

THE GENUS *PENENIRMUS* (Mallophaga) FOUND ON NORTH AMERICAN WOODPECKERS

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The genus *Penenirmus* Clay and Meinertzhagen, 1938, is found on hosts of the avian orders Piciformes and Passeriformes. Among the forms found on the Passeriformes, considerable range in external morphological differences exist. Among the forms found on the Piciformes, external morphological differences are slight. Carriker (1956) and Emerson (1958) considered that the known forms found on North American Piciformes were subspecies of *Penenirmus auritus* (Scopoli, 1763), the first species of the genus described from specimens collected off a woodpecker.

Reported herein are the results of a study of a large number of specimens collected off fifteen of the twenty-two species of woodpeckers found in North America (north of Mexico). The known species found on woodpeckers elsewhere are not discussed in detail but have been included in a key to indicate possible relationships.

External morphological differences believed sufficient to warrant specific rank have been incorporated in a key. Those considered to be of lesser value have been illustrated for the North American forms to facilitate separation of the subspecies. In general appearance, all forms are very similar; therefore complete illustrations have been included for only one form. The following key utilizes the chaetotaxy of the tergites in separating many of the species. This character is fairly reliable, but occasionally a specimen will be encountered which does not possess normal chaetotaxy on the tergites. These specimens can be determined by comparison with the illustrations.

The authors gratefully acknowledge the assistance provided by Dr. Theresa Clay, British Museum (Natural History); Mr. Robert E. Elbel, University of Oklahoma; Dr. H. G. Deignan, U.S. National Museum; and the many individuals who loaned specimens.

Key to the species of *Penenirmus* found on Piciformes

- | | |
|--|--------------------|
| 1. Abdominal tergites III-IV-V with an average of four centro-posterior setae each | 2 |
| Abdominal tergites III-IV-V with an average of six centro-posterior setae each | 5 |
| Abdominal tergites III-IV-V with an average of eight centro-posterior setae each | 6 |
| Abdominal tergites III-IV-V with an average of ten centro-posterior setae each | <i>maculipes</i> |
| 2. Abdominal tergite VIII of female with two centro-posterior setae | <i>serrilimbus</i> |
| Abdominal tergite VIII of female with four centro-posterior setae | 3 |

3. Pterothorax with four centro-posterior setae 4
 Pterothorax with six centro-posterior setae *jungens*
4. Abdominal tergite IX of female with six posterior setae *auritus*
 Abdominal tergite IX of female with eight posterior setae .. *californiensis*
5. Abdominal tergite VII of female with four centro-posterior
 setae *macrotrichus*
 Abdominal tergite VII of female with six centro-posterior setae .. *villosus*
6. Pterothorax with four centro-posterior setae *pici*
 and *tuktola*
 Pterothorax with at least six centro-posterior setae 7
7. Mesosternal plate with two posterior setae *heteroscelis*
 Mesosternal plate with four posterior setae *campephili*

Penenirmus auritus auritus (Scopoli, 1763)

Pediculus auritus Scopoli. 1763. Entomologia Carniolica: 383.

Docophorus superciliosus Burmeister. 1838. Handb. Ent., 2:427.

Clay and Hopkins (1951) designated neotypes from specimens collected off the type host, *Dryobates major pinetorum* (Brehm), from Yugoslavia. Neoparatypes were examined during this study.

Diagnosis. The dorsal anterior plate of the forehead is the same shape as, but slightly larger than that of *P. auritus evagens* (Fig. 5). Chaetotaxy of pterothorax is the same as that shown in Figure 20. Posterior margin of female vulva as shown in Figure 23. Clay and Hopkins (1951) have provided other illustrations.

Measurements

	Male	Female
Length of head	0.53 mm	0.57 mm
Breadth of head	0.48	0.50
Breadth of prothorax	0.29	0.30
Breadth of pterothorax	0.46	0.51
Breadth of abdomen	0.60	0.65
Total length	1.72	1.99

Penenirmus auritus evagens (Kellogg, 1896)

Docophorus evagens Kellogg. 1896. Proc. Calif. Acad. Sci., 6:480, pl. 66, fig. 2.

