THE MALLOPHAGA (INSECTA) INFESTING SEVERAL ANATIDAE (AVES) SPECIES IN MICHIGAN

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ABSTRACT

THE MALLOPHAGA (INSECTA) INFESTING SEVERAL ANATIDAE (AVES) SPECIES IN MICHIGAN

by David B. Crockett

A collection was made of Mallophaga infesting several species of Anatidae in Michigan. Fifty-two ducks of six species (Anas platyrhynchos, A. rubripes, A. carolinensis, A. discors, Aix sponsa and Lophodytes cucullatus) yielded 217 lice of four species (Anaticola crassicornis (Scopoli, 1763), Anatoecus dentatus (Scopoli, 1763), Anatoecus icterodes (Nitzsch, 1818) and Trinoton querquedulae (Linnaeus, 1758)).

A new Mallophaga collecting technique was used. The method consisted of ethyl acetate vapors contained in a polyethylene bag in which the duck was placed. After three to five minutes exposure to the vapors, the bird was removed and the Mallophaga brushed from its feathers.

Written descriptions and whole-animal illustrations for each species of Mallophaga, and a brief description of each genus represented, are included. There is a discussion of the reasons why the author is considering placing Anatoecus dentatus (Scopoli, 1763) as a synonym of Anatoecus icterodes (Nitzsch, 1818).

Statistical analysis of the data gave a k coefficient of 1.05, indicating a relatively high degree of aggregation of lice on ducks. The mean number of lice per duck was 4.2; the variance was 20.7. There was an indication that female Mallards and Wood Ducks had a lower

frequency of Mallophaga infestation than did males of these species, but the Chi-square value was 2.7 (uncorrected) and a probability of 0.08, and a Chi-square of 1.6 (with Yates' correction for continuity) and a probability of 0.22.

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By

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Dr. Theresa Clay very kindly determined my Mallophaga specimens by comparison with specimens in the British Museum (Natural History) collections. I am also indebted to Miss Clay for her answers to my many questions on the details of Mallophagan taxonomy, morphology and biology.

I wish also to thank Dr. C. T. Black and his staff at Rose Lake Wildlife Experiment Station for their help and the use of the station facilities during the field collection aspects of this study. Dr. William E. Miller gave me considerable help and many suggestions concerning the statistical analyses I have used in this work.

Finally, and certainly not least, I thank my wife, Sonie, for her constant encouragement and deep understanding during this study, which was concurrent with our courtship.

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INTRODUCTION

During October, 1962, a collection of Mallophaga from various wild waterfowl was made at Rose Lake Wildlife Experiment Station, Michigan Department of Conservation, near East Lansing, Michigan. Fifty-two ducks of six species were examined. A total of 217 Mallophaga representing four species in three genera were collected. The species of ducks were: Mallard, Anas platyrhynchos Linnaeus; Black Duck, Anas rubripes Brewster; Green-winged Teal, Anas carolinensis Gmelin; Blue-winged Teal, Anas discors Linnaeus; Wood Duck, Aix sponsa (Linnaeus); and Hooded Merganser, Lophodytes cucullatus (Linnaeus). The species of Mallophaga represented included: Anaticola crassicornis (Scopoli, 1763), Anatoecus dentatus (Scopoli, 1763), Anatoecus icterodes (Nitzsch, 1818), and Trinoton querquedulae (Linnaeus, 1758).

The collection was sent to Dr. Theresa Clay for determination, because adequate determined material is unavailable in the United States. Clay and Hopkins, over the past fifteen years, have established neotypes for many species in cases where the original types and paratypes were known to have been lost or destroyed (mostly during World War II). The majority of these neotypes are now in the British Museum (Natural History) in London.

In March, 1964, I was able to visit the British Museum for five days. Dr. Clay discussed with me some of the specimens in my collection; and answered many questions which provided a background for the taxonomic interpretations contained in this study. My interpretations of the collection under study here are not necessarily those of Miss

Clay. For example, I suggest placing two species in synonymy. Miss Clay prefers to consider them as two species, sensu lato, or as two species-groups.

Several general comments apply to the host records following the description of each species of Mallophaga. Both Malcomson (1960) and Emerson (1962) gave host records, but they were not clear in their papers about the geographic locality of the record. There are no indications whether the Mallophaga were collected in North America, or were collected outside of North America from hosts which have been known to occur in North America. All of Peters' (1928) records were from Ohio. Further, Malcomson gave no literature citations to the sources of the records he gave. Emerson, who follows Keler's (1946) classification of Anatoecus in which nearly every population from a different species of duck is a separate subspecies, listed host records for each subspecies of Mallophaga. These have been lumped together at the species-level in this study, because I believe subspecific separation in the genus Anatoecus is unjustified at this time.

The statistical aspects of this study are introduced only to give indications of certain trends manifested by the data -- not to prove anything conclusively. Many more data and specimens will be required before definite taxonomic and statistical conclusions can be drawn.

Revisions of most duck-infesting Mallophagan genera are needed to clarify the synonymy of these groups before study of their biology and population dynamics is attempted. Very inadequate -- in many cases useless -- original descriptions are the rule rather than the exception in the duck-infesting groups of Mallophaga.

METHODS AND MATERIALS

A new collecting method was used in this study. The method consisted of ethyl acetate vapors contained in a polyethylene bag in which the bird was placed. The vapors were introduced into the bag via ethyl acetate saturated cotton balls. After three to five minutes exposure to the vapors, the bird was removed to a white enamel laboratory pan where the feathers were brushed with a stiff-bristled artist's oil brush. Mallophaga dislodged by the brushing were then recovered from the pan and stored in 95% ethyl alcohol, each bird's ectoparasites in a separate vial.

All specimens were mounted on microscope slides. Adult lice are usually heavily chitinized and darkly pigmented, and often require considerable clearing. Immature Mallophaga are lightly chitinized and almost transparent, and therefore need no clearing. The immatures were mounted directly from 95% ethyl alcohol into Diaphane.

Adult specimens were taken from 95% through 70% to 50% to 35% ethyl alcohols with ten minutes at each step. They were then transferred to a cold 10% sodium hydroxide (NaOH) solution for 24 hours, or until sufficiently cleared. Particles of dirt and feathers adhering to the specimen were then removed. The specimens were then taken back to 95% ethyl alcohol by successive 15 minute stages in 35% ethyl alcohol, 50% glacial acetic acid alcohol, 50% and 70% ethyl alcohols.

After an additional rinse in 95% ethyl alcohol, each specimen was mounted in Diaphane on standard glass microscope slides. Twelve millimeter round glass cover slips were used, except in cases of large

specimens when 22 mm. round glass cover slips were more satisfactory. The slides were then dried in 95-105° F. heat in an electric laboratory oven for one week.

A plesiotype was established for each species of Mallophaga in the collection. The specimen was microprojected onto tracing paper, and the major features were outlined in pencil. After corrections were made, the tracing was transferred to smooth surface white Strathmore drawing paper on a light table. To obtain symmetry in the dorsal and ventral views, the tracing was reversed and the other view then transferred to the drawing paper. Detail drawings (figures 3 and 6) were done with the use of a camera lucida attachment on the microscope. Details were then added in pencil, and the drawing was completed and rendered with India ink. Inking errors were covered with Pelican Graphic White ink. Each drawing was photographically reproduced and reduced to six inches overall length: approximately a one-half reproduction reduction ratio.

The use of a phase contrast microscope, at 100 and 400 magnifications, facilitated observation of setae and other minute structures. Mandibles and their adjacent major supporting structures are shown from the dorsal aspect only. All whole-animal drawings otherwise depict the dorsum on the left half and the venter on the right.

