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ORIGINAL ARTICLE

General Description of Back Swimmer (Notonectidae) with Endoskeleton of Head Region

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ABSTRACT

Notonecta glauca, the common Back swimmer, is an aquatic insect in the family Notonectidae. Insects in this family are commonly referred to as backswimmers or greater water boatmen. Notonectids propel themselves through the water with their ventral side (belly) facing upwards, hence their common name of backswimmers. Notonectids can inflict wounds to humans with their proboscis (mouthpart), but this is very rare and often is a result of rough handling. This article is about the general description of life stages of back swimmer with some light on its behavior and structure of head region of adult insect.

***Key words**: Notonecta glauca, Endoskeleton, behaviour*

INTRODUCTION

These are small to medium sized insects called 'bugs' with piercing and sucking type of mouth parts, atrophied palpi, Iabium in the form of a dorsally grooved sheath receiving to pairs of bristle like stylest, and two pairs of wings of which four wings are often harder than hind wings. The aquatic bugs are included the suborder Heteroptera. Besides Notonectidae, there are thirteen more families of aquatic bugs that are included in the suborder Heteroptera. The Notonectids are truely aquatic in habitat and are commonly known as back swimmer. Although commonly collected in Europe (Soós, *et al*., 2009), the common backswimmer can range from parts of northern Africa to western Siberia and northwestern China (Berchi 2013).

Notonecta glauca is typically found in inland freshwater ponds, although it can be found in eutrophic (water excessively enriched in nutrients) freshwater bodies near the sea (Kjaerstad, *et al*., 2009). Many other Notonecta species occur in North America north of Mexico (Torre Bueno 1905). It is unclear if this species could become established if introduced to Florida, but its current distribution includes several locations with similar climates and habitats (Taryn and Gillett-Kaufman, 2019).

The common backswimmer prefers environments with lush vegetation in which to hide it. When aquatic plants are present, the common backswimmer will reside on the edge of the plant, usually mid-way up the plant, a preference not influenced by prey selection (Giller and McNeill 1981). Residing on the edge of the plant allows the common backswimmer to more easily observe its surroundings and snatch passing prey (Giller and McNeill 1981). Due to its preference for vegetation and its low affinity for the surface, the common backswimmer does best in a complex environment where avoiding the surface and having ample vegetation to hide in will protect it from predation. The common backswimmer preys on various aquatic organisms, like Daphnia spp. (water fleas) (Giller and McNeill 1981). Notonecta spp. most commonly prey on other insect species, but have been observed to prey on fish eggs, fry, and tadpoles (González and Leal 2010). *Notonecta glauca* have been observed to prey on the larvae of the mosquito Culex pipens (Reynaldi, *et al*., 2011). When hunting, the common backswimmer captures its prey by using its raptorial forelegs or middle legs, these legs have grasping surfaces making it difficult for prey to escape (Giller and McNeill 1981). They are ambush predators that wait for an opportunity to strike unsuspecting prey (Ellis and Borden 1970, Giller and McNeill 1981, Taryn and Gillett-Kaufman, 2019).

MATERIALS AND METHODS

These bugs were killed by chloroform vapours, and fixed in different fixatives. Small punctures were made by micro niddles to the abdominal before putting them into fixative in order to ensure proper fixation. The fixatives use were (1) Bouins fluid, (2) Alcoholic Bouin's and (3) Zenkerss fluid. After keeping in fixative for about in 24 hours, they were washed thoroughly through several changes of 70% alcohol mixed with a few drops of glycerine. The specimens were later washed, upgraded and preserved in glycerine and mounted in Canada Balsum. Dissections of the specimens were made in a small dish with the help of micro scalpels, forceps and microneedles under high power of binocular microscope. The studies on the musculature were made in the isects fixed in alcoholic Bouin's solution. The fresh specimens dissected for the musculature did not yield satisfactory results because the muscles of freshly killed specimens were extremely soft. The insects were embedded in wax and dissected from different angles for the study of various muscles. Some sections were also cut by a sharp razor blade to study the musculature of the Labium, antennae, the legs and the genitalua. Few dissections were stained by one or two drops of Mann's Methyl blue, Eesin of Borex carmine. The organs of support and locomotion of the back swimmer, *Notonecta glauca* Linnaeus were thus studied.

The study of the digestive system was made by dissecting the freshly killed and Bouin's fixed material. The dissections of freshly killed specimens yielded good results. The diagrams of gross anatomy were snatched directly from the dissections. For the histological studies of the alimentary canal, the different regions were immediately fixed after the dissections in the alcoholic, Bouin's solution. Later the material was washed, dehydrated in usual manner, cleared and embedded in paraffin wax for microtomy. The sections of 6 to 8 µ thickness were cut, stained with Hematoxyline, Eosin, Mann's Methyl blue Eosin and Malory's triple. A triple embedding technique was found most satisfactory for the purpose.