Original description was based on a single male collected off the Downy Woodpecker, *Dendrocopos pubescens medianus* (Swainson), at Lawrence, Kansas. Illustrations are for specimens from the type host collected in Virginia. Other specimens, from the type host, collected in Oklahoma and Indiana were examined.

Diagnosis. Female as shown in Figure 1. Male as shown in Figure 2. Male genitalia as shown in Figure 3. Posterior margin of female vulva as shown in Figure 4. Dorsal anterior plate of forehead as shown in Figure 5. Chaetotaxy of pterothorax as shown in Figure 20. Smaller than the nominate form, and with a different chaetotaxy of the posterior margin of female vulva.

Specimens from the Arizona Woodpecker, *Dendrocopos arizonae* (Hargitt), collected in Chihuahua, Mexico, are considered to be this subspecies.

Penenirmus auritus peusi Eichler, 1953

Penenirmus peusi Eichler. 1953. Zool. Anz., 150:242, figs. 4, 9, 11 and 18.

Described from specimens collected in the Balkans off *Dendrocopos syriacus balianicus* (Gengler and Stresemann). Specimens were not available for study, so this classification is tentative based upon Eichler's illustrations and description.

Penenirmus californiensis californiensis (Kellogg, 1896)

Docophorus californiensis Kellogg. 1896. Proc. Calif. Acad. Sci., 6:483, pl. 66, fig. 6.

Original description was based on specimens collected off the Acorn Woodpecker, *Melanerpes formicivorus bairdi* Ridgway, at Palo Alto, California. Illustrations and measurements are for specimens off *Melanerpes formicivorus formicivorus* (Swainson), collected in Arizona. Two female syntypes were also examined.

Diagnosis. Dorsal anterior plate of forehead as shown in Figure 7, chaetotaxy of pterothorax as shown in Figure 16, and posterior margin of female vulva as shown in Figure 25 are distinctive. Other characters, except measurements, as given in the key.

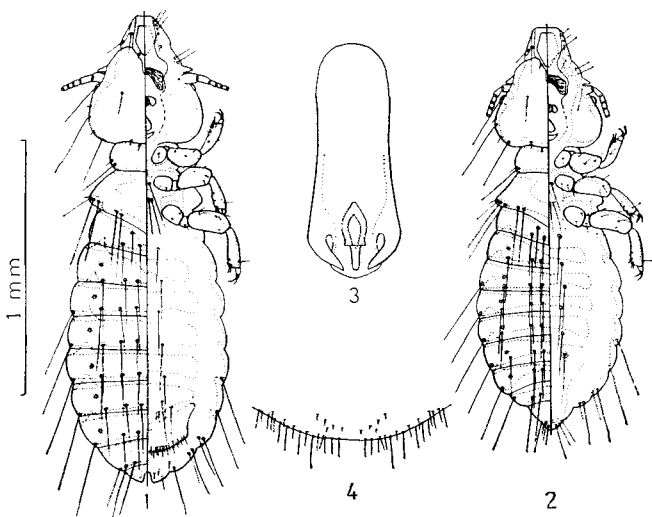


PLATE I. *Penenirmus auritus evagans* (Kellogg, 1896). Fig. 1. Dorsal-ventral view of female. Fig. 2. Dorsal-ventral view of male. Fig. 3. Male genitalia. Fig. 4. Posterior margin of female vulva. Figures 1 and 2 drawn to the same scale.

Measurements

	Male	Female
Length of head	0.52 mm	0.59 mm
Breadth of head	0.45	0.52
Breadth of prothorax	0.29	0.33
Breadth of pterothorax	0.45	0.52
Breadth of abdomen	0.60	0.61
Total length	1.71	2.04

Specimens from the Red-headed Woodpecker, *Melanerpes erythrocephalus erythrocephalus* (Linnaeus), collected in Kansas, South Carolina, North Carolina, Virginia, and Indiana are considered to be this species.

