International Journal of Engineering, Science and Humanities
An international peer reviewed, refereed, open-access journal
Impact Factor 8.3 www.ijesh.com ISSN: 2250-3552

Description of Digestive Tract of Anisops Sardea Herr schaff Indian Back Swimmer

Nidhi Singh
Research Scholar, Department of Zoology, Maharaja Agrasen Himalayan Garhwal University, Uttarakhand
Dr. Sachin Choudhary
Associate Professor, Department of Zoology, Maharaja Agrasen Himalayan Garhwal University, Uttarakhand

Abstract
The back swimmer, Anisops sardea Herr-Schäffer (Notonectidae), was collected for morphological and bioecological investigation from July to November from various ponds, ditches, and canals in Kanpur and surrounding regions. The species is easily identifiable by its oblong, convex body; large compound eyes; short four-jointed antennae; four-segmented rostrum; and distinct triangular scutellum. Additional diagnostic traits include anterior legs inserted near the posterior margin of the pronotum, a moderately long pronotum, the last antennal segment being much shorter than the preceding one, and posterior tarsi lacking unguiculi. These insects, commonly known as water boatmen or back swimmers, swim on their backs using long, oar-like hind legs. Highly predaceous in nature, they inhabit the margins of freshwater bodies such as ponds, lakes, and streams throughout India and can be easily collected using a net. In the present study, a detailed description of the digestive tract of this species has been documented, highlighting its structural organization and functional significance in relation to its predatory habits.

Keywords: Anisops sardea, digestive tract, morphology, Notonectidae, aquatic insects

Introduction

Notonecta Anisops Sardea Herr schaff is the most commonly distributed insects of family Notonectidae Leach (1815) in India. Theseare most interesting and Fascinating of all aquatic hemiptera of tropics and subtropics and are commonly known as back-swimmers as they swimontheirbackswithlongoarlikehindlegs.Thesearemediumsized,about15to18 mm. long aquatic insects and are at once distinguished from the all other water bugs, When seen in the water because they swim "Up side down" i.e. their backs. The body is linear, developed wide posteriorly: wings well developed. Hemelytra with corium and clavus well defined, membrane short without anal vein. Fore legs relatively short and raptorial. Middle legs somewhat shorter and used for killing the prey. Hind legs very long, oar like with swimming

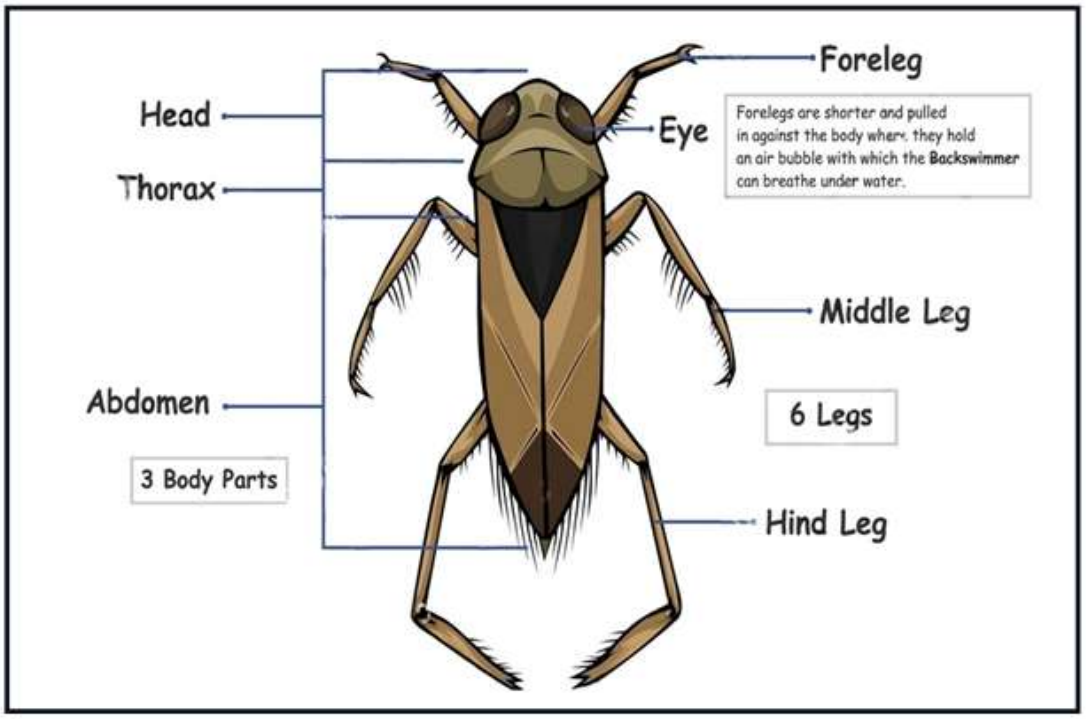
International Journal of Engineering, Science and Humanities
An international peer reviewed, refereed, open-access journal
Impact Factor 8.3 www.ijesh.com ISSN: 2250-3552

