Observations of the Head and Tail Regions of Male *Physaloptera praeputialis* von Linstow, 1889, and *Physaloptera rara* Hall and Wigdor, 1918, Using Scanning Electron Microscopy

KENNETH L. TIEKOTTER
Harold W. Manter Laboratory, University of Nebraska State Museum, Lincoln, Nebraska 68588

ABSTRACT: The morphology of *Physaloptera praeputialis* and *Physaloptera rara* have been studied using light microscopy but details of taxonomic characteristics using SEM are limited. Based on observations by von Linstow (1889) and Hall and Wigdor (1918) using light microscopy, primary taxonomic characters for identification of these two species include the number, size, and location of posteroventral papillae. These characters as well as posteroventral microtopography, comparisons of the head and neck regions, and possible preparation artifacts are illustrated using SEM.

Morgan (1947) reviewed the Physalopterinae and listed characters for species determination. In male individuals Morgan considered the number and arrangement of male ventral papillae as well as the shape and length of spicules valid taxonomic characters. Based on the degree of variation within species Morgan (1947) stated the shape of the bursa and bursal markings cannot be used for species determination.

Generic characters for members of the family Physalopteridae (Railliet, 1893) Leiper, 1908 have recently been divided into genera by Chabaud (1975). Based on the keys for family, subfamily, and generic determination (Chabaud, 1975) cervical alae are not present as a generic or specific character. Specific characters for the genus *Physaloptera* (Ortlepp, 1922) do not include cervical alae. However, cervical alae have been reported by previous investigators (Marchiondo and Sawyer, 1978).

The present study was undertaken to (a) differentiate adult and fifth stage immature specimens of *Physaloptera praeputialis* and *Physaloptera rara* solely on the basis of posteroventral characteristics using SEM, (b) determine the validity of posteroventral microtopography as a taxonomic character, and (c) discuss possible artifacts associated with preparation. The head and neck regions are compared. Clarification of a previous report (Marchiondo and Sawyer, 1978) of cervical alae exhibited by *P. rara* is illustrated.

**Materials and Methods**

Seventy-six bobcat (*Lynx rufus*) carcasses were collected from fur-buyers, taxidermists, trappers, and game biologists in Nebraska during the 1977 and 1978 trapping seasons. The carcasses had been frozen and thawed repeatedly between capture and examination. The condition of the worms varied from good to extremely poor. Adult specimens were identified as *Physaloptera praeputialis* and *P. rara*. Fifth-stage individuals were separated on the basis of size and placed in

---

1 Present address: Veterans Administration, Neurology Research 151N, Medical Center, 3710 S.W. U.S. Veterans Hospital Road, Portland, Oregon 97201.

Copyright © 2011, The Helminthological Society of Washington
separate vials. All specimens were fixed in AFA and stored in a mixture of 70% ethanol and glycerine. Specimens prepared for light microscopy were cleared in lactophenol, further cleared in beechwood creosote, and mounted in Canada balsam.

For examination using SEM, the prepuce sheath of adult *P. praeputialis* and the superficial cuticle of immature *P. praeputialis* were removed. This step was not necessary for specimens of *P. rara*. Macrobebris was eliminated with the aid of microforceps. The neck region of both species was surgically removed below the excretory pore. To further eliminate any debris, the neck and tail sections of both species were placed in an ultrasonicator for 5 minutes. They were then dehydrated through 100% ethanol, critical point dried with a Sorvall CO₂ critical point drying system, coated with gold/palladium, and examined with a Cambridge stereoscan SEM at 20 keV.

**Results**

Scanning electron micrographs (Figs. 1–4) illustrate the characteristic microtopographical features of the posteroventral region of adult and immature *P. praeputialis* and *P. rara*. Using light microscopy these taxonomic characters were described by von Linstow (1889) for *P. praeputialis* and Hall and Wigdor (1918) for *P. rara*.

*Physaloptera praeputialis* (Figs. 1, 3) possess four pairs of pedunculated papillae approximately equidistant from each other; two pairs of precloacal and two pairs postcloacal. Because of photographic limitations, not all these papillae are shown in Figure 1. However, these papillae are illustrated on the left ventrolateral side in Figure 3.