GENERAL MORPHOLOGY

Of the two Mallophagan suborders, Amblycera and Ischnocera, the latter is the more advanced and complex in morphological modifications. The descriptive terminology applied to the Amblycera is similar to that used throughout the remainder of the class Insecta. Ischnoceran terminology, however, contains terms exclusive to this suborder of lice, or only infrequently used in other orders. Therefore, only those terms applied to the Ischnocera have been dealt with in detail. Any terms not mentioned here are either used in their general entomological meaning, or are applicable only to insignificant details. Much of the following discussion is based on Clay (1951).

The Head

Preantennal Region

A sclerotized band, the marginal carina, forms the subfrontal rim of the preantennal region in primitive forms. This carina may be modified by inflection of the medial anterior margin, leaving a translucid anterior margin, or hyaline margin. Lateral and anterior carinal interruptions are further modifications. A lateral interruption creates, posteriorly, a postmarginal carina extending from the interruption caudad to the preantennal nodus, and a premarginal carina anteriorly extending forward to the anteromedial interruption.

The dorsal preantennal suture transverses the head predorsally. This suture may be absent, or may be discontinuous and represented only by two lateral sutures. In more modified forms, the suture arises at the distal end of either the interrupted marginal carina or the postmarginal carina.

The sclerotized predorsum, anteriorly interrupting the marginal carina and delineated posteriorly by the dorsal preantennal suture, is the dorsal anterior plate. This plate has a ventral component, the ventral anterior plate, which may be fused throughout its length, or only at its proximal end, to the dorsal plate. Both plates may be variously modified in shape and thickness.

Continuous with the marginal carina and the mandibular framework is a thickening, the ventral carina, to which the pulvinus, a membranous lobe is attached. Primitively, the ventral carina forms a complete semicircle forward of the mandibular framework. Although various modifications of the ventral carina may be found in the order Ischnocera, the most common is a medial interruption by the ventral preantennal suture which extends forward from the distal ends of the ventral carina to, or nearly to, the complete marginal carina. The ventral carina may be thickened or flattened laterad, and may be continued forward as the ventral preantennal suture if the latter is also thickened. The ventral carina may be fused to the anterior, sometimes infracted, ends of the premarginal carina if the marginal carina is incomplete.

Postantennal Region

An endocarina, the temporal carina, extends from the occipital margin of the head across the temple, becoming continuous with either the preantennal nodus, a heavily sclerotized internal thickening just anterior of the antennal fossa, or the supraorbital margin. The temporal carina may be absent, or it may merge with the inner surface of the dorsal sclerotization and thus be visible only near the occipital margin.

Enclosing the temples is a thickened rim, the marginal temporal carina, which may be irregularly thickened. A thickening ahead of the eye is the preocular nodus; behind the eye, a postocular nodus; and on the occipital margin, the occipital nodus.

The postantennal suture either extends across the temples or appears as a lateral suture.

Extending orad from the occipital margin, or near it, to the mandibular framework is the occipital carina. The posterior tentorial pits are always associated with this carina.

Chaetotaxy

All or any of the head setae may be greatly elongated or reduced to stout spines, or reduced to microchaetae so that they are often difficult to find. Some species may have additional setae on the dorsum of the head so arranged that it is no longer possible to identify the primitive ones to which names have been given. Abnormally, any of the setae may be duplicated in a specimen, often only on one side of the head.

Five pairs of setae on the head are always present and quite constant in position throughout the suborder Ischnocera. These five consist of the preconal seta (pc.s.), which arises ventrally just anterior to the conus. Also ventrally, the mandibular seta (md.s.) is on or near the outer surface of the mandibular framework. In some cases this seta has been lateroverted, and actually arises on the ventral margin of the conus. The preantennal seta (pa.s.) arises usually from the anterodorsal margin of the antennal fossa. Dorsocaudad of the preantennal nodus is the postnodal seta (pn.s.). Where there is a postantennal dorsal suture this seta lies in or near the suture. On

the dorsum of the eye lens is the ocular seta (o.s.).

Three anterior setae (a.s.1-3) may be marginal or submarginal on the dorsum or venter. Where the dorsal preantennal suture interrupts the marginal carina, the first anterior seta is often (but not always) associated with the point of interruption, either marginally or submarginally on the dorsum or more rarely on the venter. When the dorsal suture does not interrupt the marginal carina, the first anterior seta is near the point where the carinal interruption usually occurs.

In the primitive head, the ventral submarginal setae (v.sm.s.1-2) are a pair of setae arising on, or below, the venter of the marginal carina. In the specialized head the outer of this pair (v.sm.s.1) usually lies on the marginal carina and the inner (v.sm.s.2) just laterad of the ventral anterior plate. This latter seta may be minute and difficult to see.

The positions of the anterior ventral setae (a.v.s.1-3) seem to depend on the head shape. In the modified head, the first anterior ventral seta (a.v.s.1) is the outer, or marginal, seta of the anterior setae, and is associated with the anterior setae. Posterolaterad of the ventral submarginal setae (v.sm.s.1-2) are the second and third anterior ventral setae (a.v.s.2-3). These three setae (a.v.s.1-3) often form a characteristic group associated with, and laterad of, the ventral carina, when the latter is modified. In some cases the outer two (a.v.s.1-2) are close together and arise just anterior to the preconal seta. In other instances, all anterior ventral setae may be grouped much nearer the front of the head, or a.v.s.1-2 may arise near the conus and a.v.s.3 near the anterior margin of the head.

A single seta, the dorsal submarginal seta (d.sm.s.), is located

dorsomedially either on the marginal carina or just ventrad of it.

Ventrad of the dorsal submarginal seta, the anterior dorsal seta (a.d.s.) is commonly associated with the dorsal preantennal suture when this is present. With modified heads, this seta often arises either in the suture or on its posterior margin; or it may arise postsuturally or be highly variable in relation to the suture.

Although always present, the marginal temporal setae (m.t.s.1-x) are quite variable in number, position and size. They may arise dorsally, ventrally or marginally. The first temporal seta is usually ventrocaudad of the eye, although it may arise on the venter of the lens, or even considerably postocularly. The remaining temporal setae usually are a small ventral seta (m.t.s.2), two dorsal macrochaetae and two smaller setae on the occipital margin.

Dorsomediad of the occipital margin is the single post-temporal seta (pt.s.).

The Abdomen

In the male genitalia of some species, an effractor is present. This is a structure on the endomeral plate and anterior to the parameres.

THE TAXA

The order Mallophaga is generally separated into two major suborders: Amblycera and Ischnocera. A third suborder, Rhynchophthirina, has one monotypic family, Haematomyzidae, the species of which infest only mammals.

The suborder Amblycera may be characterized largely as follows: Meso-metanotum distinct; antennae concealed and clavate; labial palpi present; mandibles horizontal; and crop simple. The genus Trinoton is the only member of this suborder represented in this study, and is in the family Menoponidae.

In contrast, the suborder Ischnocera may be characterized as follows: Meso-metanotum fused into a pterothorax; antennae exposed and not clavate; labial palpi absent; mandibles vertical; and crop an esophageal diverticulum. The other two genera, Anaticola and Anatoecus, represented in this study are members of the family Philopteridae and belong to this suborder.

Suborder Amblycera

Family Menoponidae

Genus Trinoton Nitzsch, 1818

Trinoton Nitzsch, 1818. Germar's Mag. Ent. 3: 300.

Type species: (by monotypy) Liotheum (Trinoton) conspurcatum Nitzsch, 1818.

Trinotum Burmeister, 1838. Handb. Ent. 2: 440.

Emendation (i.e., nomen novum) for Trinoton Nitzsch, 1818.

Trinotion Perry, 1876. Proc. Lit. Phil. Soc. Liverpool 30: lxxx. (Misprint).

Ewingella Eichler, 1941. Stettin. Ent. Ztg. 102: 126.

Type species: Trinoton femoratum Piaget.