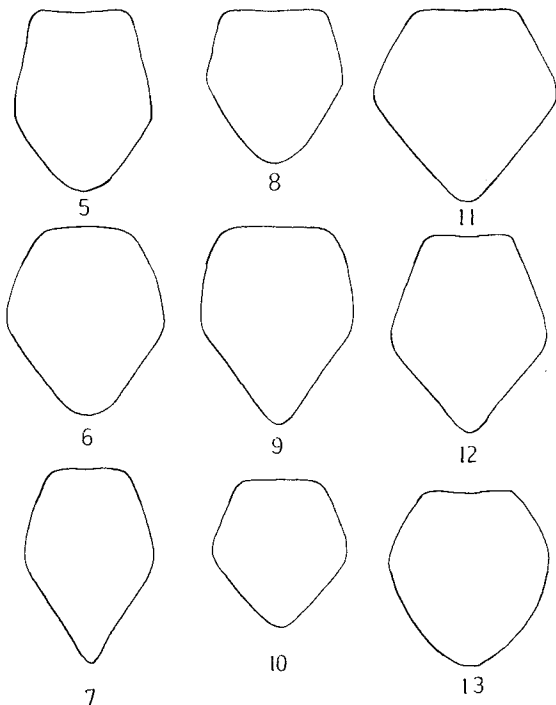


PLATE II. Dorsal anterior plate of forehead, *Penenirmus* sp. Fig. 5. *P. auritus evagens* (Kellogg, 1896). Fig. 6. *P. jungens* (Kellogg, 1896). Fig. 7. *P. californiensis californiensis* (Kellogg, 1896). Fig. 8. *P. californiensis varius* Emerson, 1953. Fig. 9. *P. serrilimbus aurifrons* Carriker, 1956. Fig. 10. *P. californiensis arcticus* Carriker, 1958. Fig. 11. *P. serrilimbus pileatus* n. subsp. Fig. 12. *P. serrilimbus asyndesmus* n. subsp. Fig. 13. *P. villosus* n. sp. All figures drawn to the same scale.

Penenirmus californiensis varius Emerson, 1953

Penenirmus varius Emerson. 1953. Jour. Kansas Ent. Soc., 26:134, figs. 6 and 8.

Described from specimens collected off the Yellow-bellied Sapsucker, *Sphyrapicus varius varius* (Linnaeus), from Arizona. Illustrations are for paratypes. Other specimens examined were off: *Sphyrapicus varius varius* (Linnaeus), from Indiana; *S. v. appalachiensis* Ganier, from Virginia; *S. v. nuchalis* Baird, from Arizona; *S. v. ruber* (Gmelin), from Alaska; and *S. v. daggetti* Grinnell, from California.

Diagnosis. Dorsal anterior plate of forehead as shown in Figure 8,

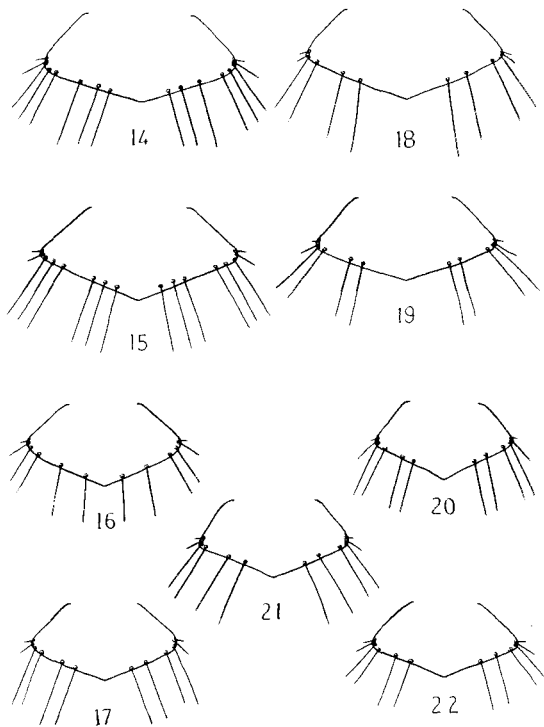


PLATE III. Dorsal view of pterothorax, *Penenirmus* sp. Fig. 14. *P. jungens* (Kellogg, 1896). Fig. 15. *P. villosus* n. sp. Fig. 16. *P. californiensis californiensis* (Kellogg, 1896). Fig. 17. *P. californiensis arcticus* Carriker, 1958. Fig. 18. *P. serrilimbus pileatus* n. subsp. Fig. 19. *P. serrilimbus aurifrons* Carriker, 1956. Fig. 20. *P. auritus evagens* (Kellogg, 1896). Fig. 21. *P. serrilimbus asyndesmus* n. subsp. Fig. 22. *P. californiensis varius* Emerson, 1953. All figures drawn to the same scale.

chaetotaxy of pterothorax as shown in Figure 22, and posterior margin of female vulva as shown in Figure 26, all of which are different from the nominate form. Also, this subspecies is slightly smaller than the nominate form.

