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Attribute of spermatheca as an authentic taxonomic tool in closely related species of predaceous Asopine bugs (Suborder: Heteroptera)

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Abstract
External genitalia is considered as one of the most stable and reliable diagnostic character to identify a species and to separate the closely related species. In the present paper, spermatheca, a part of female genitalia has been chosen to illustrate its taxonomic significance. The variations in the shape of the structure, number of additional processes in spermathecal bulb, length of proximal and distal spermathecal duct etc. enable us to differentiate more closely allied species within a given taxon.

Keywords: spermatheca, female, asopine, taxonomy

1. Introduction
Order Hemiptera is the most diverse group of exopterygote insects with respect to the wide variety of their biological and morphological characters. They are adapted to a broad range of habitats - terrestrial, aquatic and semi-aquatic, and are capable of exploiting variety of food sources ranging from being exclusively phytophagous damaging fruits, seeds, leaves to voracious predators feeding upon coleopteran and lepidopteran larvae. Asopine group under this order are exclusively predatory bugs. When compared to allied phytophagous groups such as pentatomine and podopine members, they show distinct feeding behavior with respect to varied structure and function of piercing and sucking type of mouthparts. Members of subfamily Asopinae are secondarily predacious feeding upon number of insects, preferentially lepidopteran and coleopteran larvae. Their role as important biological control agents has been exploited in the field e.g. *Perillus bioculatus* (Fabricius), which feeds specifically on Colorado potato beetle (*Leptinotarsa decemlineata* Say). Morphological approach in taxonomy generally involves identification of distinct visible characters of the insect followed by the preparation of dichotomous keys to the subfamilies, genera and species. External genitalia is considered as one of the most stable and reliable diagnostic character to identify a species and to separate the closely related species. Further, structure of the external genitalia of both the sexes has often been considered to be a very reliable taxonomic tool for authentication of the specific identification. In the present paper, spermatheca, a part of female genitalia has been chosen to illustrate its taxonomic significance. The variations in the shapes of the structures, number of additional processes in spermathecal bulb, lengths of proximal and distal spermathecal ducts etc. enable us to differentiate more closely allied species within a given taxon.

2. Materials and Methods
The collection of Asopine bugs was done by conducting extensive and intensive collection-cum-survey tours to cover maximum far flung localities of Northern India. After collection, the captured specimens were killed in killing jars prepared by pouring few drops of ethyl acetate on the cotton. For preparing the slides of external genitalia, a gentle upward push was applied to detach the entire abdomen off the insect body so that the rest of part remains undamaged. In case of female genitalia, the abdomen was potashed in 10% KOH and boiled for 5-10 minutes on a gas burner. In this case, the potashed sclerites were removed, washed with water without disturbing the terminal segment that represents genital plate and spermatheca was exposed. The genital plate was then upgraded in various grades of alcohol and finally cleared and preserved in clove oil. The spermatheca was stored in 70% alcohol. The procedure and nomenclature for female genitalia was adopted[10]. The preserved external female genitalic structures were then photographed with the help of image processing unit installed in DRS laboratory of Department of Zoology and Environmental Sciences, Punjabi University, Patiala.

3. Observations
***Perillus bioculatus* (Fabricius)**
[5] *Cimex bioculatus,* Fabricius (1775) *Syst. Ent*., p. 715.
[9] *Perriloides bioculatus,* Schouteden (1907) *Genera Insectorum Fasc.,* 52: p. 37.
[8] *Perillus bioculatus*: Knight (1952) *Ann. Entomol. Soc. Am.*, 45: p. 229.
It is commonly known as a two spotted stink bug. This species shows distinct colour polymorphism ranging from red, yellow, white and black. Studies have proved that the food of this bug consists of the eggs and larvae of the potato beetle as well as the adult beetle itself, which is responsible for its colour variations. Carotin has also been proved to be one of the reasons for the red and yellow color patterns in the hypodermis of this stink-bug.

Distribution: Czechoslovakia; France; Germany; Russia; Yugoslavia; India (Punjab, Himachal Pradesh).

Structure of Spermatheca: Spermatheca (Fig. 1) is with distinct distal and proximal flanges; its pump region is membranous and short; spermathecal bulb is longer than broad, somewhat rectangular in shape with subrounded margins; proximal spermathecal duct is 2X longer than distal spermathecal duct.

***Picromerus obtusus* (Walker)**

[13] *Picromerus obtusus*, Walker (1867) *Cat. Het.*, 1: p. 133.
[4] *Picromerus obtusus:* Distant (1902) *Faun. Brit. Ind. Rh.*, 1: p. 252.

Picromerus obusus (Walker) has been reported as a minor pest of *Mangifera indica* from Uttar Pradesh, India and is usually found on *Lantana camara* (Navratan Plant). It is characterized by having a pair of sclerotized penial lobes that are basally fused as U-shaped structure.

Distribution: India (Himachal Pradesh, Sikkim, Uttar Pradesh, Nagaland).

Structure of Spermatheca: Spermatheca (Fig. 2) is with distinct proximal and distal flanges; the pump region is narrow, tube like, slightly broad at the proximal end, and is also subequal to distal proximal duct; spermathecal bulb is oblong and well defined; proximal spermathecal duct is distinctly longer than its distal spermathecal duct.

