

## Hidden Treasures of the Paddy Fields: A Close Look at Water Beetles in Rice Ecosystems

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### Introduction

Rice fields, nourished by irrigation, offer a continuous water supply throughout the growing season, creating an ideal environment for aquatic insects to flourish and establish a thriving food chain (Bambaradeniya *et al.*, 2004). While much research has focused on terrestrial insects in rice fields (Jauharlina *et al.*, 2019), exploring aquatic fauna in irrigated rice has been relatively limited. In the context of the Indian rice ecosystem, Rai *et al.* (2000) documented an impressive 368 species of Coleoptera, with around 41 species inhabiting aquatic environments. A comprehensive global checklist of aquatic Coleoptera in irrigated rice was provided by Divya and Chitra (2019), revealing 262 species across 110 genera and 17 families. Among these, the Hydrophilidae (22 genera, 94 species) and Dytiscidae (40 genera, 90 species) emerged as dominant families. Understanding the diverse range of aquatic coleopteran species within the rice habitat is crucial, as they play pivotal roles as prey, predators, scavengers, and bioindicators, influencing the ecosystem balance. Water beetles, with few exceptions of marine species dwelling in the intertidal or littoral zone, primarily thrive in freshwater environments. Spanning over 2000 different habitats globally, true water beetles are encompassed by various common names, including real or diving water beetles, whirligig beetles, and water scavenger beetles. Impressively, these true water beetles inhabit both aquatic and terrestrial areas, collectively comprising approximately 2000 different species worldwide.

In this article, we embark on a captivating journey into the hidden world of aquatic beetles in rice fields, uncovering their significant contributions to the intricate rice ecosystem. We shed light on their fascinating behaviour, remarkable adaptations, and ecological significance, highlighting the need to appreciate and conserve these incredible creatures that enrich our natural world

### Habitat and habit of the water beetle

Water beetles, often known as "water tigers," exhibit fascinating behaviours and adaptations that set them apart as formidable aquatic predators. These resilient insects spend a significant portion of their adult lives dormant in submerged earth, only awakening during the spring to actively hunt for their insect prey. Notably, water beetles possess hardened wing covers, known as elytra, which create a cavity above their bodies. Males typically boast smooth elytra surfaces, while females display grooves. To replenish the air in this specialized cavity, these beetles occasionally ascend to the water's surface, allowing them to remain submerged for extended periods. Among the remarkable water beetle species are the whirligig beetles, found in temperate and tropical regions worldwide. These intriguing insects spend much of their lives gliding gracefully at the water's surface, equipped with eyes capable of functioning both in water and air. With their unique ability to dive to considerable depths, whirligig beetles are true marvels of adaptation. During colder months, they hibernate, occasionally emerging for their characteristic whirling dances, adding a touch of elegance to their enigmatic nature. Lustrous black above and yellow, black, or brown below, these elliptical and convex-bodied adults make for a captivating sight in aquatic habitats.

Meanwhile, the water scavenger beetles, boasting about 2000 diverse species, spread across the globe with abundance in warmer regions. These resourceful scavengers play vital ecological roles, with most species primarily feeding on vegetable matter. However, some exhibit predatory skill, preying on small aquatic creatures. Reflecting their aquatic lifestyle, water scavenger beetles display dark and shiny coloring, possessing an elliptical shape. While not as swift in swimming as their diving or whirligig counterparts, these beetles are well-adapted to an aquatic or amphibian lifestyle, although a few species can thrive in terrestrial environments. With their global distribution and varied habits, water scavenger beetles contribute significantly to the ecological balance of their habitats.

Species	Family
<i>Acilius sp.</i>	Dytiscidae
<i>Coelambus impressopunctatus (Schaller, 1783)</i>	Dytiscidae
<i>Cybister sp.</i>	Dytiscidae
<i>Cybister lateralimarginalis (De Geer, 1774)</i>	Dytiscidae
<i>Dytiscus sp.</i>	Dytiscidae

