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Morphological Study of Female Genetalia Organs of Indian Back Swimmer Insulata Kirby (Heteroptera: Notonectidae)

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Abstract
The present study provides a detailed morphological investigation of the female genital organs of the Indian back swimmer Insulata kirby (Heteroptera: Notonectidae). The research focuses on analysing the structure, arrangement, and functional significance of various components of the reproductive system, including the ovipositor, spermatheca, genital plates, and associated sclerites. Using standard dissection and microscopic techniques, the study highlights key diagnostic characters that differentiate Insulata kirby from other notonectid species such as Anisops sardea. The comparative assessment contributes to a clearer understanding of species-level taxonomy, reproductive adaptation, and evolutionary relationships within the family Notonectidae. The findings hold importance for insect systematics, reproductive biology, and ecological studies, as accurate identification of genital structures supports both biodiversity assessment and future phylogenetic research.

Keywords: female genitalia, Insulata kirby, Notonectidae, morphology, taxonomy.

Introduction

Economically the back swimmer, Notoneciden Anisops Sardea, is of great importance to the human being as they destroy the eff of fishs of water tanks. They have also been observed to destroy the eggs larva pupae and the adults of Anapheles Culex and Ades mosquitoes, are predated by them and thus keep a check on Population of such greatly harmful mosquitoes.

Hemiptera comprises bug, cicads, leafhopper, Scale insect etc it is divided into I Heteroptera, Which includes stink and shield bugs, assassin bugs, lace bug, bed bug and many families of water bug: and II

Aquatic hemipteran insects are of variable size from minute 1.5 mm. to large 110 mm. living mainlyin the lentic and lotic fresh water Some even live in brackish water, only one or two species are marine. The back swimmer, Anisops Sarder is very voracious and feed's upon aquatic insects which fall into water. They have also been observed to feed upon the ova of the fishes. At Time several insects collectively capture and feed if the prey isto large for one bug. They Capture and Kill the prey by pierching with their rostrum, Sometime they have been found to eat the dead as well.

The Indian back swimmer, Notonectr Anisops. Sarder are found in fresh water and brackish water. They are admirably fitted in form in Structure fora subqueous life. They are attached to aquatic plant and objects beneath the Surface of water. The adults fly readily and are often not

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only annoying because of their presenle around light but even invade open air, Swimming Poolsand freely bite the bathers.

These bug's sweep all sports of organic ooze, including both animal and plat matter. They also break the cell wall and extract the contents of spirogyra and other water plants

Significance of Studying Female Genitalia

The study of female genitalia in insects, including the Indian back swimmer Insulata kirby, holds profound significance in morphological, anatomical, and evolutionary research because these structures provide some of the most stable and species-specific characters for scientific analysis. In aquatic Hemiptera, genital structures are often internal, highly modified, and adapted to the ecological conditions in which reproduction occurs, making them an essential source of diagnostic information. Female genitalia, particularly components such as the ovipositor, spermatheca, accessory glands, and genital plates, reveal patterns of reproductive strategies, egg-laying adaptations, and mating behaviours, all of which contribute to a deeper understanding of species biology. Since many notonectid insects exhibit subtle external similarities, internal genital structures become crucial for accurate species identification, helping researchers differentiate closely related taxa that might otherwise appear identical. Moreover, the morphology of female reproductive organs often reflects evolutionary pressures such as sexual selection, habitat preference, and reproductive isolation, offering insights into the evolutionary pathways that shaped the diversity within the family Notonectidae. Understanding these structures also aids in ecological studies, as reproductive anatomy influences population dynamics, fecundity, and species distribution. In applied sciences, the accurate identification of aquatic insects is important for biomonitoring, water quality assessments, and ecological modelling; therefore, genital morphology contributes indirectly to environmental studies. Overall, the significance of studying female genitalia extends beyond taxonomy to include evolution, ecology, physiology, and conservation biology, making it a fundamental aspect of entomological research.

Taxonomic Relevance of Insulata Kirby

The taxonomic relevance of Insulata kirby, an important species of the family Notonectidae, lies in the species' distinct morphological features—particularly its female genitalia—that help researchers resolve classification challenges within aquatic Hemiptera. Many species of back swimmers share similar external structures such as body shape, coloration, and swimming adaptations, making external morphological traits insufficient for precise identification. In this context, female genitalia of Insulata kirby provide highly diagnostic, stable, and evolutionarily conserved characteristics that serve as reliable indicators in systematic and phylogenetic studies. Detailed examination of structures like the ovipositor, spermathecal complex, sclerotized plates, and genital chamber architecture helps distinguish Insulata kirby from morphologically similar species such as Anisops sardea and other notonectids. These differences play a key role in understanding species boundaries, evolutionary relationships, and adaptive divergence within the group. Taxonomic clarity is crucial because aquatic insects often serve as indicators of ecosystem health, and misidentification can affect ecological assessment and biodiversity records. Furthermore, accurate taxonomy is essential for

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constructing identification keys, revising classification systems, and supporting molecular studies that rely on verified morphological data. The genital structures of Insulata kirby also contribute to tracing evolutionary trends such as mating system evolution, reproductive isolation mechanisms, and habitat-driven morphological specializations. By documenting and describing these structures in detail, researchers strengthen the foundation for comparative morphology and future biological research. Thus, the taxonomic relevance of Insulata kirby is rooted in its capacity to provide clear, consistent genital characters that enhance species identification, support phylogenetic frameworks, and improve the overall understanding of diversity within the Notonectidae family.