Three precloacal sessile papillae are situated in a transverse row, the median one being much larger than the other two; the external surface of the cloaca is divided into two marginal borders, the anterior border being much wider than the posterior border. In Figure 1, a single spicule is seen projecting from the cloacal orifice. Immediately posterior to the cloaca are two pairs of sessile papillae arranged almost transversely; a third pair directly follows; the remaining two pairs of posteroventral papillae are situated approximately between the cloaca and the end of the tail and near the posterior third of the tail. In Figure 3, there is an aberration from the normal number of posteroventral papillae (asterisk). A previous undescribed phasmid (Fig. 1) is situated approximately postero-medially between the third and fourth pairs of posteroventral papillae. Longitudinal ridges are present on either side of the cloaca which extend in a lateral direction supporting the pedunculated papillae. These ridges give rise immediately anteriorly and posteriorly to beadlike projections, bordered by lateral folds, and extend posteriorly to just short of the end of the tail. These beadlike projections are divided from their posterior extremity medially by a narrow strip of tegument, without ornamentation, and extend anteromedially to a thin line just below the third pair of posteroventral papillae. The beadlike projections surround the anterior portion of the precloacal papillae and the posterolateral margins of the two outer precloacal papillae. The large medial precloacal papilla is surrounded by its anterolateral margin while the inner margin touches the anterior marginal border of the cloaca. *Physaloptera rara* (Figs. 2, 4) possess four pairs of pedunculated papillae approximately equidistant from each other; two pairs are precloacal, and
Figures 1, 2. Scanning electron photomicrographs of the posteroventral region of adult and immature specimens of Physaloptera praepudialis and P. rara. 1. Adult P. praepudialis illustrating posteroventral taxonomic characters and microtopography; precloacal papillae, arrow (pcp); pedunculated papillae (pp); spicule extending from the cloacal orifice (sp); postcloacal papillae, arrow (post c p); three pairs of posteroventral papillae, arrows (pvp); a single previously undescribed phasmid (ph); and the characteristic microtopography. ×120. 2. Adult P. rara illustrating posteroventral taxonomic characters and microtopography; three precloacal papillae (pcp); four pairs of pedunculated papillae, arrows (pp); two pairs of postcloacal papillae, arrow (post c p); three pairs of posteroventral papillae (pvp); and one pair of phasmids, arrow (ph). ×210.
two pairs are postcloacal; three precloacal sessile papillae of equal size are arranged in a triangular row, the middle one being slightly closer to the cloacal region; the external surface of the cloaca is not divided as in *P. praeputialis*; a wide posterior marginal border is present but partly as an artifact due to critical point drying. In Figure 4, a single spicule is seen projecting from the cloacal orifice. Posterior to the cloaca (Fig. 2) are five pairs of sessile papillae and one pair of phasmids; the first two pairs are situated in a transverse row, the third and fourth pair equidistant from each other; one pair of phasmids is situated directly behind the fourth pair of sessile papillae. The fifth pair of papillae are approximately one fourth the distance from the end of the tail to the fourth pair of sessile papillae. Longitudinal rows of elongated projections extend from the anterior portion of the bursa, posteriorly to the fifth pair of sessile papillae. From the postcloacal papillae to just short of the fifth pair of sessile papillae, there is a strip of beadlike projections, tapered at either end, and limited to the inner margins between the third and fourth pair of sessile papillae. The lateral margins posterior to the bursa and the posterior third of the tail exhibit no ornamentation.

To differentiate *P. praeputialis* from *P. rara* on the basis of externolateral and internolateral teeth, several specimens of both species were examined using SEM (Figs. 7–10). There is a slight difference between the height of the single externolateral and the three internolateral teeth of *P. praeputialis* and *P. rara*. This minor difference is not large enough to support the use of this structure as a valid taxonomic character (Morgan, 1947).

Two porelike openings located below two of the three internolateral teeth (Marchiondo and Sawyer, 1978) were not discernible in either *P. praeputialis* or *P. rara* (Figs. 7–10). Spherical-shaped amphids located behind the large externolateral tooth and medial to the papillae (Marchiondo and Sawyer, 1978) were observed in the same location of *P. praeputialis* and *P. rara* (Figs. 7–10). The papillae on each pseudolabia are dome-shaped (Marchiondo and Sawyer, 1978) and exhibit the same arrangement as described by previous investigators. The neck region of *P. praeputialis* and *P. rara* exhibit the typical cylindrical shape (Figs. 5, 6). Some folding (Fig. 6) is present as an artifact due to critical point drying. The location of the excretory pore (Figs. 5, 6) shows no great differences and is of little taxonomic significance (Morgan, 1947).