***Andrallus spinidens* (Fabricius)**

[6] *Cimex spinidens*, Fabricius (1787) *Mant. Inst.*, 2: p. 285.
[3] *Picromerus spinidens*, Dallas (1851) *List Hem.*, 1: p. 95.
[11] *Audinetia spinidens*, Stål (1868) *Hem. Fabr.*, 7(11): p. 16.
[1] *Andrallus spinidens:* Bergroth (1906) *Ann. Soc. Ent. Belg.*, 49: p. 370.

This species has been recorded as a serious pest of rice in the Kangra Valley of Himachal Pradesh. Its nymphs and adults are known to feed on some lepidopteran larvae of *Pelopidas mathias* (F.), *Melanitis leda ismene* (Cram.), *Spodoptera litura* (F.), *S. mauritia* (Boisd.), *Eurema hecabe* (L.) (Terias hecabe) and *Mythimna separata* (Wlk.) in rice fields. Its other food plants include *Medicago sativum* and *Triticum vulgare*.

Distribution: China; Taiwan; Japan; Phillipines; Sumatra; Indonesia; Indonesia; Vietnam; Borneo; New Guinea, Bangladesh; Fiji; Tahiti; Russia; Azerbaijan; Turkey; Iran; Syria; Ethiopia; Equatorial Guinea; Malawi; South Africa; Mozambique; Sudan; Zaire; Madagascar; Malaysia; Australia; North America; India (Punjab, Himachal Pradesh, Haryana).

Structure of Spermatheca: Spermatheca (Fig. 3) with indistinct distal and proximal flanges; pump region is distinctly short and subequal to distal spermathecal duct; bulb is elongated and egg shaped; medial dilation is balloon like; posterior spermathecal duct is distinctly longer than the distal spermathecal duct.

***Eocanthecona furcellata* (Wolff)**

[14] *Cimex furcellatus*, Wolff (1801*) Icones Cimicum descriptionibus illustratae Erlangae*, 5: p. 176.
[7] *Asopus armiger*, Herr.-Schaff. (1844) *Wanz. Ins.*, 7: pp. 113 & 119.
[3] *Canthecona furcellata*, Dallas (1851) *List Hem.*, 1: p. 91.
[9] *Cantheconidea furcellata*, Schouteden (1907) *Genera Insectorum Fasc.*, 52: p. 45.
[2] *Eocanthecona furcellata:* Bergroth (1915) *Ann. Mag. Nat. Hist.*, 8(15): p. 484.

Eocanthecona furcellata has been used as biological control agent for control of several lepidopterous caterpillar pests, throughout the growing season of cotton in various countries. It has also been useful as a predator of the introduced *Parthenium Zygogramma bichlorata* (Pallister) (Coleoptera: Chrysomelidae), an exotic beetle introduced in India for biological suppression of *Parthenium hysterophorus* Linnaeus. It has also been reported as a minor pest of mulberry tree in Formosa.

Distribution: Phillipines; Sri Lanka; Myanmar; Indonesia; Molucca Island; Caroline Island (Palau); Bangladesh; Taiwan; China; Japan; Thialand; Pakistan; India (Punjab, Himachal Pradesh, Uttarakhand, Jammu and Kashmir, Paschim Banga, Jharkhand, Maharashtra, Tamil Nadu, Andhra Pradesh).

Structure of Spermatheca: Spermatheca (Fig. 4) with distinct distal and proximal flanges; the pump region is distinctly short and tube like, subequal to distal spermathecal duct; the bulb is elongated; medial dilation is balloon like; posterior spermathecal duct is distinctly longer than the distal spermathecal duct.

SPERMATHECAE OF ASOPINE BUGS

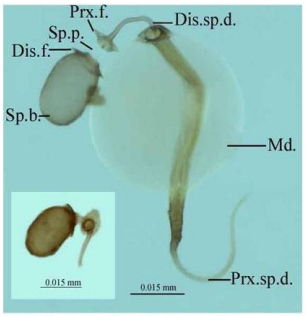

Fig. 1 *Perillus bioculatus* (Fabricius)

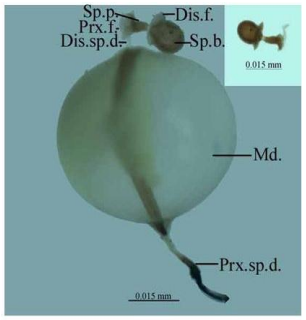

Fig. 2 *Picromerus obtusus* (Walker)

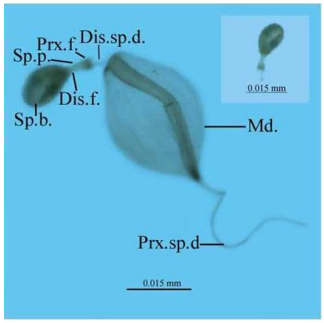

Fig. 3 *Andrallus spinidens* (Fabricius)

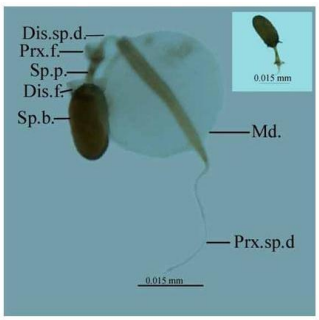

Fig .4 *Eocanthecona furcellata* (Wolff)

4. Abbreviations used

Sp. b. - Spermathecal bulb; Dis. f. - Distal flange; Prx. f. - Proximal flange; Dis. sp. d. - Distal spermathecal duct; Prx. sp. d. - Proximal spermathecal duct; Md. - Median dilation; Sp. p. - Spermathecal pump

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