

IDENTIFYING *PSOROPHORA HORRIDA* FEMALES IN NORTH CAROLINA (DIPTERA: CULICIDAE)

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ABSTRACT. Morphological characters to separate *Psorophora horrida* (Dyar and Knab) and *Psorophora ferox* (Von Humboldt) females are identified and defined. In addition to the 3 characters used to separate these 2 species in published keys, an additional 6 characters were found. Of the total of 9 characters identified, 6 are reliable at the 100% level, based on North Carolina specimens. These additional characters will assist greatly in identifying *Ps. horrida* specimens. Variations on hindtarsomere 4 of *Ps. horrida*, consisting of dark-scaled patterns, were also noted. Characters for separating *Psorophora cyanescens* (Coq.) and *Psorophora mathesoni* Belkin and Heinemann from *Ps. ferox* and *Ps. horrida* are discussed.

INTRODUCTION

There are 4 species belonging to the subgenus *Janthinosoma* Lynch Arribalzaga, of *Psorophora* Robineau-Desvoidy, in most of the southeastern states (Florida has 5 species). Where common, these species are among the most irritating pest mosquitoes in the area. Anyone working outdoors on mosquito projects quickly learns to identify the dark mosquito with "white boots," *Psorophora ferox* (Von Humboldt), that prefers to attack the head and face. What is not known by many of those workers is that there are two *Psorophora* species that, on gross examination, appear similar and have the last 2 hindtarsomeres white. Although *Ps. ferox* will normally be the most common and abundant species throughout the summer and fall, the second species, *Psorophora horrida* (Dyar and Knab), can be common locally, is a very aggressive pest, and usually occurs with *Ps. ferox*. Because of the numerical dominance of *Ps. ferox* we believe that *Ps. horrida* is often overlooked in many mosquito surveillance programs. This is particularly true if specimens are collected in light traps and are badly rubbed, with few or no remaining scales on the scutum.

Psorophora horrida was described by Dyar and Knab (1908). Unfortunately, the specimens used for the original description were composed of not only *Ps. horrida*, but also an unrecognized species that would not be described for another 37 years. This caused considerable confusion in identifying *Ps. horrida*. Another contribution to this confusion was that the male genitalia of *Ps. horrida* are extremely similar to those of *Ps. ferox*. Roth (1945) finally eliminated this confusion by describing the 2nd species, *Psorophora longipalpus* Roth, from the Midwestern states, and also provided a detailed description of *Ps. horrida*. Roth (1945) indicated that although the male genitalia of *Ps. ferox* and *Ps.*

horrida are nearly identical, the color differences of the adults are very distinctive.

During our mosquito surveys in the western half of North Carolina we encountered *Ps. horrida* in several counties in conjunction with collections of *Ps. ferox*. These collections prompted a comparison of the 2 species and a search for additional characters other than those used in current keys (Carpenter and LaCasse 1955, King et al. 1960, Darsie and Ward 1981, Slaff and Apperson 1989).

MATERIALS AND METHODS

Specimens were collected in landing-biting catches and CDC light traps supplemented with dry ice and killed in an ice chest with dry ice. Females were glued with ambroid cement to paper points on insect pins and labeled. Specimens were identified using Carpenter and LaCasse (1955), Darsie and Ward (1981), and Slaff and Apperson (1989).

The specimens used in this study are deposited in the Public Health Pest Management Collection, Department of Environment, Health and Natural Resources, Winston-Salem, NC. These specimens were examined for additional differentiating morphologic characters with a binocular dissection microscope using 70× magnification. In addition, previous descriptions of *Ps. ferox* and *Ps. horrida* were screened for likely differentiating characters. Character variations were also assessed for overlap between the two species. The morphologic terminology follows Harbach and Knight (1980).

RESULTS AND DISCUSSION

Over the past 3 years 106 females of *Ps. horrida* were collected in the following 6 piedmont counties of North Carolina: Alamance, Forsyth, Guilford, Rockingham, Stanly, and Yadkin (Harrison et al., unpublished data). Ninety-six of these were used in this study. The other 10 specimens were identified and then discarded because of their poor condition. These specimens were almost always collected in association with *Ps. ferox* females. For this study

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Table 1. Characters used to separate females of *Psorophora ferox* and *Psorophora horrida*.

Character	<i>Ps. ferox</i>	<i>Ps. horrida</i>
1. Scutal midline scales	Mixed gold and brown-purple	Bronzy brown
2. Lateral scutal scales	Mixed gold and brown-purple	Cream to yellow-white
3. Scales on abdominal tergum I	Purple	Creamy white
4. Scales on median half of pedicel	None, rarely 1-4 small scales	Large patch of many gray-white scales
5. Scutal pale scales just above paratergite and prealar knob	Few silvery white, compared to mixed gold and brown-purple of other lateral scales	All scales cream to yellow-white
6. Subspiracular scale patch	Many white scales	None
7. Lateral decumbent scales on vertex	Yellow	Small purple patch on each side (96%)
8. Scales on apex of hindtarsomere 3	White	Purple (87%)
9. Scales on base of proboscis and palpi	Light golden (90%)	Dark purple (96%)

44 females of *Ps. ferox* from Davidson, Forsyth, Gaston, Pender, Rowan, and Stanly counties were examined. Of the 106 *Ps. horrida* females, 80 were collected in 8 different landing-biting collections in association with 235 *Ps. ferox*. This is an approximate ratio of *Ps. horrida* to *Ps. ferox* of 1:3 (80/235). However, because *Ps. horrida* was extremely abundant in one collection and outnumbered *Ps. ferox*, we feel a ratio of 1:16 (11/181) taken from the other 7 landing-biting collections is more representative. An additional 26 *Ps. horrida* females were taken in 5 CDC light trap (with CO₂) collections in association with 646 *Ps. ferox* females (ratio 1:50). Based on these ratios, *Ps. horrida* is an uncommon species in the areas we collected. However, on one occasion it was common: 69 females in a 30-min landing-biting collection, in association with 54 *Ps. ferox*. All of the *Ps. horrida* females were collected landing or biting in shaded deciduous forest near temporary ground pools. Although larval collections were made, no *Ps. horrida* larvae were found.

