.110	1.074	1.071	1.028	1.175	1.090	1.000	1.000	1.000
34	.674	1.110	1.045	.971	.789	1.099	.721	1.000	1.000	1.000
35	.963	1.110	1.119	.789	.789	1.099	.721	1.000	1.000	1.000
36	.906	1.110	1.421	1.075	1.065	1.175	1.090	1.000	1.000	1.000
37	.934	1.110	1.119	.789	.789	1.099	.721	1.000	1.000	1.000
38	.804	1.110	.964	1.075	1.065	1.175	1.090	1.000	1.000	1.000
39	.599	1.110	.822	1.172	1.041	1.099	.721	1.000	1.000	1.000
40	.781	1.110	1.089	.341	.867	1.099	.721	1.000	1.000	1.000
41	.444	1.110	.540	.938	.660	1.099	.721	1.000	1.000	1.000
42	.753	1.110	.893	1.022	.961	1.099	.721	1.000	1.000	1.000
43	.922	1.110	1.263	.872	1.118	1.099	.721	1.000	1.000	1.000
44	.386	1.110	.640	.841	.904	1.099	.721	1.000	1.000	1.000
45	.894	1.110	1.223	.809	1.151	1.099	.721	1.000	1.000	1.000
46	.972	1.110	.996	.756	.926	1.099	.721	1.000	1.000	1.000
47	.674	1.110	.846	1.187	1.175	1.099	.721	1.000	1.000	1.000
48	1.046	1.110	1.296	.998	1.175	1.099	.721	1.000	1.000	1.000
	.893	1.110	1.131	1.118	1.026	1.099	.721	1.000	1.000	1.000
41	41	42	43	44	45	46	47	48		
42	0	0	0	0	0	0	0	0		
43	.896	.700	.630	.897	1.109	1.175	1.021	0		
44	.822	.672	.806	1.128	1.069	.722	0	0		
45	.953	.939	.702	1.097	1.299	0	0	0		
46	1.243	1.185	.836	1.042	1.069	0	0	0		
47	.668	1.184	.836	1.042	1.299	0	0	0		
48	1.125	.980	.861	1.042	1.299	0	0	0		
	.562	.980	.861	1.042	1.299	0	0	0		

APPENDIX H

Matrix of Manhattan Distance Coefficients for 46 species of Notiphila. Columns are OTU's (numbered according to Appendix A); rows are characters (numbered according to Appendix D).

21	21	22	23	24	25	26	27	28	29	30
0	0	0	0	0	0	0	0	0	0	0
.524	.573	.5	.470	.147	.326	.473	.691	.615	.618	.405
.602	.855	.119	.102	.201	.381	.823	.442	.604	.538	.405
.224	.934	.111	.104	.103	.824	.590	.600	.604	.116	.405
.226	.630	.111	.170	.085	.600	.744	.416	.442	.760	.405
.227	.135	1.	.082	.907	.727	.563	1.	.611	.603	.405
.228	.855	1.	.053	.885	.907	.744	.600	.604	.538	.405
.229	.350	1.	.911	.884	.426	.563	.416	.442	.760	.405
.230	.685	1.	.912	.884	.231	.563	.416	.442	.760	.405
.231	.350	1.	.907	.952	1.	.688	.565	.604	.538	.405
.232	.855	1.	.889	.660	1.	.630	.694	.114	.838	.405
.233	.755	1.	.121	.220	1.	.778	.645	.114	.838	.405
.234	.989	1.	.114	.998	1.	.774	.645	.114	.838	.405
.235	.846	1.	.656	.116	1.	.744	.699	.114	.838	.405
.236	.330	1.	.117	.162	1.	.514	.266	.114	.838	.405
.237	.755	1.	.926	.904	1.	.640	.477	.114	.838	.405
.238	.819	1.	.754	.943	1.	.547	.357	.114	.838	.405
.239	.721	1.	.950	.689	1.	.601	.586	.114	.838	.405
.240	.860	1.	.912	.908	1.	.753	.623	.114	.838	.405
.241	.971	1.	.077	.127	1.	.639	.477	.114	.838	.405
.242	.688	1.	.931	.032	1.	.406	.773	.114	.838	.405
.243	.695	1.	.170	.180	1.	.551	.323	.114	.838	.405
.244	.602	1.	.243	.151	1.	.551	.323	.114	.838	.405
.245	.702	1.	.306	.151	1.	.684	.611	.114	.838	.405
.246	.993	1.	.709	.614	1.	.756	.611	.114	.838	.405
.247	.993	1.	.309	.127	1.	.714	.611	.114	.838	.405
.248	.756	1.	.824	.817	1.	.810	.586	.114	.838	.405
31	31	32	33	34	35	36	37	38	39	40
0	0	0	0	0	0	0	0	0	0	0
.840	.5	.8	.702	.610	.533	.752	.445	.601	.508	.807
.517	.171	.512	.538	.503	.633	.750	.533	.204	.400	.807
.278	.297	.844	.624	.713	.751	.522	.578	.601	.400	.807
.644	.667	.455	.652	.895	.633	.523	.663	.601	.400	.807
.455	.997	.338	.652	.591	.597	.451	.663	.601	.400	.807
.338	.708	.513	.532	.591	.582	.451	.663	.601	.400	.807
.399	.338	.223	.671	.591	.582	.451	.663	.601	.400	.807
.411	.513	.484	.301	.673	.582	.451	.663	.601	.400	.807
.422	.484	.561	.583	.703	.657	.515	.663	.601	.400	.807
.433	.561	.612	.815	.635	.761	.582	.663	.601	.400	.807
.444	.612	.596	.492	.566	.610	.459	.663	.601	.400	.807
.455	.596	.628	.819	.493	.841	.554	.663	.601	.400	.807
.466	.628	.453	.684	.472	.653	.633	.663	.601	.400	.807
.477	.453	.619	.570	.837	.648	.672	.663	.601	.400	.807
.488	.619	1.	.889	.648	.681	.662	.663	.601	.400	.807
	.517	1.	.718	.733	.669	.587	.647	.553	.520	.417
41	41	42	43	44	45	46	47	48		
0	0	0	0	0	0	0	0	0		
.565	.474	.338	.369	.493	.825	.846	.693			
.474	.699	.422	.518	.802	.588					
.699	.812	.622	.442	.705	.889					
.812	.434	.683	.470	.687						
.434	.755	.669	.501							
.477	.309	.627								
.488										