**Discussion**

Ortlepp (1922) stated that the arrangement of the caudal papillae of *P. praeputialis* differed considerably from those reported by von Linstow, 1889. Von Linstow (1889) stated that the arrangement of caudal papillae present on *P. praeputialis* may be different than he reported. He (1889) had only one male for examination, which was difficult to study. According to von Linstow, there are three pre-anal papillae; one immediately behind the anus; three papillae toward the tail; and an additional pair slightly in front of these three.

Morgan (1947) lists the number and arrangement of male ventral papillae as well as shape and length of the spicules as valid taxonomic characters. He (1947) rejected certain taxonomic characters because of the wide variation found within species. Among the characters listed are the posterior sheath, size and height of teeth, position of the excretory pore and cervical papillae, shape of bursa and bursal markings.
However, upon examination of several hundred adult male *P. praeputialis* and *P. rara*, the prepuce sheath and shape of the bursa can be used for gross separation of *P. praeputialis* from *P. rara*. Aside from the number of posteroventral papillae, microtopography (bursal markings) can be used to differentiate these two species (Figs. 1–4). Posteroventral characters must be used to differentiate immature male individuals. The present study shows that in immature specimens of *P. praeputialis*, the rudimentary posteroventral papillae, which under light microscopy are difficult to differentiate, exhibit the same arrangement as in adult *P. praeputialis* (Figs. 1, 3). In Figure 3, there is an aberration from the normal number of posteroventral papillae in *P. praeputialis*. Out of a total of 484 specimens of *P. praeputialis* only five or approximately 1% of the immature individuals were found to exhibit an extra pair of papillae. In immature specimens of *P. rara* (Fig. 4) the posteroventral papillae exhibit the same arrangement as found in adult *P. rara* (Fig. 2).

As stated earlier, cervical alae are not characteristic of members of the family Physalopteridae. However, Marchiondo and Sawyer (1978) describe the antero- lateral neck region of *Physaloptera felidis (=*P. rara*, Morgan, 1946) as possessing four cervical alae forming a rectangular collarette when observed with SEM. In the present study, no cervical alae were observed on either *P. praeputialis* or *P. rara* (Figs. 5, 6). Differences in preparation for light microscopy as well as for SEM can lead to considerable variation in structural morphology and characters used in taxonomy. Variations in the cuticular region of the pseudolabia and the collapse of the neck region are considered artifacts caused during fixation, dehydration, and critical point drying (Figs. 6–10).

Primary taxonomic characters for identification of physalopteran males are the number, size, and location of posteroventral papillae and posteroventral microtopography. These characters, unlike the size and height of externolateral and internolateral teeth, the presence or absence of a posterior prepuce sheath in immature forms or cephalic collarette, remain constant during preparation for examination and throughout developmental and adult stages. Known generic and specific characters within a given genus, which are described using light microscopy, should be examined closely before an investigator can differentiate taxo-

---

Figures 3–10. Scanning electron photomicrographs of *Physaloptera praeputialis* and *P. rara*. Figures 3–4. Posteroventral region. Figures 5–6. Head and neck regions. Figures 7–10. Head region of *P. praeputialis* and *P. rara* mounted en face. ×600. 3. Immature specimen of *P. praeputialis* showing: two of four pairs of pedunculated papillae, arrows (pp), one pair precloacal and one pair postcloacal; three precloacal papillae, arrow (pcp); two pairs of postcloacal papillae, arrows (post cp); three pairs of posteroventral papillae, arrows (pvp); and characteristic microtopography. An aberration marked by asterisk (*) is also illustrated. ×200. 4. Immature specimen of *P. rara* showing posteroventral region and microtopography as described in Figure 2 with addition of a spicule extending from the cloacal orifice. ×250. 5. *P. praeputialis* illustrating cylindrical shape with location of the excretory pore (ep). ×135. 6. *P. rara* illustrating cylindrical shape with collapse near the head region which is an artifact of preparation; location of excretory pore (ep). ×120. 7. Angular view of head region of *P. praeputialis*. 8. Same specimen en face view illustrating cervical papillae (cp), amphid (am), externolateral tooth (elt), and internolateral teeth (ilt). 9. En face view of *P. rara* illustrating the characters described in Figure 8. 10. Same specimen of *P. rara* at different angle.
nominal characters from artifacts which may alter these characters or specimen’s appearance (Tiekotter, 1980).

Acknowledgments

The author wishes to express his appreciation to Ms. Carol Epperson Mahan for furnishing the bobcat carcasses for helminth examination and aid in necropsy, and to Professor Mary Hanson Pritchard for advice during the preparation of this paper.

Literature Cited