Three characters are used in the keys of Carpenter and LaCasse (1955), King et al. (1960), Darsie and Ward (1981), and Slaff and Apperson (1989) to separate females of *Ps. ferox* and *Ps. horrida*. These are: 1) color of the median scales on the scutum, 2) color of the lateral scales on the scutum, and 3) color of the scales on abdominal tergum 1. We found an additional 6 characters that are very useful in separating these 2 species. They are: 4) presence or absence of scales on the median half of the antennal pedicel, 5) color of the pale lateral scutal scales just above the paratergite and the prealar knob, 6) presence or absence of subspiracular scales, 7) color of the lateral decumbent scales on the vertex, 8) color of the scales on the apex of hindtarsomere 3, and 9) color of the scales on the base of the proboscis and palpi.

These 9 characters easily separate females of *Ps. ferox* and *Ps. horrida* and are defined in Table 1.

The first 6 characters in Table 1 were 100% reliable on the specimens examined. The remaining 3 characters were slightly less reliable. The color of the lateral decumbent scales on the vertex of *Ps. ferox* was always yellow, whereas only 4% of *Ps. horrida* had yellow scales, and the remaining 96% had small purple lateral scale patches. The color of the scales on the apex of hindtarsomere 3 was always white on *Ps. ferox*, whereas 13% of *Ps. horrida* had a few white scales at the extreme apex, and the remaining 87% had the apex dark purple. When viewing the base of the proboscis and palpi of *Ps. ferox* from the side, 90% had light golden scales, whereas 96% of *Ps. horrida* had these scales dark purple.

Although hindtarsomere 4 of *Ps. horrida* is supposed to be white scaled, Roth (1945) noted that it infrequently has dark scales. He described 8 different patterns for the dark scales on hindtarsomere 4, and in 2 of these patterns dark scales also occurred on hindtarsomere 5. Since then the dark-scaled variations of hindtarsomere 4 have been described as rare (Carpenter et al. 1946, Carpenter and LaCasse 1955) to frequent (Matheson 1966). More than 27% (26/95) of our *Ps. horrida* exhibited dark scales on hindtarsomere 4, and they agreed with 5 of the patterns described by Roth (1945). Most of our specimens exhibiting dark scales had them on the ventral portion of hindtarsomere 4. We did not encounter specimens with dark scales on hindtarsomere 5.

Two other characters that could potentially separate these 2 species were evaluated. One, the presence or absence of a white knee spot on the apex of the forefemur, was found to be less reliable. Approximately 71% of the *Ps. ferox* lacked a white knee spot on the forefemur, whereas 96% of the *Ps. horrida* had this spot. The 2nd character, the dark scale patterns on abdominal sternum II-VII, was found to be totally unreliable, with complete overlap. *Psorophora ferox* was described by Carpenter

and LaCasse (1955) as having sterna II–VI entirely yellow scaled. Only 14.3% of our *Ps. ferox* agreed with this description, whereas the remainder had dark scales on sterna III, IV, V, and/or VI. *Psorophora horrida* was described by Roth (1945) as having only sterna II and III entirely pale scaled. Approximately 60% of our *Ps. horrida* agreed with this description. The remaining 40% also had sterna IV, V, and/or VI entirely pale. We do not recommend the use of the color patterns on the abdominal sterna or the presence or absence of a white knee spot on the forefemur for separating *Ps. ferox* and *Ps. horrida*.

The 2 other members of the *Psorophora* subgenus *Janthinosoma* occurring in most of the southeastern states (Florida has 3) could be confused with *Ps. ferox* and *Ps. horrida* if the females are rubbed or damaged. The first, *Psorophora cyanes-cens* (Coq.), is a stout, heavy-bodied species with yellow-golden scutal scales, dark purple legs without white tarsal markings, and distinctive apical pale markings dorsally on abdominal segments II–VI. The other 3 *Janthinosoma* species have the dorsum of those segments dark purple. *Psorophora cyanes-cens* also has a dense scale patch on the subspiracular area like *Ps. ferox*, but unlike *Ps. horrida* and *Psorophora mathesoni* Belkin and Heinemann. The 2nd species, *Ps. mathesoni*, is extremely similar to *Ps. horrida*, but can be separated from *Ps. ferox* by the 9 characters listed for *Ps. horrida* in Table 1. However, *Ps. mathesoni* only has 3 female characters that will distinguish it from *Ps. horrida*. These are: 1) hindtarsomere 5 is dark scaled, whereas that of *Ps. horrida* is white scaled; 2) the dark median longitudinal stripe on the scutum nearly extends to the scutellum on both sides of the prescutellar area, whereas that of *Ps. horrida* ends some distance from the scutellum in the prescutellar area; and 3) the postspiracular area is without or rarely has several scattered pale scales, whereas that of *Ps. horrida* has a distinct patch of broad pale spatulate scales.

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