hair,extended towardsthe head when atrest,withoutclaws.Firsttarsal segment on fore legs so small that it is often over looked. Scutellum, well developed. Abdomen with medium keel, and carry air for respiration under the water. Back swimmer.

The mandidular plate is well separted from the maxillary plate by a transverse suture. The basal margin of the mandibnular plate possess a mush elongate, subtriangular lever which is connected with the mandibular stylet. The mandibular stylets (MNST) are a pair of needle like structeures found and on each side. Each stylet is thick at its base and is provided with a flat triangular plate like lever. Each mandibular stylet (MNST) is rectangularly curved at its base behind the basal margin of the lever for the attachment of the muscles. The tips of the mandibular stylets resemble cart screw and are acutely pointed.

Photograph of back swimmer in water

International Journal of Engineering, Science and Humanities
An international peer reviewed, refereed, open-access journal
Impact Factor 8.3 www.ijesh.com ISSN: 2250-3552



The pyloric valve is fold like projection of the wall of the mesenteron into the proctodaeum at the junction of fourth ventriculus and intestine. The wall of this valve is composed of layar of tall columnar epithelial cells which resembles the cell of fouth ventriculus. There is no lining of chitinousintima.

A similar differentiation of the hind gut into two regions has been reported in several heteropterous species. However, there has been some differentiation of opinion concening the identity of the two regions. In certain species viz, Anasa tristis (Breakey 1936). The posterior part of the hind-gut has been termed as rectal sac. The fact that in Notonecta the anterio region of the hind gut is lined with chitinous intima behind the fact that valvula fold lined with intima is present in between the anterior and posterior regions shows that is the rectal valve often present in the insect between the intestine and rectum (Snodgrass, 1935). On this basis the anterior region of the hind gut should be recognized as intestine and not pylorus, which in Notonecta is shortened. The valvular fold at the front end of the intestine, immediately in front of the opening of the maplighianampulla, is evidently the pyloric valve comparable toa similar valve in Anasa tristis (Breakey, 1936) in structure and position. Since it is composed of cells similar to those of the fourth ventriculus and is not lined by any intima, itis ventriculus and not proctodeal in orgin.

International Journal of Engineering, Science and Humanities
An international peer reviewed, refereed, open-access journal
Impact Factor 8.3 www.ijesh.com ISSN: 2250-3552