Materials And Methods

The Indian back swimmer, Notonecta anisops sardea collected from the various pond at Kanpur. They are usually found in groups and were easily collected with the help of aquitic net. The female genetalia were overted by sub merging the bugs in 0.5% KOH Solution and applying gentle pressure to the posterior part of abdomen with the help of a forcep. Genitalia were also examined in situ in living back summer. The measurement was made by using the eye piece micrometer.

Results And Discussion

The female genitalia: The ovipositor in back swimmer, Notonecta Anisops Sardea consists of a shaft and a basal apparatus. The shaft consists of three pairs of closely appresssed elongated processes, the valvulae. The first valvulae (VI) is ventral to the second and devided into two lobes, and outer along apically rounded outer lobe (OLV_1) and a short inner lobe (INV_1). The first valvulae are directly attached with the first valvifer (VF1) which is a broad sclerite behind the seventh sternite. The second valvulae (V_2) are lobate apically and extend much beyond the apical margin of the inter valvular membrane. The third valvulae (V3) are elongate, narrow, pointed apically and attached with the basal part of the second valvifer (VF2). The vulva (VU) is located in between the inner lobes of first valvulae (INV_1). The second valvifers (VF2) are thick sclerites situated a little behind the first valvifer of the eighth abdominal segment.

IXABSE	=	Ninth abdominal segment
XABSE	=	Tenth abdominal segment
APPL	=	Apical plate
APSEN	=	Apical sclerotized partg of endosoma
INV1	=	Inner lobe of first valvula
OLV	=	Outer lobe of first valvula
V2	=	Second valvula
V	=	Third valvula
VF1	=	First valvifer
VF2	=	Second valvifer
VU	=	Valvula

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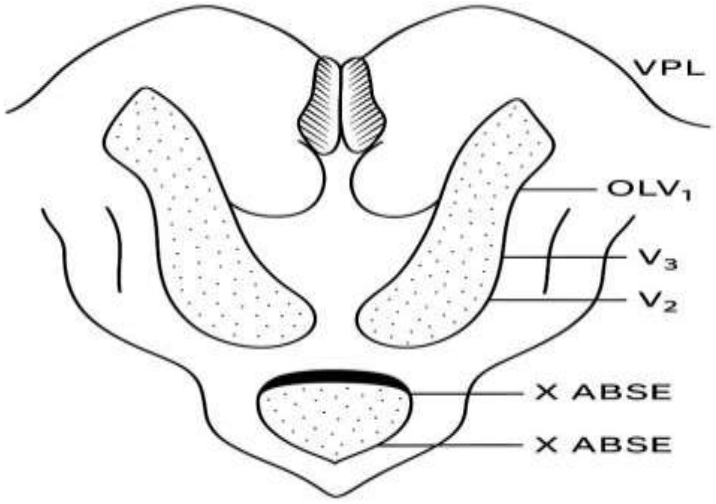

Fig.1: External genitalia (female) lateral view

Conclusion

The present morphological study of the female genital organs of the Indian back swimmer Insulata kirby (Heteroptera: Notonectidae) contributes significantly to understanding the species' reproductive anatomy, taxonomic position, and evolutionary adaptations. Detailed examination of internal and external genital structures—including the ovipositor, spermatheca, sclerotized plates, and associated reproductive tissues—revealed a set of stable and diagnostic characters essential for precise species identification. These findings highlight the crucial role of female genital morphology in distinguishing Insulata kirby from closely related notonectid insects such as Anisops sardea, where external features often overlap and create taxonomic ambiguity. The structural variations observed reflect adaptations to aquatic habitats, reproductive strategy, and mating behaviour, thereby offering insights into the evolutionary pressures shaping genital specialization within the family Notonectidae.

The study strengthens the taxonomic framework by providing clear morphological markers that can support future systematic revisions and aid in constructing improved identification keys for aquatic Hemiptera. Additionally, the research underscores the ecological and biological importance of reproductive structures, as genital morphology influences fecundity, species distribution, and overall population dynamics. By documenting and analysing the female genitalia of Insulata kirby, this work lays a foundation for further comparative studies, molecular correlations, and ecological investigations. Overall, the study enhances scientific understanding of notonectid diversity and contributes valuable knowledge to entomology, taxonomy, and aquatic insect research.

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