Distinguished by large size (4-6 mm. length); triangular head; distinctly lobate and posteriorly raised temporal margin. Mesothorax large.

Trinoton querquedulae (Linnaeus, 1758)

(Figure 7)

Pediculus querquedulae Linnaeus, 1758. Syst. Natr., ed. 10: 612.

Nomen novum for Redi's Pollino del' arzavola o farquetola.

Ricinus lari Degeer, 1778. Men. Hist. Ins. 7: 77, pl. 4, fig. 12 (?).

Trinoton pygmaeum Kolenati, 1846. Melet. Ent. 5: 138, pl. 19, fig. 5 (?).

Head: Very broadly triangular, two-thirds as long as broad. Temples greatly expanded laterally.

Chaetotaxy: Two transverse rows of small setae on venter of anterior margin, a cluster of postocular hairs on anterior margin of temporal marginal carina. Six setae laterad on temporal marginal carina: anterior and third setae moderately long; second, fifth and sixth extremely long; and fourth long. Two long setae on anterior edge of occipital margin between temporal carina and medial line. Gular area outlined by

double or triple rows of short stout setae.

Thorax: Prothorax subtriangular with base anteriorly; lateral margins very broadly produced over base of foreleg, with three stout setae on anterolateral margin, and seven long setae on posterolateral margin. Two small peg-like setae arranged side by side on prothorax dorsum. Posterior dorsal margin of prothorax with one short and four long setae. Prothorax venter with heavily sclerotized and pigmented V-shaped sternite. Posterior margin of "V" with ten moderately long setae; numerous stout short setae in area anterior to this margin. Mesothoracic margin rounded anterolaterally, nearly transverse posteriorly. Metathorax twice length of mesothorax, and broader.

Legs: Anterior margin of hind tibia with dense row of twenty nearly equally long setae; posterior margin with double row of short setae. Anterior margin of hind femur with ten long setae; posterior margin with nine long to moderately long setae; and venter of femora with brush of numerous fine, short setae.

Abdomen: Oblong; greatest width at segment IV; segments III-VIII with reniculus near lateral dorsal margin. Segments III, IV, IX and X with brushes of numerous fine, short setae on ventral surfaces. Other abdominal chaetotaxy as in Figure 7.

HOST RECORDS

Malcomson (1960) listed Anas platyrhynchos Linn., A. rubripes Brewster, A. strepera Linn., Mareca americana (Gmelin), Aythya affinis (Eyton), Mergus merganser Linn. and M. serrator Linn. as hosts. Peters (1928) gives as hosts: Chen caerulescens (Linn.), Anas platyrhynchos, A. strepera, A. acuta Linn., Mareca penelope (Linn.), M. americana, Spatula clypeata (Linn.), Aythya affinis, Melaritta deglandi (Bonaparte),

Mergus merganser, M. serrator and, probably in error, Podiceps auritus (Linn.). Emerson (1962) lists the following hosts: Anas platyrhynchos, A. acuta, A. crecca Linn., Mareca penelope, Aythya ferina (Linn.), Oidemia nigra (Linn.) and Mergus serrator.

Material collected in this study included: six adults of undetermined sex and nine immatures from six male and two female Anas platyrhynchos; two adults of undetermined sex from an Anas rubripes of undetermined sex; one adult of undetermined sex from a male Anas carolinensis; one adult of undetermined sex and two immatures from two female Anas discors. Other material, Trinoton sp., comprised one adult female and nine immatures from two male and three female Aix sponsa.

DESCRIPTIVE ANALYSIS

According to Clay and Hopkins (1960), the querquedulae group can be separated into two subgroups on the basis of chaetotaxy; querquedulae being found on Anas and related genera, and anserinum (J. C. Fabricius, 1805) on Anser and related genera. The primary characters distinguishing Trinoton querquedulae from T. anserinum are the fewer hairs in the brushes on the third femora and fourth sternites and on the genital region of the male querquedulae. A less significant distinction between the females is the possession in T. anserinum of a thickening, indistinct in outline, in the dorsal wall of the genital chamber which projects below the vulva (Clay and Hopkins, 1960). This thickening may be obscured in specimens treated with sodium hydroxide.

The plesiotype selected for Figure 7 (slide number DBC-44: 1) was collected from Anas carolinensis. No specimens from the type host, Anas crecca, were available for illustration. Of the possible hosts in the genus Anas (A. discors, A. rubripes, and A. platyrhynchos) from which

specimens were available, A. carolinensis was chosen as the plesiotype host for two reasons. First, A. carolinensis is superficially closer to the type host (A. crecca) than is A. rubripes or A. platyrhynchos, both in terms of size and presumed phylogenetic position (Delacour and Mayr, 1945). Second, the range of Anas carolinensis is closer to that of A. crecca than to that of A. discors (A.O.U., 1957). The effect of any subspecific variations between Mallophaga of two different host species would be reduced by the above manner of plesiotype selection.

Suborder Ischnocera

Family Philopteridae

Genus Anaticola Clay, 1936

Anaticola Clay, 1936. Proc. Zool. Soc. Lond. 1935: 617.

Type species: Esthiopterum crassicorne (Scopoli).

Species elongated and of medium size (3-5 mm. length). Head characterized by clypeus narrowly rounded anteriorly; anterior plate sexually dimorphic, in females semilunate, with two pustulated setae on dorsum anterior to oral fossa. Antenna five-jointed: normal in female; basal segment enlarged and third segment produced laterad apically in male. Prothorax small, sides slightly convex. Pterothorax longer and slightly wider than prothorax. Abdomen elongated, first segment small. Spiracles present on segments II-VII.

Clay and Hopkins (1954) summarized the intrageneric characteristics of taxonomic value as follows: All the specimens of Anaticola from the Anseriformes examined are very similar, having male genitalia differing only in proportions of the various structures, and in the chaetotaxy of the genital region of the female.

Anaticola crassicornis (Scopoli, 1763)

(Figures 2 - 3)

Pediculus crassicornis Scopoli, 1763. Entomologia Carniolica : 383.

Host: (Anas Boschas) = Anas p. platyrhynchos Linn.

Pediculus anatis Schrank, 1781. Enum. Ins. Austr. Indig. : 503.

Host: (Anas Boschas, varietas fera) = Anas p. platyrhynchos Linnaeus.

Pediculus anatis J. C. Fabricius, 1794. Ent. Syst. Suppl. : 571.

Host: (Anas Boschas) = Anas p. platyrhynchos Linn.

Philopterus squalidus Nitzsch, 1818. Germar's Mag. Ent. 3: 292.

Nomen novum for Pediculus anatis Fabricius.

Head: Sexually dimorphic; narrowly ovate; well sclerotized; length about one-and-one-half times width; greatest width immediately postocularly. Marginal carina strongly sclerotized laterally, incompletely interrupted by preantennal suture. Dorsal preantennal suture a lateral slit in the male, a transverse suture with posteromedial prolongation in female. Dorsal anterior plate well chitinized, semilunate in female, concave-concave in male. Pulvinus a simple lobe with groove medially. Postantennal region with temples slightly expanded; marginal temporal carina heavily sclerotized; temporal carina extending forward toward mandibular articulations from occipital margin. Gular plate distinct, well-sclerotized and roundly sagittate. Antenna five-segmented, sexually dimorphic (as shown in Figure 3); female normal, male with basal

segment greatly elongated and third segment laterally produced apically.

Chaetotaxy: Dorsum of preantennal region with three marginal setae, the posterior one long. Anterior dorsal setae in wide pustule of postero-medial prolongation of dorsal preantennal suture in female. Preantennal seta small. Venter of preantennal region with three anterior and two posterior setae. Postantennal region with a dorsal temporal seta; three marginal temporal setae with third extremely long; and ocular seta on dorsum of eye lens.