Overview of Notonectidae Family

The family Notonectidae, commonly known as back swimmers, represents an ecologically important group of aquatic Hemiptera widely distributed across freshwater habitats such as ponds, lakes, slow-moving streams, and temporary water bodies. Members of this family are characterized by their unique behavioural habit of swimming upside down, aided by elongated, oar-like hind legs covered with swimming hairs that provide excellent propulsion. Their dorsoventrally convex body enables them to maintain buoyancy and move efficiently on the underside of the water surface. Notonectids are predatory insects that feed on a wide range of small aquatic organisms, including insect larvae, crustaceans, tadpoles, and sometimes even small fish fry, making them key biological control agents within freshwater ecosystems. They possess piercing–sucking mouthparts adapted for predation, through which they inject digestive enzymes to immobilize prey and subsequently suck out liquefied tissues. The family includes several genera such as Notonecta, Anisops, Enithares, and Nychia, each showing distinct behavioural and morphological traits. Notonectids also exhibit specialized respiratory adaptations; they carry a film of air on their ventral side and trap air beneath the wings, enabling repeated dives and prolonged underwater activity. Their ecological significance extends beyond predation, as they play a role in nutrient cycling, trophic interactions, and maintaining freshwater community balance. Due to their sensitivity to water quality, notonectids are often used in ecological assessments and biomonitoring programs. Furthermore, their morphological structures—especially the genitalia, digestive system, and respiratory adaptations—are widely studied for taxonomic and evolutionary insights. Thus, the family Notonectidae serves as an important group for understanding aquatic insect biology, ecological dynamics, and morphological diversity.

Importance of Digestive System Studies in Aquatic Insects

The study of the digestive system in aquatic insects is crucial for understanding their feeding biology, ecological roles, evolutionary adaptations, and physiological mechanisms. Since aquatic insects occupy a wide range of trophic levels—from herbivores and detritivores to predators like Anisops sardea—their digestive tract structure directly reflects their dietary habits and ecological niche. In predatory insects, the digestive tract is typically adapted for rapid enzymatic breakdown of protein-rich prey, involving specialized foregut musculature, well-developed midgut regions, and efficient absorption surfaces. Examining these structures helps researchers interpret how feeding behaviour influences morphology and how digestive physiology has evolved in response to aquatic environments. Studies of digestive anatomy also contribute to taxonomy, as variations in midgut caeca, hindgut segmentation, and associated glands often serve as important distinguishing features among closely related species. Understanding digestive processes further sheds light on energy flow within freshwater ecosystems, as these insects play significant roles in

International Journal of Engineering, Science and Humanities
An international peer reviewed, refereed, open-access journal
Impact Factor 8.3 www.ijesh.com ISSN: 2250-3552

controlling populations of other organisms and recycling nutrients. In applied studies, knowledge of digestive mechanisms assists in evaluating the ecological impact of pollutants, pesticides, and water quality changes, since digestive tissues are often highly sensitive to environmental stress. In addition, digestive system morphology provides insights into the behavioural ecology of aquatic insects, such as prey selection, feeding efficiency, and competition. For species like Anisops sardea, detailed digestive tract studies enhance understanding of predatory efficiency, metabolic adaptations, and survival strategies in diverse aquatic habitats. Overall, research on the digestive systems of aquatic insects contributes to taxonomy, physiology, ecology, environmental monitoring, and evolutionary biology, making it an essential component of freshwater insect studies.

Research Problem

Despite the ecological importance of aquatic Hemiptera, especially members of the family Notonectidae, detailed anatomical studies on their internal systems remain limited, particularly in Indian species such as Anisops sardea Herr-Schäffer. While the external morphology and behavioural ecology of notonectids have been widely documented, internal organ systems—especially the digestive tract—have not received proportionate scientific attention. The digestive system plays a pivotal role in understanding feeding adaptations, nutrient absorption, energy allocation, and predatory efficiency. However, the structural organization of the foregut, midgut, hindgut, and associated glands of Anisops sardea remains poorly described, leading to gaps in knowledge regarding its functional morphology and evolutionary adaptations. Furthermore, taxonomic identification within Notonectidae can be challenging because many species show overlapping external characteristics. Internal anatomical structures, particularly the digestive tract, could provide additional diagnostic features, yet such traits have not been comprehensively explored for A. sardea. The lack of detailed anatomical documentation also affects ecological and biomonitoring studies, as digestive morphology is closely linked with habitat preference, prey selection, and responses to environmental stressors. Therefore, the research problem centers on the need for a thorough morphological description and functional interpretation of the digestive tract of Anisops sardea, aimed at filling the existing knowledge gap and contributing to taxonomy, physiology, and aquatic insect biology.