Penenirmus californiensis arcticus Carriker, 1958

Penenirmus arcticus Carriker. 1958. Proc. Ent. Soc. Wash., 60:168, figs. 1-2.

The original description was based on specimens collected off the Black-backed Three-toed Woodpecker, *Picoides arcticus* (Swainson), at Pike Lake, Michigan. Illustrations are from paratypes.

Diagnosis. Dorsal anterior plate of forehead as shown in Figure 10, chaetotaxy of pterothorax as shown in Figure 17, and posterior margin of female vulva as shown in Figure 27. The size and chaetotaxy of the pterothorax do not appear to be distinctive, but the other two characters given are distinctive.

Specimens from the Northern Three-toed Woodpecker, *Picoides tri-dactylus bacatus* Bangs, collected in Labrador are considered to be this subspecies.

Penenirmus serrilimbus serrilimbus (Burmeister, 1838)

Docophorus serrilimbus Burmeister. 1838. Handb. Ent., 2:427.

The original description was based on specimens collected off *Jynx torquilla* Linnaeus. Specimens off the type host collected in England were examined.

Diagnosis. Dorsal anterior plate of the forehead is the same shape as that shown in Figure 9. Chaetotaxy of pterothorax is the same as that shown in Figure 19. Posterior margin of female vulva as shown in Figure 28.

Measurements

	Male	Female
Length of head	0.51 mm	0.62 mm
Breadth of head	0.44	0.48
Breadth of prothorax	0.23	0.23
Breadth of pterothorax	0.40	0.48
Breath of abdomen	0.55	0.74
Total length	1.76	2.30

Penenirmus serrilimbus aurifrons Carriker, 1956

Penenirmus auritus aurifrons Carriker. 1956. Florida Ent., 39:37, figs. 34-35.

Described from specimens off the Golden-fronted Woodpecker, *Centurus aurifrons grateloupensis* (Lesson), collected in Mexico. Illustrations are for specimens off *Centurus aurifrons aurifrons* (Wagler), collected in Texas.

Diagnosis. Dorsal anterior plate of forehead as shown in Figure 9, chaetotaxy of pterothorax as shown in Figure 19, and posterior margin of female vulva as shown in Figure 29. Larger than the nominate form, and with a different chaetotaxy of the posterior margin of the female vulva.

Specimens from the Red-bellied Woodpecker, *Centurus carolinus carolinus* (Linnaeus), collected in South Carolina, Florida, and Georgia are considered to be this subspecies.

Penenirmus serrilimbus pileatus n. subsp.

Type host: Pileated Woodpecker, *Dryocopus pileatus abieticola* (Bangs).

Type material: From *Dryocopus pileatus abieticola* (Bangs)—Holotype male, allotype female and seventeen paratypes collected at Tillamook, Oregon, on November 14, 1929, and January 22, 1931, by Alexander Walker; one paratype collected at Woodinville, Washington, on April 7, 1935, by A. Hangen; and one paratype collected at Mercer Lake, Oregon, on January 28, 1933, by H. H. Stage. From *Dryocopus pileatus pileatus* (Linnaeus)—one paratype collected at Dewitt, Arkansas, on December 22, 1917, by A. Wetmore.

Diagnosis. Dorsal anterior plate of forehead as shown in Figure 11. Chaetotaxy of posterior margin of female vulva as shown in Figure 30. Pterothorax as shown in Figure 18. Total length of male 1.85 mm; of female, 2.18 mm. Distinguished from the other subspecies and the nominate form by the distinctive dorsal anterior plate of forehead, and chaetotaxy of the posterior margin of the female vulva.

Penenirmus serrilimbus asyndesmus n. subsp.

Type host: Lewis' Woodpecker, *Asyndesmus lewis* (Gray).