Thorax: Prothorax small, sclerotized lightly dorsally and heavily laterally. Posterior and lateral margins of prothorax heavily sclerotized. Pterothorax longer than broad, sclerotized heavily laterad and lightly mediad; dorsal posterior margin with six long setae. Pterosternum with one small seta anteriorly and one posteriorly.

Abdomen: Elongated, widest at segment IV. Pleura strongly sclerotized; spiracles on segments II-VII. Sternum I in both sexes small, laterally compressed and continuous with pterosternum.

HOST RECORDS

Malcomson (1960) listed Branta bernicla (Linn.), Anas platyrhynchos Linn., A. rubripes Brewster, Mareca americana (Gmelin), Bucephala albeola (Linn.), Clangula hyemalis (Linn.), Oxyura jamaicensis (Gmelin), Mergus merganser Linn. and M. serrator Linn. as hosts. Peters (1928) gives as hosts: Anas platyrhynchos, A. rubripes, A. strepera Linn., A. discors Linn., Mareca penelope (Linn.), M. americana, Spatula clypeata Linn., Aythya affinis (Eyton), Mergus merganser and M. serrator. He listed this Mallophagan species as Esthiopterum crassicorne (Scopoli). Emerson (1962) lists the following hosts: Anas platyrhynchos, A. strepera, A. acuta Linn., A. crecca Linn., Mareca penelope, Spatula

clypeata, Aix sponsa (Linn.), Aythya ferina (Linn.), A. affinis, Bucephala islandica (Gmelin), Clangula hyemalis, Somateria mollissima (Linn.), S. spectabilis (Linn.), Melanitta fusca (Linn.), M. deglandi (Bonaparte), M. perspicillata (Linn.), Oidemia nigra (Linn.) and Mergus serrator.

Material collected in this study consisted of: 13 males, 18 females and 25 immatures from 8 male and 4 female Anas platyrhynchos; 5 females and 2 immatures from one male, and one of undetermined sex, Anas rubripes; one immature from a female Anas carolinensis; and two females and two immatures from two female Anas discors. Other material, Anaticola sp., comprised 37 males, 31 females and 14 immatures from 11 male and 8 female Aix sponsa.

DESCRIPTIVE ANALYSIS

Species of the genus Anaticola are very similar. Anaticola crassicornis is distinguished from A. mergiserrati (DeGeer, 1778) (which should perhaps be considered as a subspecies of A. crassicornis) only by the narrower marginal carinae of the head and the shorter penis (Clay and Hopkins, 1954). (See table 1 for comparison of penis lengths of several species of Anaticola.) Anaticola crassicornis is separable from A. anseris (Linn.) by the characters of the anterior region of the head and the shorter penis (Clay and Hopkins, 1951). A. crassicornis also tends to have a greater number of setae on the genital region of the male and on the vulva of the female than anseris, according to Clay and Hopkins (1954).

Table 1. Comparative ranges of penis lengths of several species of Anaticola. (Data from Clay and Hopkins, 1951 and 1954).

Species	Range of penis lengths, in mm. (number of specimens in brackets)	
A. crassicornis	0.13 - 0.16	(9)
A. mergiserrati	0.20 - 0.23	(10)
A. anseris	0.27	(3)

Genus *Anatoecus* Cummings, 1916

Anatoecus Cummings, 1916. Proc. Zool. Soc. Lond. 1916: 653.

Type species: "*Anatoecus icterodes* Nitzsch."

Distinguished on the head by the characteristic alation of the clypeus; the presence of two small peg-like setae dorsally, one each side of posterior apex of dorsal anterior plate; and the rather short antennae. The dorsal chaetotaxy of the head is a generic character. Abdomen characterized by the lateral tergite forms, which in segment I meet each other in the medial line, and leave an uncovered median field in subsequent sections except the last. In male genitalia, parameres are fused distally with the pseudopenis. Forms of endomeral plate, pseudopenis, sac, *vesicula seminalis* and extremely short *ductus* are good generic characters.

The members of this genus are remarkably uniform, and the species presumably all closely related.

Anatoecus dentatus (Scopoli, 1763)

(Figures 3, 6A)

Pediculus dentatus Scopoli, 1763. "Entomologia Carniolica" : 383.

Host: *Anas* presumably (*p. platyrhynchos* Linn.).

MALE

Head: Subtriangular; nearly as wide as long. Clypeus produced, semi-orbicular. Marginal carina interrupted anteromediad and laterad. Pre-marginal carina anteriorly infracted, extending posteromediad, fusing

with ventral carina opposite lateral interruption of marginal carina. Postmarginal carina forms preantennal nodus posterodorsally and fuses with ventral carina to form mandibular framework posteroventrally. Hyaline margin complete from near anterior end of postmarginal carina. Dorsal preantennal suture extends from anterior end of postmarginal carina generally posteromedially joining longitudinal mediodorsal suture opposite anterior margin of antennal fossa. Anterior plate with two components; anterior dorsal plate orbicular to hexagonal except at confluence with ventral plate. Sclerotization on each laterodorsal margin of dorsal plate extends dorsoposteromedially, fusing into heavily sclerotized retrorse process rounded apically. Ventral anterior plate margin flattened anteriorly, laterally slightly concave, and rounded and slightly thickened posteriorly. Anterior half ventral carina subparallel, distally fused with infracted end of premarginal carina; posterior half ventral carina extends posterolaterally toward conus. Pulvinus attached percurrently laterad. Labrum, in posterior margin of pulvinus, bowed forward mediad. Temporal carina extends forward from occipital margin, fuses with internal surface of dorsum posterior of preantennal nodus. Antenna five-jointed; second segment twice, and apical segment one-and-one-half times, length of third or fourth segments.

Thorax: Prothorax obcordate. Pterothorax subconical, dorsum channelled medially, posterior margin arcuate.

Abdomen: Obtusely ovate. First and last segments with pigmented sclerotization reaching the median dorsally. Dorsum first segment channelled medially. Anterior half first segment fasciate on dorsum. Other segments heavily pigmented laterad; reniculate dorsally, hepaticoform

ventrally; posterior segments laterally less pigmented and more variable in form.

Chaetotaxy: Not diagnostic on specific level.

FEMALE

Females and immatures have not been assigned to described males. See Descriptive Analysis.

HOST RECORDS

Malcomson (1960) listed Branta bernicla (Linn.), Anas rubripes Brewster, A. strepera Linn., A. carolinensis Gmelin, A. discors Linn., Aix sponsa (Linn.), Aythya americana (Eyton), A. marila (Linn.), A. affinis (Eyton), Bucephala albeola (Linn.), Somateria spectabilis (Linn.), Lophodytes cucullatus (Linn.) and Mergus merganser Linn. as hosts. Peters (1928) gave as hosts: Anas rubripes, A. platyrhynchos Linn., A. acuta Linn., Aythya marila, A. affinis, Clangula hyemalis (Linn.), Oxyura jamaicensis (Gmelin), Lophodytes cucullatus, Mergus serrator Linn., and (probably in error) Erolia melanotos (Vieillot). Emerson (1962) listed the following hosts: Branta leucopsis (Bechstein), Dendrocygna autumnalis (Linn.), Anas platyrhynchos, Spatula clypeata (Linn.), Aythya affinis, A. fuligula (Linn.), Clangula hyemalis, Polysticta stelleri (Pallas), Somateria mollissima (Linn.), Melanitta fusca (Linn.) and Mergus merganser.

Of the material examined in this study, two males were collected from one female Anas platyrhynchos; one male from a male A. rubripes; and a male from a male Aix sponsa.