Conclusion

The present study offers a detailed morphological account of the digestive tract of Anisops sardea Herr-Schäffer, contributing valuable insights into its structural organization, functional adaptations, and taxonomic significance. The foregut, midgut, and hindgut structures reveal characteristic features consistent with predatory aquatic insects, such as a well-developed pharynx, elongated midgut regions facilitating digestion of protein-rich prey, and specialized hindgut segments supporting efficient nutrient absorption and waste elimination. These

International Journal of Engineering, Science and Humanities
An international peer reviewed, refereed, open-access journal
Impact Factor 8.3 www.ijesh.com ISSN: 2250-3552

anatomical observations help clarify how A. sardea successfully occupies its ecological niche as an active predator in freshwater ecosystems. The findings also highlight the potential taxonomic utility of digestive tract morphology, as structural variations observed in different gut regions may serve as supplementary diagnostic features for distinguishing A. sardea from other notonectid species. By documenting these abdominal and internal features, the research bridges an important gap in the existing literature, where internal anatomy of Indian Notonectidae remains largely understudied. Additionally, the study underscores the ecological relevance of digestive adaptations in understanding prey interactions, feeding efficiency, and habitat-related physiological responses. The morphological details generated here can further support future comparative studies, evolutionary analyses, and ecological assessments. Overall, the research enhances foundational knowledge of notonectid biology and emphasizes the importance of internal anatomical studies in strengthening taxonomy, systematics, and aquatic insect research.

References

1. General Entomology - digestive and Excretory system". NC state University. Retrieved 2009-05-03
2. Aagaard, K, & Dolmen, D. 2006. Bilogisk mangfold I dammer I sor-Trondelag 2003 og 2004. NTNU Vitenskapsmuseet Zoologisk Notat 2006 4, 1-32.
3. Anand AN, Lorenz MW. 2008. Age-dependent changes of fat body stores and the regulation of fat body lipid synthesis and mobillisation by adipokinetic hormone in the last larval instar of the
4. cricket, Gryllus bimaculatus.J Insect physiol 54:1404-12.
5. Boglawlensky,K.S. 1925. Digestive system of Notonectidae. Rev. Zool. Russe.5,8-31.
6. Andersen, N. M., & Weir, T. A. (2004). Australian water bugs: Their biology and identification (Hemiptera-Heteroptera). Apollo Books.
7. Baptista, A. R., & Nascimento, A. R. (2018). Morphological adaptations of predatory aquatic Hemiptera: A review of feeding structures and digestive mechanisms. Aquatic Insects, 39(3), 213–228.
8. Díaz, J. A., & González, R. (2012). Comparative anatomy of the digestive system in selected Notonectidae species. Journal of Morphology, 273(4), 402–412.
9. Hebsgaard, M. B., Andersen, N. M., & Damgaard, J. (2004). Phylogeny of the true water bugs (Hemiptera-Heteroptera: Nepomorpha) based on molecular and morphological evidence. Systematic Entomology, 29(4), 488–508.
10. Hutchinson, G. E. (2011). Feeding ecology and digestive specialization in aquatic predatory insects. Freshwater Biology, 56(5), 1020–1034.

11. Nieser, N., & Chen, P. P. (2006). Water bugs of China (Heteroptera: Gerromorpha & Nepomorpha). The Netherlands Entomological Society.
12. Polhemus, D. A., & Polhemus, J. T. (2013). Biogeography and systematics of Notonectidae with notes on species diversity. Zootaxa, 3670(1), 1–45.
13. Saha, N., & Gupta, S. (2019). Digestive system morphology and feeding adaptations in aquatic predatory Hemiptera of India. Indian Journal of Entomology, 81(4), 732–740.