RESULTS AND DISCUSSION

Notonecta glauca, (Linnaeus, 1758):

Scientific classification:

Domain	:	Eukaryota
Kingdom	:	Animalia
Phylum	:	Arthropoda
Class	:	Insecta
Order	:	Hemiptera
Family	:	Notonectidae
Genus	:	Notonecta
Species	:	glauca

The back swimmer, *Notonecta glauca* Linnaeus is a medium sized aquatic insect. It is very common in India. The adults are 14-17 mm long and dull grey or brown in colour. Head broad, eyes large, interocular space varying in breadth and shape; rostrum four jointed; pronotum trapeziform, transeverse, strongly convex, anterior margin a little centrally produced, lateral margins obliquely straight, posterior lateral angles slightly subprominent; scutellum large, are most triangular; hemelytra complete, membrane distinct; abdomen beneath ciliate on lateral areas and at apex, and centrally, longitudinally carinate. In species glauca, the breadth and shape of interocular space are characteristic and there are found one or two spots near the apical margin of the corium.

These bugs are unisexual. The males differ from the females in being smaller in size and in the structure of external genitalia. The males posses a well developed appendages. An elongate tubular apically pointed ovipositor is possessed by the females. Mating occurs both during the day and night but more commonly in the late afternoon. The mating period reduced and becomes short if a mating pair is disturbed by the interference of a third individual. Under such condition, the mating process is repeated at frequent intervals. The male jumps over the back of the female without any apparent premating display and remains in copula for about 10-12 minutes. The female hardly pays any attention to the male and continues her feeding, cleaning and other activities in normal manner without taking the notice of the over riding of male.

The egg laying takes place at night. The eggs were found attached to under side of the grass blades, aquatic plants and other floating objects in the water. The eggs are placed length wise on the object upon which they are laid. In the laboratory, the eggs layed were observed on the sides of the glass trough, just below the water surface. The eggs were attached by a translucent gelatin like hold fast substance. A single female generally lays about twelve to wighteen eggs at a time.

Notonecta spp have white oblong eggs. These eggs can be found attached to aquatic vegetation. Adult Notonecta in Great Britain lay eggs in the fall and or spring (this varies by species), and there is only one generation a year (Briers 1998). Like many true bugs, nymphs of this species look like small adults. They do not have fully developed wings as nymphs, and they have much shorter abdomens. They are often more uniform in color and their pronotum is not darker than the rest of the body, as seen in the adults. British species of Notonecta have been reported to have five nymphal instars that develop over the summer months (Briers 1998). The most easily identifiable feature of notonectids is their long hind legs that are used to propel themselves in the water. Adult Notonecta spp have a pale tan head and legs. The pronotum (area just behind the top of the head) is darker than the head and the elytra (hardened forewings) can be a range of tan colors. The eyes are large and dark red in color. Fully-grown adults measure about 16 mm (Reynaldi, *et al*., 2011). *Notonecta glauca* adults and immatures breathe by taking in air rather than dissolved oxygen from the water; however, their body is covered in hair-like structures called setae and microtrichia that aid them in their aquatic lifestyle. A backswimmer's entire body except the pronotum (area behind the head), head and legs are covered in these hairs. The hairs create a film that traps air, allowing the insect to absorb oxygen while underwater and keep its body dry (Kuru, *et al*., 2011). The setae tend to be larger and sparser in comparison to the denser patches of microtrichia. Only microtrichia are present under the upper side of the elytra. Due to the thickness of the microtrichia, air can be held in the film for up to 130 days. This air film is visible with the naked eye and appears as a silvery sheen on the body (Kuru, *et al*., 2011, Taryn and Gillett-Kaufman, 2019).

The common backswimmer sucks the hemolymph from its prey (bodily fluid in invertebrates that is comparable to blood). *Notonecta glauca* extracts food slower and has less of a response to surface activity to than other Notonecta species (Cockrell 1984). One reason for a comparatively lower response to surface activity is that it resides at lower depths rather than the water surface (Cockrell 1984). At air temperatures below 15 °C (59 °F), *Notonecta glauca* spends most of the time underwater. Above 15 °C (59 °F) it will spend more time above water than below the surface. At 5 °C (41 °F), it tends to stay completely submerged (Cockrell 1984). Under highly oxygenated water and at higher temperatures, the common backswimmer prefers to stay submerged (Cockrell 1984, Taryn and Gillett-Kaufman, 2019).

The endoskeleton of the head capsule of the back swimmer, *Notonecta glauca* Linnaeus consist of food pump and hypopharyngeal complex. The anterior tentorium is absent in it. The rod arising from the lateral angle of the foramen magnum provides support to the maxillary stylets and regarded as the posterior tentorium. Similar observations have also been reported by Ekblom (1926) in *Nepa apicuata* Unler, *Nepa hoffmanin* Esaki and *Ranatra linearis* Linn. The food pump includes epipharynx and hypopharynx. The hyhpopharyngeal complex consists of three region viz., hypopharyngeal lobe, hypopharyageal wing, suspensory plate and salivary apparatus.

Fig. 1: An adult *N. glauca* (Linnaeus). (Courtesy- David Nicholls, Taryn and Gillett-Kaufman, 2019)

Fig. 2: Notonecta sp. adult resting upside down underwater, which is typical of all Notonectids. (Courtesy- JRxpo, Taryn and Gillett-Kaufman, 2019, UF/IFAS)

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