DESCRIPTIVE ANALYSIS

Synonymy in the genus Anatoecus is particularly difficult because the species grouped in the genus are very closely related. After

attempting to unravel the synonymy of this group, Clay and Hopkins (1951) stated: "... pending redescription of the numerous species that have been described from ducks we are unable to suggest which names are synonyms of Anatoecus dentatus (Scopoli)." And they mention further (Clay and Hopkins, 1960), "as it is impossible to tell from the earlier descriptions to which group a name refers, it is necessary to fix the names arbitrarily for the two types." The two types referred to are A. dentatus and A. icterodes. Because these two taxa pose special problems within the genus, and because they are the only representatives of the genus in this study, they shall be dealt with in some detail here.

At the present time, I am not convinced that A. dentatus and A. icterodes are truly separate and distinct species. I am considering placing Anatoecus dentatus, sensu lato, as a synonym of Anatoecus icterodes (Nitzsch, 1818). The reasons I would consider icterodes as the senior synonym will be discussed later.

Cummings (1916) established Philopterus icterodes Nitzsch as the type species of Anatoecus, but did not mention dentatus Scopoli. He did, however, recognize two distinct forms of male genitalia in the genus: those possessing an "effractor", and those without. Figure 6 illustrates the terminal portions of the two male genitalia types. According to Clay and Hopkins (1960), in a discussion of the morphology and chaetotaxy of A. icterodes, "most of [these] characters are also found in the dentatus group and cannot be used to distinguish the two species; these are apparently separable only on the characters of the male genitalia." With the exception of the genitalia, all male specimens of Anatoecus dentatus and A. icterodes in this study were found to be

essentially similar in all observable characteristics; the observed variations between specimens of dentatus or icterodes were equal to, or greater than, the observed variations between the two taxa.

Clay and Hopkins (1951) designated Anatoecus dentatus as the name for specimens in which the male possesses an effractor. There is no statement, apparently, in the literature as to what function the effractor serves, or that it is even a "reproductively isolating" factor. It may be pointed out here that the effractor is not a part of the extrudable portion of the male copulatory apparatus. Therefore, it seems highly unlikely that the effractor, or lack of an effractor, is a physical barrier to successful copulation. If "reproductive isolation" is used as the criterion for the separation of species, the mere presence or absence of an effractor is a rather weak morphological justification for the separation of the two taxa in question here.

Emerson (1962) and Clay and Hopkins (1951, 1952, 1960) mention that all examined ducks normally have two species of Anatoecus -- one species with the males possessing an effractor, and the other without. No data in the present study refute or substantiate their statements, but no other genus of duck-infesting lice regularly has more than one species represented on any host duck. Only in rather rare instances do two closely related animal species of the same genus occupy continuously the same macrohabitat; and when this syntopy does occur, one or both species usually manifests some difference from the other species in terms of morphology, habitat preference, food requirements, life cycle, etc. It is perhaps presumptuous to assume, without proof, that Anatoecus dentatus and A. icterodes do comprise an example of syntopy. It seems likely that Anatoecus is represented normally on any individual host by

only one species, as is the case with other duck-infesting genera.

When, and if, Anatoecus dentatus is placed in synonymy with A. icterodes, the latter must be considered the senior synonym. In 1763, Scopoli used the name Pediculus dentatus in reference to what, solely on the basis of the description of the animal's appearance, could be either an Anatoecus or a Trinoton. His designation of the length of dentatus (given as roughly the equivalent of 1½ mm.), however, limits the description to that of a Trinoton.

Denny, in 1842, (Anoplura Britannica : 102) placed Pediculus dentatus Scopoli, 1763, in synonymy with Docophorus icterodes Nitzsch, 1818, and appended a question mark. Denny apparently overlooked the importance of the length designation, and gave the length of icterodes as about 2 mm. Giebel, in 1874, (Insecta Epizoa : 115) removed the question mark, thus completing the error in synonymy.

Although dentatus Scopoli, 1763, may be a nomen dubium for Trinoton, it is certainly not an available name for Anatoecus. Clay and Hopkins (1951) erected a neotype for Anatoecus dentatus (Scopoli, 1763). They, also, had overlooked the importance of the length designation. When their error was brought to their attention, they stated (Clay and Hopkins, 1958) their intention of asking the International Commission on Zoological Nomenclature to validate their neotype. Regardless of the decision of the Commission, Anatoecus dentatus (Scopoli, 1763) represents a misidentification according to Article 49 of the International Code of Zoological Nomenclature.

If dentatus and icterodes are the same species, Article 23 (e)(ii) of the Code would have to be followed. This Article is the so-called Law of Priority which states: A species-group taxon formed by the union

of two or more species-group taxa takes the oldest valid name among those of its components,(italics added). A misidentification, such as dentatus Scopoli, 1763 is when placed in Anatoecus, constitutes an invalid name. This error should not be continued, if an opportunity arises (such as placing dentatus in synonymy with icterodes) to remove the error. Therefore, when, and if, Anatoecus dentatus (Scopoli, 1763) and Anatoecus icterodes (Nitzsch, 1818) are determined to be the same species, Anatoecus icterodes (Nitzsch, 1818) would be the senior synonym and A. dentatus (Scopoli, 1763) the junior synonym.

As stated in the descriptions, females of Anatoecus dentatus and A. icterodes have not been assigned to their respective males. Females of these species have been collected. Ten are represented in this study. (Represented also are ten male Anatoecus dentatus and A. icterodes, three adults of undetermined sex, and one immature).

Anatoecus icterodes (Nitzsch, 1818)

(Figures 5, 6B)

Docophorus icterodes Nitzsch, 1818. Germar's Mag. Ent. 3: 290.

Nomen novum for "Degeer vii. t. 4. f. 14."

Host: Mergus serrator Linnaeus.

Nirmus fuligulae Denny, 1852. List Brit. Animals in Brit. Mus., II, Anoplura : 13.

Nomen novum for Docophorus icterodes Nitzsch, 1818.

Pediculus mergi Guerin, 1818 (nec J. C. Fabricius, 1781).

Bonaterre's Encycl. Method. 24: 128, pl. 254, fig. 2.

Nomen novum for De Geer's pl. 4, fig. 14.

Host: Mergus serrator Linnaeus.

MALE

Head: Subtriangular; nearly as wide as long. Clypeus produced, semi-orbicular. Marginal carina interrupted anteromediad and laterad. Premarginal carina anteriorly infracted, extending posteromediad, fusing with ventral carina opposite lateral interruption of marginal carina. Postmarginal carina forms preantennal nodus posterodorsally and fuses with ventral carina to form mandibular framework posteroventrally. Hyaline margin complete from near anterior end of postmarginal carina. Dorsal preantennal suture extends from anterior end of postmarginal carina generally posteromedially joining longitudinal mediodorsal suture opposite anterior margin of antennal fossa. Anterior plate with two components; anterior dorsal plate orbicular to hexagonal except at confluence with ventral plate. Sclerotization on each laterodorsal margin of dorsal plate extends dorsoposteromedially, fusing into heavily sclerotized retrorse process rounded apically. Ventral anterior plate margin flattened anteriorly, laterally slightly concave, and rounded and slightly thickened posteriorly. Anterior half ventral carina subparallel, distinctly fused with infracted end of premarginal carina; posterior half ventral carina extends posterolaterally toward comus. Pulvinus attached percurrently laterad. Labrum, in posterior margin of pulvinus, bowed forward mediad. Temporal carina extends forward from occipital margin, fuses with internal surface of dorsum posterior of preantennal nodus. Antenna five-jointed; second segment twice, and apical segment one-and-one-half times, length of third or fourth segments.

Thorax: Prothorax obcordate. Pterothorax subconical, dorsum channelled medially, posterior margin arcuate.

Abdomen: Obtusely ovate. First and last segments with pigmented

sclerotization reaching the median dorsally. Dorsum first segment channelled medially. Anterior half first segment fasciate on dorsum. Other segments heavily pigmented laterad; reniculate dorsally, hepaticoform ventrally; posterior segments laterally less pigmented and more variable in form.