Type material: Holotype male, allotype female and nine paratypes collected at Seapoose, Oregon, on May 19, 1933, by C. M. Gjullin; one paratype collected at Logan, Utah, on July 19, 1946, by P. E. Telford; and ten paratypes collected at Portland, Oregon, on May 6, 1932, by M. F. Conova; all specimens were off the type host.

Diagnosis. Dorsal anterior plate of forehead as shown in Figure 12. Pterothorax as shown in Figure 21. Chaetotaxy of posterior margin of female vulva as shown in Figure 31. Total length of male, 1.55 mm; of female, 1.98 mm. Distinguished from other subspecies and the nominate form by the distinctive dorsal anterior plate of the forehead, chaetotaxy of the pterothorax, and chaetotaxy of the posterior margin of the female vulva.

Penenirmus serrilimbus fiebrigi Eichler, 1953

Penenirmus fiebrigi Eichler. 1953. Zool. Anz., 150: 240, figs. 2, 7, and 11.

The type host is *Colaptes campestris campestroides* (Malherbe), found in southern South America. Paratypes, in poor condition, were examined. The dorsal anterior plate of the forehead and the chaetotaxy of the posterior margin of the female vulva differ from the other subspecies.

Penenirmus jungens (Kellogg, 1896)

Docophorus jungens Kellogg. 1896. Proc. Calif. Acad. Sci., 6:481, pl. 66, fig. 4.

The original description was based on specimens off the Yellow-shafted Flicker, *Colaptes auratus lutens* Bangs, collected at Lawrence, Kansas. Illustrations and measurements are for specimens from the type host collected in Oklahoma. Other specimens examined were off: *Colaptes auratus lutens* Bangs, from Indiana, New York, and Iowa; *C. a. auratus* (Linnaeus),

from Texas and Virginia; and *C. a. borealis* Ridgway, from Mississippi.

Diagnosis. Dorsal anterior plate of forehead as shown in Figure 6, chaetotaxy of pterothorax as shown in Figure 14, and posterior margin of female vulva as shown in Figure 24 are distinctive. Other characters, except for measurements, as given in the key.

Measurements

	Male	Female
Length of head	0.56 mm	0.63 mm
Breadth of head	0.52	0.60
Breadth of prothorax	0.31	0.35
Breadth of pterothorax	0.51	0.61
Breadth of abdomen	0.69	0.69
Total length	1.82	2.21

Specimens from the Red-shafted Flicker, *Colaptes cafer cafer* (Gmelin), collected in Oregon; and from *Colaptes cafer collaris* Vigors, collected in Texas and Ohio are considered to be this subspecies.

Penenirmus villosus n. sp.

Type host: Hairy Woodpecker, *Dendrocopos villosus villosus* (Linnaeus).

Type material: Holotype male, allotype female and two paratypes off *Dendrocopos villosus villosus* (Linnaeus), collected at Orient, New York, on May 2, 1952, by Roy Latham. Seven paratypes off *Dendrocopos villosus audubonii* (Swainson), collected at Hamburg, Mississippi, on December 24, 1914, by W. E. Dove. Six paratypes off *Dendrocopos villosus harrisi* (Audubon), collected at Tillamook, Oregon, on November 19, 1929, by Alexander Walker. Two paratypes off *Dendrocopos villosus monticola* (Anthony), collected at Florence, Montana, on April 1, 1910, by W. V. King. In the British Museum (NH), forty-eight paratypes off *Dendrocopos villosus hyloscopus* (Cabanis and Heine), collected in California in 1939.

Diagnosis. Dorsal anterior plate of forehead as shown in Figure 13, pterothorax as shown in Figure 15, and chaetotaxy of posterior margin of female vulva as shown in Figure 32 are distinctive. Other characters, except for measurements, as given in the key.

Measurements

	Male	Female
Length of head	0.52 mm	0.58 mm
Breadth of head	0.48	0.56
Breadth of prothorax	0.30	0.33
Breadth of pterothorax	0.51	0.58
Breadth of abdomen	0.65	0.79
Total length	1.75	2.05

Penenirmus heteroscelis (Nitzsch, 1866)

Pediculus pici Schrank. 1803. Fauna Boica. Landshut.: 188. (nec J. C. Fabricius, 1798).

Nirmus heteroscelis Nitzsch. 1866. In Giebel, Z. ges. NatWiss., 27:117.