APPENDIX I

Matrix of Manhattan Distance Coefficients for 25 species of the subgenus Notiphila. Columns are OTU's (numbered according to Appendix B); rows are characters (numbered according to Appendix D).

	1	2	3	4	5	6	7	8	9	10
100	.387	.402	.691	.615	.116	.814				
101	.388	.403	.692	.616	.117	.815				
102	.389	.404	.693	.617	.118	.816				
103	.390	.405	.694	.618	.119	.817				
104	.391	.406	.695	.619	.120	.818				
105	.392	.407	.696	.620	.121	.819				
106	.393	.408	.697	.621	.122	.820				
107	.394	.409	.698	.622	.123	.821				
108	.395	.410	.699	.623	.124	.822				
109	.396	.411	.700	.624	.125	.823				
110	.397	.412	.701	.625	.126	.824				
111	.398	.413	.702	.626	.127	.825				
112	.399	.414	.703	.627	.128	.826				
113	.400	.415	.704	.628	.129	.827				
114	.401	.416	.705	.629	.130	.828				
115	.402	.417	.706	.630	.131	.829				
116	.403	.418	.707	.631	.132	.830				
117	.404	.419	.708	.632	.133	.831				
118	.405	.420	.709	.633	.134	.832				
119	.406	.421	.710	.634	.135	.833				
120	.407	.422	.711	.635	.136	.834				
21	.493	.825	.846	.693	0					
22	.802	.588	.485							
23	.705	.889								
24	.687									
25										

APPENDIX J

Matrix of Average Euclidean Distance Coefficients for 22 species of the subgenus Agrolimna. Columns are OTU's (numbered according to Appendix C); rows are characters (numbered according to Appendix D).

	1	2	3	4	5	6	7	8	9	10
1	0									
2	.721									
3	.882									
4	.802									
5	1.014									
6	1.396									
7	.721									
8	.816									
9	.758									
10	1.007									
11	1.797									
12	1.017									
13	1.152									
14	.768									
15	1.205									
16	1.211									
17	1.040									
18	.687									
19	.928									
20	1.170									
21	.787									
22	1.205									
23	.771									
24	.842									

	11	12	13	14	15	16	17	18	19	20
1	0									
2	1.150									
3	2.292									
4	1.675									
5	2.372									
6	2.363									
7	2.215									
8	1.987									
9	2.210									
10	2.555									
11	1.960									
12	1.799									
13	1.810									
14	1.794									

	21	22	23	24
1	0			
2	1.092			
3	.805			
4	.934			

APPENDIX K

Matrix of Manhattan Distance Coefficients for 22 species of the subgenus Agrolimna. Columns are OTU's (numbered according to Appendix C); rows are characters (numbered according to Appendix D).

	1	2	3	4	5	6	7	8	9	10
24	5193	5565	4893	5733	758	5938	5498	5607	5508	5508
23	5193	5565	4893	5733	758	5938	5498	5607	5508	5508
22	5193	5565	4893	5733	758	5938	5498	5607	5508	5508
21	5193	5565	4893	5733	758	5938	5498	5607	5508	5508
20	5193	5565	4893	5733	758	5938	5498	5607	5508	5508
19	5193	5565	4893	5733	758	5938	5498	5607	5508	5508
18	5193	5565	4893	5733	758	5938	5498	5607	5508	5508
17	5193	5565	4893	5733	758	5938	5498	5607	5508	5508
16	5193	5565	4893	5733	758	5938	5498	5607	5508	5508
15	5193	5565	4893	5733	758	5938	5498	5607	5508	5508
14	5193	5565	4893	5733	758	5938	5498	5607	5508	5508
13	5193	5565	4893	5733	758	5938	5498	5607	5508	5508
12	5193	5565	4893	5733	758	5938	5498	5607	5508	5508
11	5193	5565	4893	5733	758	5938	5498	5607	5508	5508
10	5193	5565	4893	5733	758	5938	5498	5607	5508	5508
9	5193	5565	4893	5733	758	5938	5498	5607	5508	5508
8	5193	5565	4893	5733	758	5938	5498	5607	5508	5508
7	5193	5565	4893	5733	758	5938	5498	5607	5508	5508
6	5193	5565	4893	5733	758	5938	5498	5607	5508	5508
5	5193	5565	4893	5733	758	5938	5498	5607	5508	5508
4	5193	5565	4893	5733	758	5938	5498	5607	5508	5508
3	5193	5565	4893	5733	758	5938	5498	5607	5508	5508
2	5193	5565	4893	5733	758	5938	5498	5607	5508	5508
1	5193	5565	4893	5733	758	5938	5498	5607	5508	5508