Chaetotaxy: Not diagnostic on the species level.

FEMALE

Females and immatures not assigned to described males. See Descriptive Analysis below.

HOST RECORDS

Malcomson (1960) listed only Mergus serrator Linn. as host. Peters (1928) did not list Anatoecus icterodes. Emerson (1962) listed the following hosts: Anser albifrons (Scopoli), A. anser, Chen hyperborea (Pallas), Anas platyrhynchos Linn., Spatula clypeata (Linn.), Aythya americana (Eyton), A. ferina (Linn.), A. affinis (Eyton), A. fuligula (Linn.), Clangula hyemalis (Linn.), Somateria mollissima (Linn.), Mergus merganser Linn. and M. serrator.

Material examined in this study included five males from one female and two male Anas platyrhynchos, and one male from a male Aix sponsa.

DESCRIPTIVE ANALYSIS

For comments on Anatoecus icterodes, see the Descriptive Analysis for Anatoecus dentatus on page 21. To summarize those comments here, I am considering placing A. dentatus, sensu lato, as a synonym of A. icterodes (Nitzsch, 1818). Except for the lack of an effractor in the male genitalia, Anatoecus icterodes is apparently the morphological equivalent of Anatoecus dentatus. Figure 6B illustrates the terminal portion of the male genitalia of Anatoecus icterodes.

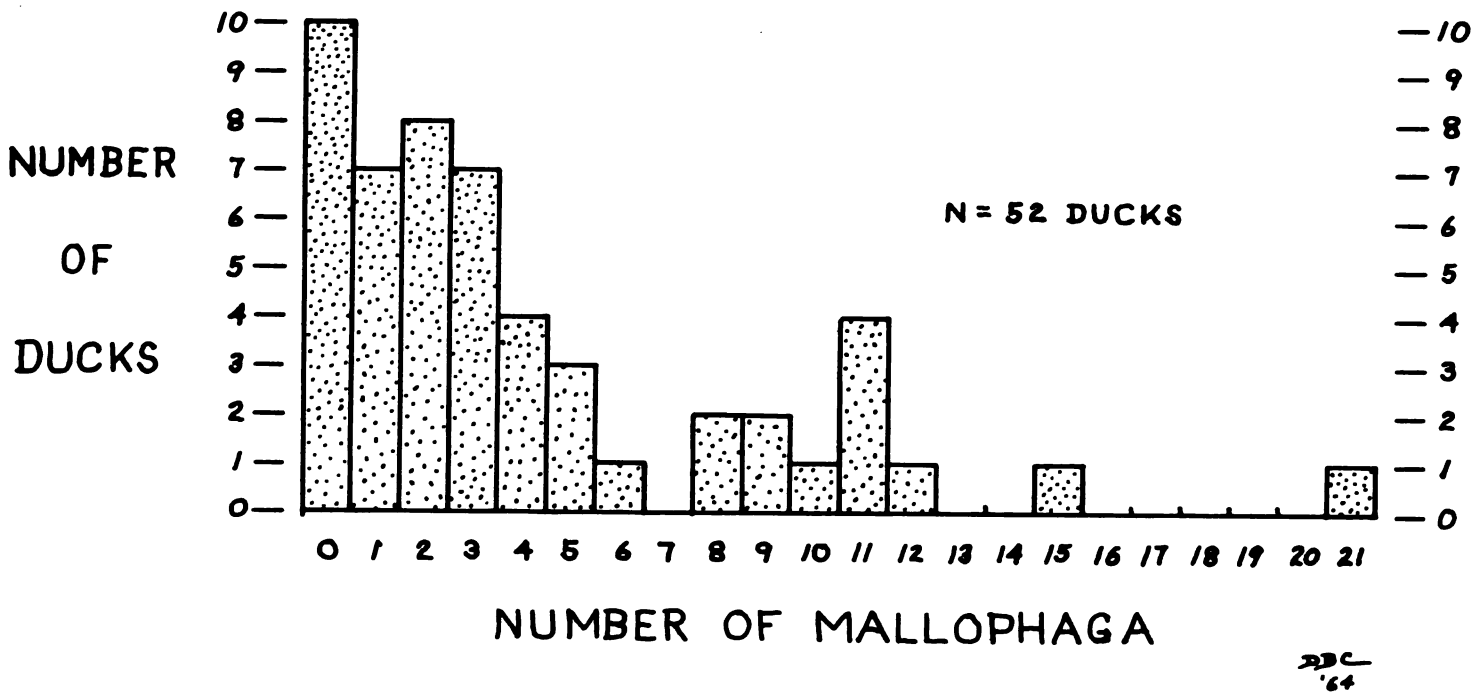
HOST-PARASITE ANALYSIS

An attempt was made in the collection of Mallophaga to treat all ducks in the same manner and to search for lice from each bird with equal effort. It is assumed that not all lice from any given host were collected. No study was made of the efficiency of the collecting method used.

Examination of 52 ducks of six species yielded a total of 217 Mallophaga. One duck had 21 lice; and ten ducks had no lice. Figure 1 shows the frequency distributions of Mallophaga on ducks. All ducks, regardless of species or sex, are treated statistically here (except where otherwise noted) as one sample because of the relatively small sample size. The mean number of lice per duck was 4.2; the standard deviation was 4.5; and the variance was 20.7. If the distribution of lice on ducks were due solely to chance, the variance and the mean should be about the same. The variance, in this case, is 4.96 times larger than the mean -- a difference signifying aggregation. Apparently, some ducks are particularly favored by nature with more lice than others, or conversely, some ducks are especially favored with fewer or no lice.

Such aggregated distributions are often characterized statistically by the negative binomial distribution. This collection of lice is assumed to be negative binomial in form: Almost all insect populations are of this form. Aggregative tendencies in populations may be measured by a coefficient termed "k". Waters (1959) and Bliss (1958) have summarized the derivation and uses of k as a measure of aggregation in

FIG. 1. FREQUENCY DISTRIBUTION OF THE NUMBER OF MALLOPHAGA ON DUCKS.



insects. The moment method of computing k was used in this study, and gave a k value for these data of 1.05. As k approaches 0, the aggregative tendency is increasing. As it approaches infinity (in practice anything over 15 or 20), the aggregative tendency disappears and a random distribution is approached. A k coefficient of 1.05 is indicative of considerable aggregation.

Casual observation of the data suggested that perhaps female Wood Ducks and Mallards had a lower frequency of Mallophaga infestation than did males of these species. Table 2 shows the percentages of uninfested ducks. Data for Mallards and Wood Ducks were combined to increase the sample size. Other host species were excluded from this analysis because their small sample sizes and uneven distributions of sexes were considered inadequate for statistical purposes.

The Chi-square test for significance was used, both with and without Yates' correction for continuity. This correction is used when the total frequency, N, is greater than 40 and when the class with the lowest observed frequency is 10 or less. In this case, N equalled 41 and the class with the lowest observed frequency was 2. Therefore, Chi-squares were computed both with and without correction. The uncorrected value was 2.7, with a probability of 0.08 that this value is due solely to chance. With Yates' correction for continuity, the Chi-square value was 1.6, with a probability of 0.22 that this value is due solely to chance. The true Chi-square value lies somewhere between the corrected and uncorrected values computed. The corrected value underestimates the true value more severely than the uncorrected value overestimates it, due to the nature of Yates' correction for continuity. Neither value meets the 0.05 significance level standard, but there is at least an

Table 2. Abundance of uninfested male and female Mallards and Wood Ducks. Numbers in brackets are the actual numbers of ducks involved: infested on left, uninfested on right.