Philopterus kumagera Uchida. 1949. Jap. Med. Jour., 1:544, fig. 12.

The type host of this species is *Dryocopus martius martius* (Linnaeus),

found in the northern regions of the Old World. Specimens were not available for study, therefore this classification is tentative based on descriptions and illustrations.

Penenirmus pici (J. C. Fabricius, 1798)

Pediculus pici J. C. Fabricius. 1798. Ent. Syst. Suppl.: 571.

Docophorus scalaris Burmeister. 1838. Handb. Ent., 2:427.

Clay and Hopkins (1960) designated neotypes from specimens collected off the type host, *Picus viridis viridis* Linnaeus, from England. Neoparatypes were examined.

Penenirmus campephili Eichler, 1953

Penenirmus campephili Eichler. 1953. Zool. Anz., 150:239, figs. 16-17.

The type host is *Campephilus magellanicus* (King), found in Chile and Argentina. The paratypes examined were in such poor condition that the information utilized in the key had to be obtained from Eichler's description and illustrations.

Penenirmus maculipes (Piaget, 1880)

Docophorus maculipes Piaget. 1880. Les Pediculines: 661, pl. 54, fig. 3.

The type host for this species was given by Piaget as *Picus* from Bangka. The information utilized in the key was provided by Dr. Clay, who

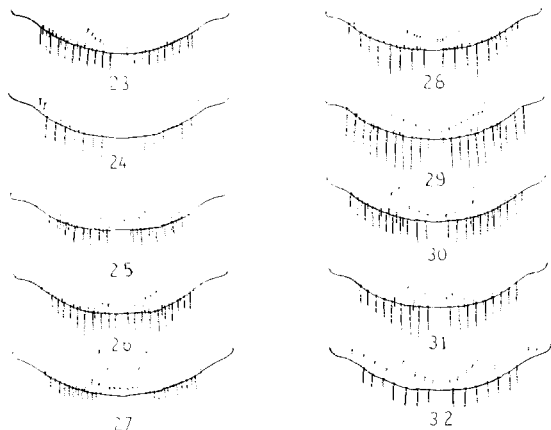


PLATE IV. Posterior margin of female vulva, *Penenirmus* sp. Fig. 23. *P. auritus auritus* (Scopoli, 1763). Fig. 24. *P. jungens* (Kellogg, 1896). Fig. 25. *P. californiensis californiensis* (Kellogg, 1896). Fig. 26. *P. californiensis varius* Emerson, 1953. Fig. 27. *P. californiensis arcticus* Carriker, 1958. Fig. 28. *P. serrilimbus serrilimbus* (Burmeister, 1838). Fig. 29. *P. serrilimbus aurifrons* Carriker, 1956. Fig. 30. *P. serrilimbus pileatus* n. subsp. Fig. 31. *P. serrilimbus asyndesmus* n. subsp. Fig. 32. *P. villosus* n. sp.

examined the type in the British Museum (Natural History). Dr. H. G. Deignan, U.S. National Museum, informs us that "*Picus* from Bangka" could be one of the following hosts: *Picus puniceus observandus* (Hartert), *Picus mineaceus malaccensis* Latham, *Picus mentalis humii* (Hargitt), *Dinopium rafflesii rafflesii* (Vigors and Horsfield), *Micropternus brachyurus badius* (Raffles), *Hemicircus concretus coccometopus* (Reichenbach), and *Dryocopus javensis javensis* (Horsfield). Specimens from *Micropternus brachyurus* and *Dryocopus javensis* are not conspecific with the type, hence should no longer be considered for type host.

Penenirmus tuktola (Ansari, 1947)

Picophilopterus tuktola Ansari, 1947. Proc. Nat. Inst. Sci. India, 13:265, fig. 4.

The type host is *Picus squamatus squamatus* Vigors, found in southern Asia. Dr. Theresa Clay examined a paratype, in poor condition, and provided the information utilized in the key.

Penenirmus macrotrichus (Kolenati, 1858)

Docophorus macrotrichus Kolenati, 1858. S. B. Akad. Wiss. Wien, 29:248, pl. I, fig. 5.

Specimens from the type host, *Picus flavinucha* Gould, collected in Thailand were examined.

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