<i>Dytiscus marginalis</i> Linnaeus, 1758	Dytiscidae
<i>Hydaticus</i> sp	Dytiscidae
<i>Hydroglyphus geminus</i> (Fabricius, 1792)	Dytiscidae
<i>Ilybius fuliginosus</i> (Fabricius, 1792)	Dytiscidae
<i>Laccophilus minutus</i> (Linnaeus, 1758)	Dytiscidae
<i>Rhantus suturalis</i> (MacLeay, 1825)	Dytiscidae
<i>Gyrinus</i> sp.	Dytiscidae
<i>Gyrinus natator</i> (Linnaeus, 1758)	Gyrinidae
<i>Haliplus lineatocollis</i> (Marsham, 1802)	Haliplidae
<i>Noterus clavicornis</i> (De Geer, 1774)	Noteridae
<i>Limnebius furcatus</i> Baudi, 1872	Hydraenidae
<i>Berosus spinosus</i> (Steven, 1808)	Hydrophilidae
<i>Coelostoma</i> sp	Hydrophilidae
<i>Enochrus melanocephalus</i> (Olivier, 1792)	Hydrophilidae
<i>Helochares lividus</i> (Forster, 1771)	Hydrophilidae
<i>Hydrophilus</i> sp.	Hydrophilidae
<i>Spercheus emarginatus</i> (Schaller, 1783)	Hydrophilidae

**Table 1: Different water beetles reported to be found in rice ecosystem**

**Table 2: Salient features of different water beetles**

Species	Size (Length in mm)	Behavior and Characteristics	Season of Activity	
<i>Agabus guttatus</i>	7.8-9.2	<i>Agabus guttatus</i> lays eggs from June to autumn, enabling them to survive winter as either larvae or adults in dried-up water bodies or at water edges. The larvae pupate in late spring or summer of the following year. Due to underdeveloped flying	Spring to Autumn	Lupi <i>et al.</i> , (2014)

		muscles, adult beetles are not strong fliers.		
<i>Hydaticus grammicus</i>	9-11	<i>Hydaticus grammicus</i> selects temporary pools for feeding during early spring but prefers more permanent waters in summer. Females lay eggs on watery vascular plants. Larvae are skilled swimmers and prey on certain juvenile insects. In winter, adults often inhabit land, away from water bodies	Early Spring to Summer	Jucker <i>et al.</i> , (2014)
<i>Lacophilus minutus</i>	4-4.5	<i>Lacophilus minutus</i> is a common and widely distributed species found in permanent still waters and appears to be resilient to water pollution.	Throughout the Year	Nilsson <i>et al.</i> , (2012)
<i>Hygrotus impressopunctatus</i>	4.1-5.5	<i>Hygrotus impressopunctatus</i> is a versatile species and is scarce in oligotrophic ecosystems like marshes. It serves as a bio-indicator of water quality and is widely distributed in Italy. The oviposition phase typically begins in the spring. Larvae take refuge among vegetation in deeper waters.	Spring	(Boukal <i>et al.</i> , (2014)

<i>Dryops luridus</i>	3.5-4.5	Dryops luridus is a microphagous species found in various regions of Italy. Information about its biology is limited, but adults have been collected from April to November. The larvae are xylophagous, and they lay eggs in decaying submerged wood. Adult beetles have a prolonged mating and egg oviposition period during summer.	Spring to autumn	Moon <i>et al.</i> , (2014)
<i>Limnius volckmari</i>	2.9-3.2	Limnius volckmari is associated with the prevalence of filamentous algae in waters with moderate flow and is considered a reliable indicator of water quality. It is semivoltine, and both adults and larvae can be found throughout the year in northern and southern Europe. Beetles undergo pupation on the shore, and they cling to rocks, aquatic mosses, or gravelly stream bottoms.	Throughout the year	Dietrich <i>et al.</i> , (1999)
<i>Helophorus brevipalpis</i>	2.4-3.2	Helophorus brevipalpis is a widespread species often found in stagnant fresh water, particularly in shallow, temporary	Throughout the year	Landin <i>et al.</i> , (1980)

		<p>pools with grassy bottoms. It is a strong colonizer of ephemeral waters due to its dispersal capacity. In northern Europe, it exhibits a univoltine life cycle, with adult beetles present throughout the year. Oviposition occurs in spring, and the larvae emerge the following spring or early summer</p>		
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### Conclusion:

In the rice fields' channels, various beetle species, including Dytiscidae and Hydrophilidae, thrive in the rice ecosystem. The study shows that the rice agroecosystem supports diverse water beetle species with unique ecological niches. Many species find favorable conditions in rice fields and waterways during specific life stages, migrating to more suitable habitats when needed. Families like Dytiscidae, Hydrophilidae, Haliplidae, Dryopidae, and Elmidae demonstrate remarkable adaptive abilities. Early colonizers like *H. geminus* and *Lacophilus minutus* settle quickly in flooded paddies. Sporadic species, though few, contribute to biodiversity and ecosystem functioning. Safeguarding this complex water beetle population, including rare and fragile species, in the rice agroecosystem is crucial.

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