	Percentage of uninfested ducks	
Species	Males	Females
Mallard	11 (8-1)	25 (6-2)
Wood Duck	8 (11-1)	33 (8-4)

indication that fewer female than male Mallards and Wood Ducks are infested with one or more Mallophaga.

CONCLUSIONS

The new Mallophaga collecting technique described beiefly here proved applicable to the mass-collecting of lice from dead or living birds in the field.

Generic revisions of Anaticola and Anatoecus, and redescriptions of their respectives species, are needed. The original species descriptions in these genera are, for the most part, useless.

Pending study of additional material, I am considering placing Anatoecus dentatus (Scopoli, 1763) as a synonym of Anatoecus icterodes (Nitzsch, 1818). Demonstration of an effractorial cline, overwhelming statistical data that these two taxa represent samples drawn from the same population, or proof of successful reproduction between the two taxa would provide the required evidence for placing these two taxa in synonymy. Data in this study were insufficient to establish conspecificity in this case.

Preliminary statistical evidence indicates that the species of Mallophaga studied here are quite aggregative in their distribution on ducks, and that apparently fewer female Mallards and Wood Ducks are infested with Mallophaga than are males of these species.

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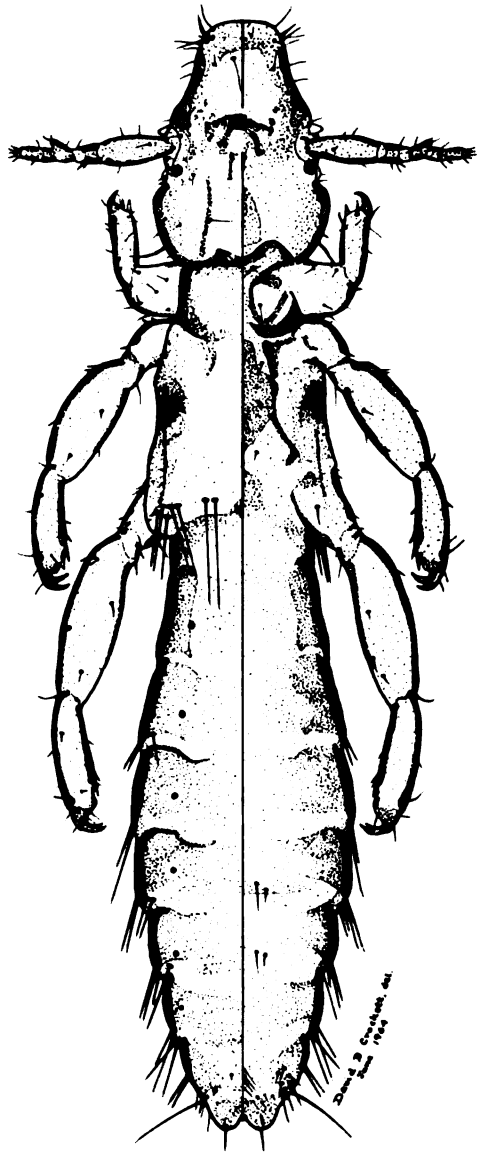
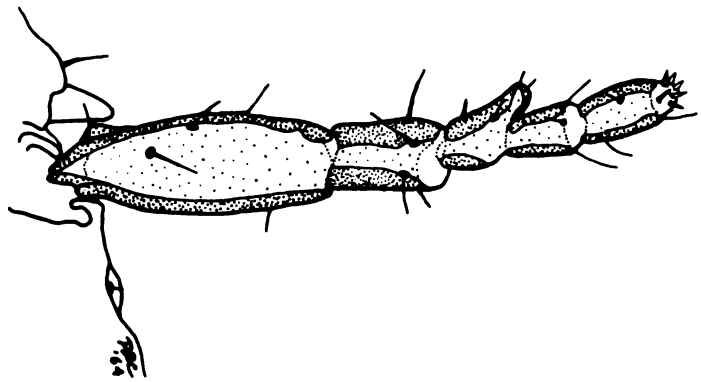


Figure 2. Anaticola crassicornis (Scopoli, 1763). Plesiotype, slide number DBC-23: 1, adult male, from female Mallard (Anas platyrhynchos Linnaeus).



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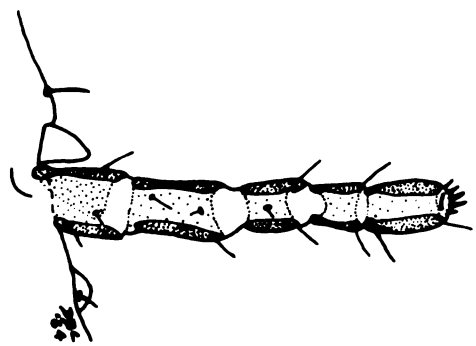

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Figure 3. Comparison of antennal sexual dimorphism in Anaticola crassicornis (Scopoli, 1763). A). Male. B). Female.

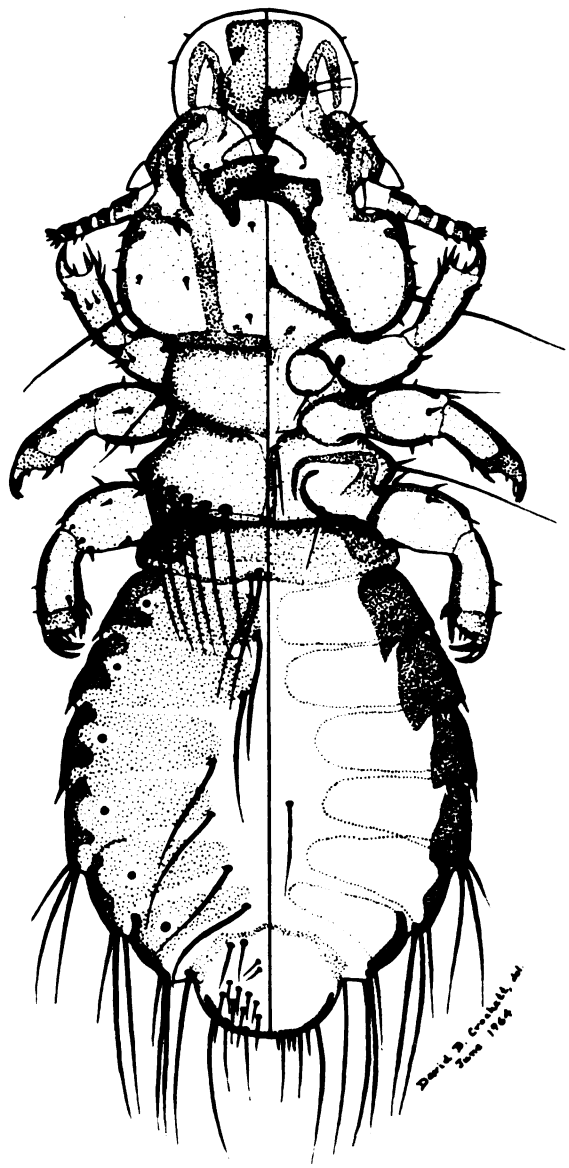


Figure 4. Anatoecus dentatus (Scopoli, 1763). Plesiotype, slide number DBC-19: 1, adult male, from female Mallard (Anas platyrhynchos Linnaeus).

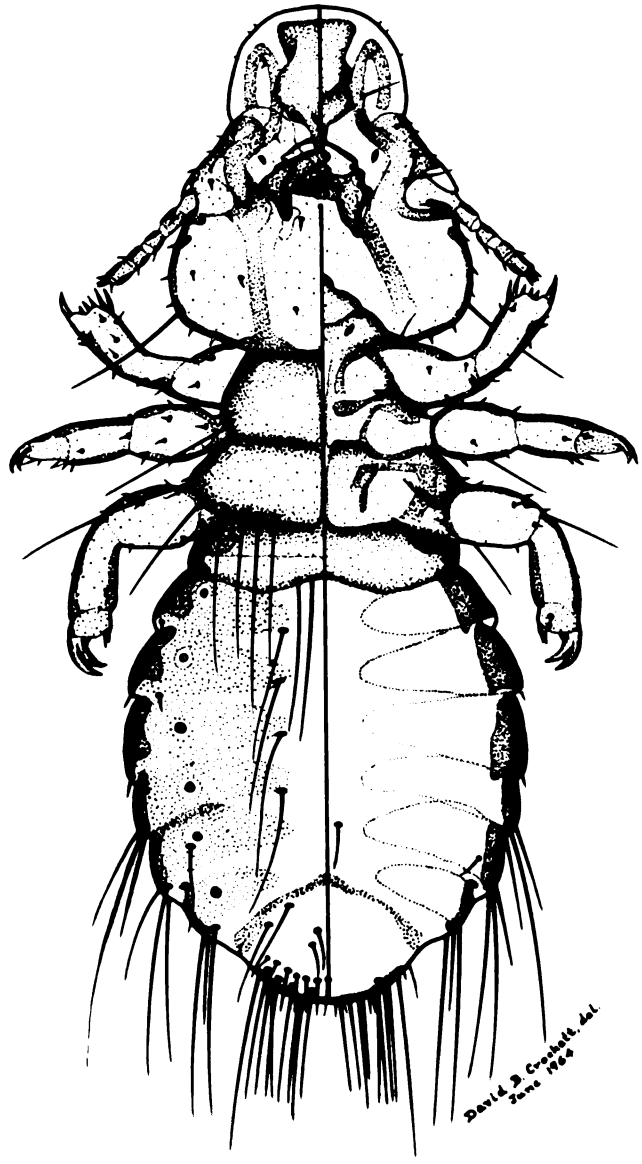
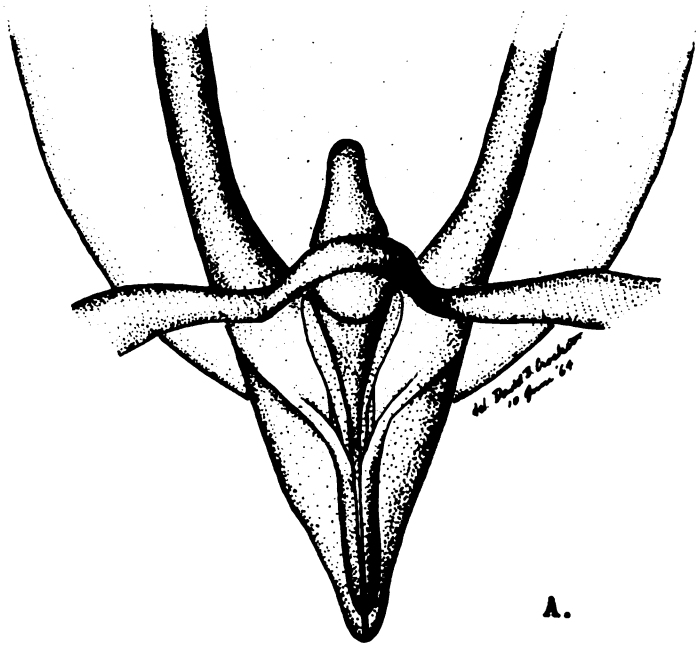
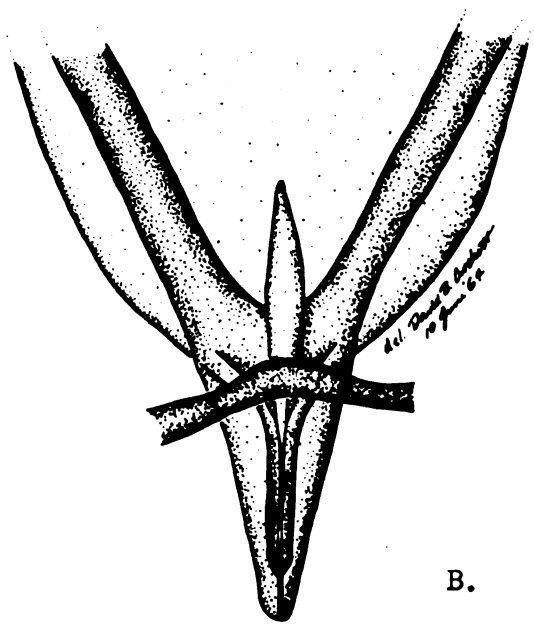


Figure 5. Anatoecus icterodes (Nitzsch, 1818). Plesiotype, slide number DBC-10: 4, adult male, from male Mallard (Anas platyrhynchos Linnaeus).



A.



B.

Figure 6. Comparison of distal portion of male genitalia of A). Anatoecus dentatus (Scopoli, 1763), and B). Anatoecus icterodes (Nitzsch, 1818).

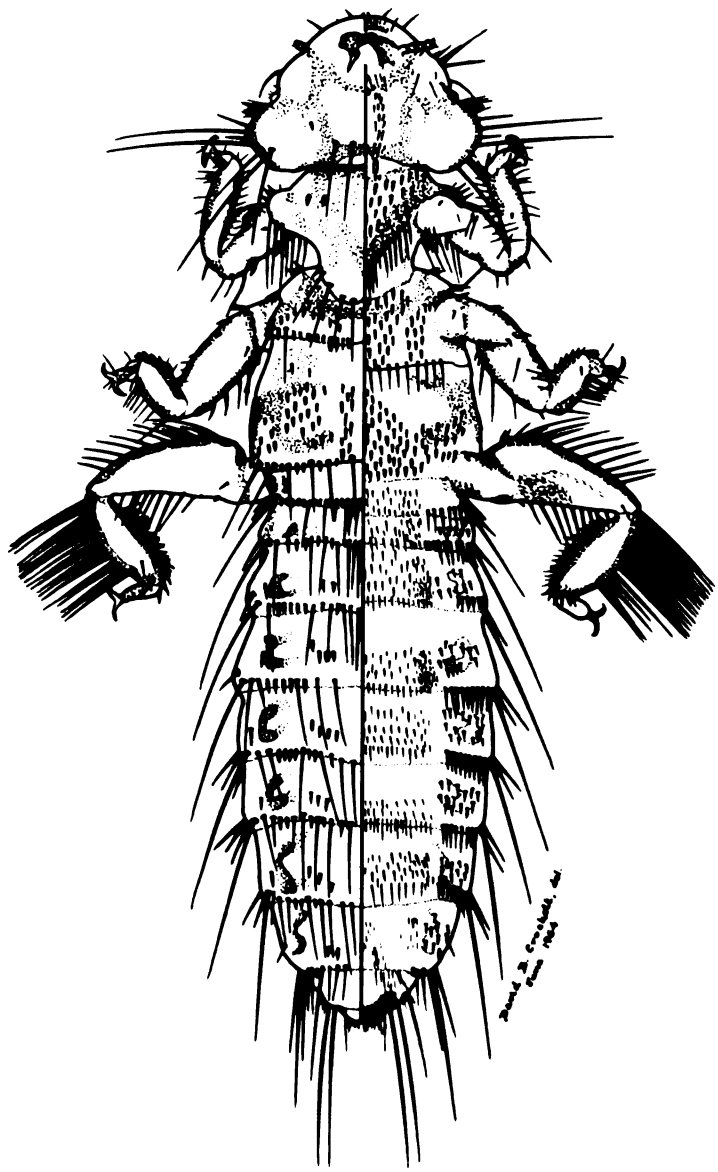


Figure 7. Trinoton querquedulae (Linnaeus, 1758). Plesiotype, slide number DBC-44: 1, adult male, from male Green-winged Teal (Anas carolinensis Gmelin).

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